Interchanges et tarification des systèmes de paiement par carte.

Marianne Verdier

TELECOM PARISTECH

Thèse soumise en vue de l'obtention du grade de
Docteur en Economie

INTERCHANGES ET TARIFICATION DES SYSTEMES DE PAIEMENT PAR CARTE

Marianne VERDIER

JURY

Jean-Charles Rochet
Professeur à l'Université de Toulouse I
Rapporteur

Léo Van Hove
Professeur associé à l'Université libre de Bruxelles
Rapporteur

Anne Perrot
Professeur à l'Université de Paris I et vice-présidente du Conseil de la Concurrence
Examinatrice

Yves Randoux
Ancien Administrateur du Groupement des Cartes Bancaires
Examinateur

Marc Bourreau
Professeur à Telecom ParisTech
Directeur de thèse

David Bounie
Maître de conférences à Telecom ParisTech
Examinateur

Avertissement

Telecom ParisTech n'entend donner aucune approbation ou improbation aux opinions émises dans les thèses.

Les opinions émises dans cette thèse doivent être considérées comme propres à leur auteur.

Je permets le prêt de cette thèse par Telecom ParisTech à d'autres institutions ou individus dans un but académique.

J'autorise également Telecom ParisTech à reproduire, intégralement ou en partie, cette thèse par photocopie ou par tout autre moyen à la demande d'institutions ou d'individus dans un but académique.

REMERCIEMENTS

Je remercie Marc Bourreau, Professeur à Telecom ParisTech, d'avoir accepté de m'encadrer pour cette thèse. Il m'a initié à la rigueur ainsi qu'à la patience, deux qualités nécessaires pour entreprendre des travaux de recherche. Ses conseils, son soutien quotidien et sa confiance m'ont été précieux pour faire parvenir ma réflexion à maturité. Son exigence en tant que co-auteur m'a stimulé pour améliorer la qualité de mon travail. Enfin, son humour m'a souvent permis de prendre du recul !

Je souhaite également remercier David Bounie, maître de conférences à Telecom ParisTech, sans qui la réalisation de ce travail de thèse aurait été impossible. David Bounie m'a permis de découvrir le champ passionnant de l'économie des paiements, et d'entrer en contact avec l'un des systèmes de paiement par carte, le « Groupement des Cartes Bancaires ». J'espère que nous aurons l'occasion de nouveau de travailler ensemble sur l'un des nombreux champs de recherche qu'il reste à explorer dans ce domaine.

Je tiens aussi à remercier le « Groupement des Cartes Bancaires », qui a financé cette thèse CIFRE, et en particulier Yves Randoux, l'ancien administrateur du Groupement des Cartes Bancaires, qui a soutenu ce projet dès sa conception. Sa démarche s'est montrée pionnière en matière de coopération entre les entreprises et le monde académique. Son ouverture m'a permis d'intégrer une équipe au sein du Groupement des Cartes Bancaires pendant deux ans et demi, et de travailler sur les problématiques auxquelles réfléchissent les acteurs d'un système de paiement. Il a toujours été très attentif à mon insertion dans l'entreprise, bienveillant, curieux, et intéressé.

Je remercie aussi les équipes du « Groupement des Cartes Bancaires », et en particulier la Direction des Affaires Juridiques et Bancaires (la « DAJB ») qui m'a accueillie pendant deux ans et demi. Les membres de la « DAJB » m'ont fait découvrir un certain nombre de différences entre le monde académique et le monde de l'entreprise. Je tiens en particulier à remercier Martine Briat pour son exigence et ses conseils de juriste qui m'ont beaucoup stimulée, Olivier Mansart et Jean-Marc Sitbon pour leurs relectures patientes et leur bonne humeur, Valérie Roy, Marie-Antoinette de Gasquet, pour leur soutien, sans oublier Sandrine Françaix et Nicole Gauchet qui ont rendu les moments passés chez « CB » très sympathiques. Je remercie également toute l'équipe de la communication qui m'accueillait souvent dans son bureau (notamment Priscilla et Farida), et les membres de l'équipe de Cédric Sarazin avec qui j'ai eu l'occasion d'échanger fréquemment. J'espère que la coopération entre chercheurs et acteurs des systèmes de paiement va continuer à se développer.

Je tiens également à remercier les membres de mon jury : Jean-Charles Rochet de l'Université de Toulouse I et Leo Van Hove de l'Université Libre de Bruxelles qui ont accepté de rapporter cette thèse, ainsi qu'Anne Perrot, vice présidente du Conseil de la Concurrence, qui a largement contribué au démarrage de cette thèse sous la direction de Marc Bourreau en m'ouvrant les portes du Laboratoire d'Economie Industrielle du CREST lors d'un stage en 2004.

Merci aussi à toute l'équipe du Département SES à Telecom ParisTech, aux participants du workshop du jeudi, ainsi qu'aux thésards et stagiaires, qui font régner une ambiance très conviviale à Telecom ParisTech (Serge, Thomas, Rémy, Régis, Joeffrey, Bruno, Maria, Anne…).

Je remercie aussi ma famille de m’avoir toujours soutenue et encouragée dans ce que j’ai voulu entreprendre : mes parents, mon frère, ma grand-mère, ainsi que mes oncles et tantes.

Je remercie également mes amis pour leur patience, leur sincérité, leur bonne humeur et leur écoute. Je tiens en particulier à remercier Marie et Françoise, qui m’ont beaucoup aidée dans le travail de relecture de l’introduction de ma thèse.

Je remercie enfin mon professeur de danse classique, Wayne Byars, qui m’a permis de trouver de nombreuses ressources en moi-même pour réaliser cette thèse, grâce à sa quête de la perfection artistique et à sa sagesse.

« Prendre du recul, c'est faire un pas en arrière
et réaliser que nous ne sommes que de tous petits poissons
dans un très grand étang »

Steve DeMasco, maître Kung-fu.

SOMMAIRE

I. INTRODUCTION GENERALE DE LA THESE

« Interchanges et tarification des systèmes de paiement par carte »

> « Quant au fait que c'est le besoin qui maintient la société, comme une sorte de lien, en voici la preuve : que deux personnes n'aient pas besoin l'une de l'autre, ou qu'une seule n'ait pas besoin de l'autre, elles n'échangent rien. C'est le contraire si l'on a besoin de ce qui est la propriété d'une autre personne, par exemple du vin, et qu'on donne son blé à emporter. Voilà pourquoi ces produits doivent être évalués. Pour la transaction à venir, la monnaie nous sert, en quelque sorte, de garant, et, en admettant qu'aucun échange n'ait lieu sur-le-champ, nous l'aurons à notre disposition en cas de besoin. Il faut donc que celui qui dispose d'argent ait la possibilité de recevoir en échange de la marchandise. Cette monnaie même éprouve des dépréciations, n'ayant pas toujours le même pouvoir d'achat. Toutefois elle tend plutôt à être stable. En conséquence de quoi, il est nécessaire que toutes choses soient évaluées; dans ces conditions, l'échange sera toujours possible et par suite la vie sociale. Ainsi la monnaie est une sorte d'intermédiaire qui sert à apprécier toutes choses en les ramenant à une commune mesure. Car s'il n'y avait pas d'échanges, il ne saurait y avoir de vie sociale; il n'y aurait pas davantage d'échange sans égalité, ni d'égalité sans commune mesure. »
>
> ARISTOTE, *Éthique à Nicomaque*, éditions Flammarion.

L'usage des cartes de paiement s'est considérablement développé dans les pays industrialisés depuis les vingt dernières années[1]. Les banques proposent aux consommateurs et aux commerçants des services de plus en plus sophistiqués accompagnant les transactions de paiement par carte, si bien que ces derniers sont prêts à supporter les coûts nécessaires à la détention et à l'usage de cet instrument de paiement, qui, contrairement aux espèces, est souvent payant. Chaque transaction de paiement par carte peut être facturée d'une part au consommateur par la banque émettrice de la carte (la banque du porteur), et d'autre part au commerçant, par la banque « acquéreur » de la transaction (la banque du commerçant). Les banques émettrices et acquéreurs sont généralement membres d'un système de paiement, qui leur fournit une partie des supports et des infrastructures nécessaires pour procéder au règlement de la transaction. Ces

[1] En 1988, dans tous les pays développés sauf en Finlande, les consommateurs effectuaient en moyenne moins de 10 paiements par carte par an. En 2006, dans les pays d'Europe de l'Ouest par exemple, cette moyenne est passée à 54. Dans certains pays (Portugal, Danemark, Finlande, Suède), ce chiffre est supérieur à 100.

systèmes de paiement régissent une partie des règles qui gouvernent les interactions entre les banques émettrices et les banques acquéreurs.

Les *interchanges* sont un mécanisme utilisé par les systèmes de paiement pour allouer les coûts des transactions de paiement entre la banque du consommateur et la banque du commerçant. Lorsque ce mécanisme est appliqué, chaque fois qu'un consommateur utilise sa carte de paiement, la banque du commerçant verse à la banque émettrice une commission appelée « interchange ». Cette commission a pour effet de diminuer le coût marginal de la banque émettrice, et donc, de faire baisser le prix payé par le porteur pour l'usage des cartes (si la banque lui fait profiter de cette baisse de coût). Nous verrons que, sous certaines conditions, le mécanisme des interchanges contribue à encourager les porteurs à choisir d'utiliser la carte de paiement plutôt qu'un autre instrument de paiement. En contrepartie, le prix payé par le commerçant à chaque transaction de paiement devient plus élevé (si la banque acquéreur répercute cette hausse de coût marginal sur le commerçant). Les interchanges peuvent donc influencer la structure des prix payés par les consommateurs et les commerçants pour une transaction de paiement par carte[2].

Plusieurs raisons ont motivé notre choix d'élaborer cette thèse sur le rôle des interchanges dans la tarification des systèmes de paiement par carte. Nous les exposons au préalable dans cette introduction.

I.1. Un sujet de thèse ancré dans les échanges économiques actuels

(1). Les interchanges font l'objet de nombreux débats et procédures réglementaires ou juridiques dans le monde.

Ces dernières années, les interchanges ont fait l'objet de nombreux débats entre banques, industriels, régulateurs, économistes, consommateurs et commerçants. La principale question posée est la suivante :

« la distorsion de structure de prix induite par le mécanisme d'interchange améliore-t-elle l'efficacité de l'usage des instruments de paiement? »

[2] Notre thèse concerne plus spécifiquement les interchanges sur les transactions faisant intervenir des cartes de paiement. Cependant, les banques utilisent aussi des commissions d'interchange pour d'autres transactions de paiement, par exemple, pour les échanges d'images-chèques et les prélèvements.

L'augmentation de l'usage des cartes de paiement a entraîné une hausse des coûts (totaux) supportés par les commerçants pour accepter cet instrument de paiement. Du point de vue des commerçants, cette augmentation est liée au fait que les systèmes de paiement par carte pratiquent des interchanges excessifs. Selon les banques, les interchanges sont nécessaires au fonctionnement des systèmes de paiement par carte, notamment pour partager les coûts liés aux infrastructures permettant de procéder aux transactions[3]. Par ailleurs, ni les consommateurs, ni les commerçants ne subissent les coûts supportés par les banques pour approvisionner l'économie en espèces, alors qu'ils utilisent ce moyen de paiement gratuitement. Le coût de la carte de paiement étant plus faible que celui des espèces ou du chèque pour certaines transactions de paiement, les banques considèrent qu'il est souhaitable d'encourager les consommateurs à l'utiliser[4].

De nombreuses procédures juridiques ont été menées en Europe, aux Etats-Unis, en Australie, au Mexique, pour examiner si les interchanges pouvaient être légitimés par une amélioration du bien-être social, liée à des décisions d'usage plus efficaces[5]. Au Mexique et en Australie, par exemple, les Banques Centrales ont pris la décision de réguler les interchanges, respectivement en 1994 et en 2000. Dans d'autres pays, les interchanges sont fixés par les systèmes de paiement, qui doivent toutefois respecter des contraintes réglementaires[6].

Il est apparu au cours de tous les débats concernant les interchanges que la théorie économique sur ce sujet méritait d'être approfondie. C'est pourquoi, nous avons choisi de nous y intéresser pour cette thèse.

(2). Les interchanges vont être amenés à jouer un rôle dans la construction de l'espace européen unique des paiements.

Nous aurons l'occasion d'expliquer dans cette thèse que les banques des différents pays européens, sous l'impulsion de la Banque Centrale Européenne et de la Commission

---

[3] Ce point de vue est aussi partagé par des économistes (comme Rochet (2003)).

[4] Un rapport publié en mars 2003 par le groupe de travail de l'EPC (European Payment Council) sur les espèces estime le coût total annuel des espèces à 50 milliards d'Euros par an en Europe, dont 65% sont supportés par l'industrie bancaire.

[5] La Commission Européenne a ainsi condamné en décembre 2007 les Commissions d'Interchange appliquées par MasterCard sur ses transactions transfrontalières, exigeant leur suppression totale, MasterCard n'ayant pas été en mesure de prouver aux yeux de la Commission leur contribution à l'amélioration de l'efficacité économique. MasterCard a fait appel de cette décision en mars 2008. Aux Etats-Unis, en 2008, le Congrès a commencé à étudier la création d'un projet de loi destiné à encadrer les négociations entre les banques et les commerçants sur le prix des cartes de crédit « Credit Card Fair Fee Act ».

[6] En France, par exemple, les interchanges pratiqués par le système « CB » ont fait l'objet d'une notification au Conseil de la Concurrence le 29 mars 1989.

Européenne, ont décidé de construire un ensemble de règles communes permettant aux consommateurs et aux commerçants d'utiliser certains instruments de paiement – dont les cartes de paiement- dans les mêmes conditions partout en Europe. L'industrie des cartes de paiement en Europe a déjà commencé à évoluer considérablement suite à cette décision : des systèmes de paiement ont fusionné, des banques réfléchissent à la construction de nouveaux systèmes, les systèmes existants s'adaptent. Or, les interchanges constituent un élément déterminant de la stratégie de tarification des systèmes de paiement. En effet, nous verrons par exemple dans cette thèse que le niveau des interchanges influence les investissements réalisés par les banques pour proposer de nouveaux services, améliorer la sécurité des transactions ou construire de nouvelles infrastructures. Le niveau des interchanges détermine aussi la qualité du service fourni aux consommateurs et aux commerçants, ce qui influence l'usage des cartes de paiement. Nous montrerons également que les interchanges peuvent avoir des conséquences sur l'incitation des firmes non bancaires à devenir fournisseurs de services de paiement par carte. Une meilleure connaissance des mécanismes d'interchange est donc souhaitable pour optimiser la façon dont ils vont contribuer à la construction de l'Europe des paiements.

(3). Les interchanges et la tarification des systèmes de paiement par carte fournissent un champ d'approfondissement d'une théorie économique récente : la théorie des marchés bifaces.

Cette théorie a été développée depuis le début des années 2000 pour caractériser le fait que, dans de nombreuses industries (cartes de paiement, jeux vidéo, médias), deux groupes d'utilisateurs distincts sont mis en relation par une plate-forme. Ces deux groupes exercent des externalités l'un sur l'autre : l'utilité obtenue par un agent lorsqu'il se raccorde à la plate-forme augmente avec le nombre d'agents de l'autre groupe ayant décidé de s'y raccorder. La théorie des marchés bifaces postule que la façon dont la plate-forme répartit le prix des transactions entre les deux groupes influence le volume d'interactions ayant lieu entre eux. Nous montrons dans cette introduction que cette théorie fournit un cadre particulièrement intéressant pour étudier le rôle des interchanges dans la tarification des systèmes de paiement de détail. Dans notre thèse, nous cherchons à enrichir la théorie des marchés bifaces pour tenir compte des spécificités des cartes de paiement.

Dans la suite de cette introduction, nous mettons en perspective notre thèse dans le cadre de l'économie générale, notamment dans le champ de l'économie des paiements. Nous expliquons pourquoi nous avons choisi de retenir l'approche de la théorie des marchés bifaces (plutôt qu'une approche macroéconomique par exemple) pour traiter de

notre sujet. Enfin, nous présentons les deux problématiques qui ont retenu notre attention.

I.2. Mise en perspective de la thèse dans le cadre de l'économie générale.

Le champ de l'économie des instruments de paiement s'est longtemps réduit à l'étude de l'émergence de l'offre et de la demande de monnaie. Nous exposons les raisons économiques et historiques qui ont conduit la monnaie à devenir un intermédiaire indispensable aux échanges. Puis nous montrons que les moyens de paiement se différencient de la monnaie, car ils ne possèdent pas toutes ses caractéristiques (ils ne servent notamment ni d'unité de compte, ni de réserve de valeur). Les moyens de paiement sont des instruments qui permettent de transférer des fonds. Enfin, nous montrons que les instruments de paiement sont des biens qui présentent des caractéristiques particulières (effets de réseau, incertitude sur la valeur etc…), dont la diffusion est optimisée par l'intervention d'intermédiaires financiers.

(1). La différence entre la monnaie et les instruments de paiement.

Depuis l'époque d'Aristote (« *Ethique à Nicomaque* »), les économistes attribuent trois fonctions à la monnaie. La monnaie sert à la fois d'unité de compte, de réserve de valeur, et d'instrument de paiement. Son utilisation résulte d'un accord entre les membres d'un groupe qui souhaitent échanger sur un marché. « *Car s'il n'y avait pas d'échange, il ne saurait y avoir de vie sociale ; il n'y aurait pas davantage d'échange sans égalité, ni d'égalité sans commune mesure* » (Aristote). Ainsi, en tant qu'unité de compte, la monnaie fournit un étalon de mesure commun qui réduit la complexité de la comparaison des prix relatifs[7]. La monnaie constitue aussi une réserve de valeur, qui permet le report dans le temps d'un pouvoir d'achat disponible sous forme liquide, à condition que sa valeur reste stable. Son utilisation en tant que réserve de valeur permet de pallier l'absence de synchronisation des recettes et des dépenses des individus. Enfin, en tant que moyen de paiement, la monnaie est une contrepartie versée à un vendeur par un acheteur en échange d'un bien. Le bon déroulement de la transaction dépend de l'acceptation de la contrepartie monétaire par le vendeur[8].

[7] Il y a $n(n-1)/2$ prix relatifs pour n biens. Selon la loi de Walras, si n marchés sont en équilibre, le nième l'est également.

[8] Pour plus d'informations sur les fonctions de la monnaie, voir « La monnaie et ses mécanismes », Dominique Plihon, Collection repères (édition 2008), ou « The economics of money, banking and financial markets », Bordes, Ch., Hautcoeur, P-C., Lacoue-Labarthe, D., and Mishkin, F., Pearson Education (2007).

Dans les économies contemporaines, la monnaie est essentiellement disponible sous forme scripturale (comptes de dépôt gérés par les banques) et fiduciaire (pièces et billets, appelés « espèces »)[9]. Les espèces ne sont pas le seul moyen de paiement dont disposent les consommateurs : ils peuvent aussi régler leurs achats en transmettant des ordres de paiement à leur banque au moyen de cartes de paiement, chèques, virement, prélèvement, Titre Interbancaire de Paiement etc… Le règlement de la transaction modifie alors la quantité de monnaie scripturale disponible sur leur compte en banque. Dans cette thèse, nous utiliserons la définition des moyens de paiement, présentée dans le Code Monétaire et Financier :

« Sont considérés comme moyens de paiement tous les instruments qui permettent à toute personne de transférer des fonds quel que soit le support ou le procédé technique utilisé » (Article L311-3, Code Monétaire et Financier).

Comme la monnaie, les moyens de paiement facilitent le bon déroulement des échanges. Cependant, les moyens de paiement se distinguent de la monnaie, car ils ne servent pas nécessairement d'unité de compte, ni de réserve de valeur. Les espèces sont le seul instrument de paiement qui peut être qualifié de monnaie. Nous montrerons par la suite que les instruments de paiement sont des biens qui possèdent des caractéristiques particulières (effet de réseau, incertitude sur la valeur…), ce qui rend leur analyse économique particulièrement intéressante.

Cette thèse s'inscrit donc dans le domaine de l'économie des paiements. Ce champ de l'économie s'intéresse aux mécanismes par lesquels se forment l'offre et la demande d'instruments de paiement, ainsi qu'à l'équilibre qui résulte de leur confrontation. Afin de mieux appréhender son objet, nous nous interrogeons sur les facteurs économiques qui conduisent à l'émergence d'une offre et d'une demande d'instruments de paiement.

[9] Le terme « scriptural » fait référence au fait que les comptes de dépôt constituent une forme de monnaie « écrite ». Le terme « fiduciaire » indique que les pièces et les billets de nos jours n'ont aucune valeur intrinsèque sur le marché des produits. Leur valeur est gagée sur la confiance (fides) des agents en leur système monétaire.

(2). A l'origine de la formulation d'une demande d'instruments de paiement : l'existence de coûts de transaction.

Nous allons montrer que la présence de coûts de transaction[10] associés aux échanges est à l'origine de la formation d'une demande d'instruments de paiement. Par ailleurs, la présence d'intermédiaires financiers offrant des services de paiement permet d'internaliser une partie des coûts supportés par les agents dans un système d'échanges parfaitement décentralisé.

L'absence d'instruments de paiement constitue un obstacle à la réalisation de certaines transactions dans un système de troc. En effet, selon Jevons (1875), dans un système de troc, les besoins des acheteurs et des vendeurs doivent coïncider exactement en quantité et en qualité sur le lieu d'échange (*problème de la double coïncidence*). Certaines transactions souhaitées par les agents ne peuvent donc se réaliser, faute d'intermédiaire. Dans un exemple célèbre, Wicksell (1911) montre que, si les agents doivent échanger plus de trois biens, il est impossible de trouver des échanges bilatéraux qui soient profitables à chacun des agents. Il manque un bien intermédiaire, qui serve d' « instrument d'échange ». Le problème de la double coïncidence et de l'émergence du besoin de monnaie est aussi formalisé par Kiotaki et Wright (1993), et par Kocherlakota (1998). Kocherlakota montre que la monnaie est indispensable pour résoudre le problème de la double coïncidence si :

i. Les agents ne peuvent pas s'engager par des contrats à payer leurs emprunts.

ii. Les agents possèdent de l'information privée sur les historiques de leurs achats.

Les agents sont donc conduits à se procurer des instruments de paiement dont ils n'ont besoin que dans le but de consommer d'autres biens. Ces instruments de paiement comportent un coût, que les agents choisissent de payer, à condition que le surplus obtenu lors de la réalisation d'une transaction (qui n'aurait pas eu lieu autrement) lui soit supérieur. Ce raisonnement économique peut expliquer pourquoi les sociétés primitives ont progressivement abandonné le troc pour utiliser des biens matériels comme instruments de paiement[11]. Par exemple, en Mésopotamie (3000 avant Jésus-Christ), certaines communautés utilisaient de l'orge

---

[10] « Par coûts de transaction, on entend les coûts de fonctionnement du système d'échange, et, plus précisément dans le cadre d'une économie de marché, ce qu'il en coûte de recourir au marché pour procéder à l'allocation des ressources et transférer des droits de propriété » (Coase (1937)).

[11] Pour plus d'informations sur les évolutions historiques des instruments de paiement, voir Plihon (2008), ou Lannoye (2005).

pour se procurer du bétail ou d'autres biens de consommation[12]. Des prêtres veillaient au bon déroulement des échanges, prêtaient de l'orge aux agriculteurs et aux commerçants, et collectaient les dépôts des individus. L'utilisation de biens servant d' « instruments de paiement » constitue une étape essentielle du processus de rationalisation des échanges. Progressivement, les biens matériels ont été abandonnés au profit des métaux précieux, qui ont donné lieu à la fabrication de pièces de monnaie[13]. Puis sont apparus les premiers banquiers, dont la première activité fut le change des pièces de monnaie[14]. L'émergence d'intermédiaires financiers semble donc être en partie liée au rôle des instruments de paiement. C'est ce que nous nous proposons d'expliquer dans le paragraphe suivant.

(3). L'offre d'instruments de paiement et l'internalisation des coûts de transaction par les intermédiaires financiers.

Nous fournissons ici les principaux résultats qui permettent de mettre en perspective notre thèse dans le champ de la littérature sur l'intermédiation financière. Il existe une vaste littérature qui s'intéresse aux raisons de l'émergence d'intermédiaires financiers et à la modélisation des firmes bancaires[15]. Cependant, les articles de ce champ de recherches concernent principalement l'activité d'intermédiation entre déposants et emprunteurs. La littérature étudiant l'internalisation par les banques des coûts des transactions de paiement est moins développée.

Selon la littérature sur l'intermédiation financière (voir par exemple Jensen et Meckling (1976)), les banques existent parce qu'elles réduisent l'aléa moral affectant les relations entre les firmes et leurs créanciers. Leland et Pyle (1977) montrent aussi que les emprunteurs ont intérêt à former des coalitions pour obtenir de meilleures conditions de financement, à condition qu'ils puissent signaler la qualité de leur projet au sein de la coalition.

Quelques modèles de la littérature s'intéressent au rôle de la banque comme intermédiaire sur les paiements. L'activité d'intermédiaire sur les paiements est étroitement liée à la collecte de dépôts. Bryant (1980) puis Diamond et Dybvig (1983) montrent que les institutions de dépôts

[12] Le bétail se dit « pecus » en latin, ce qui est à l'origine de l'adjectif « pécuniaire ».
[13] En Egypte, les lingots étaient pesés avant chaque transaction (monnaie pesée). Vers 800 avant Jésus-Christ, les lingots sont divisés en pièces (monnaie comptée). Ensuite, les pièces ont été frappées d'une inscription indiquant leur poids et leur provenance (monnaie frappée).
[14] En Grec, le mot banque se dit « trapeza ». Il désigne la balance que les changeurs utilisaient pour déterminer le poids du métal précieux contenu dans la pièce de monnaie. Le mot « banque » provient de l'italien « banco » qui désigne le banc sur lequel étaient assis les changeurs.

constituent des « pools de liquidité », qui fournissent aux agents une assurance contre les chocs susceptibles d'affecter leurs besoins de consommation. Les agents ne savent pas, lorsqu'ils investissent dans des projets non liquides, s'ils auront besoin de leurs liquidités rapidement pour consommer. Puisqu'il n'existe pas de marché contingent à la réalisation de l'état de la nature, l'allocation réalisée par le marché est inefficace. Elle peut être améliorée par un contrat de dépôt offert par un intermédiaire financier. Selon MacAndrews et Roberds (1999), les modèles de la littérature de l'intermédiation sur les crédits n'expliquent pas correctement la façon dont sont apparus les changeurs de monnaie à Bruges au Moyen Age. La fonction d'intermédiation sur les paiements a joué un rôle essentiel dans l'apparition des premiers intermédiaires financiers. En effet, si les contrats de dettes ne peuvent pas être parfaitement respectés, les commerçants qui produisent des biens intermédiaires ont intérêt à passer par une banque pour obtenir le règlement de leur production. S'ils attendent que l'entrepreneur produise le bien final, ils courent le risque de n'être jamais payés pour la production du bien intermédiaire. Par conséquent, la présence d'une banque qui centralise les positions de chaque commerçant et effectue de la compensation permet d'effectuer des économies.

Dans les paragraphes qui suivent, nous montrons en quoi la présence d'intermédiaires qui gèrent les paiements permet une diminution des coûts de transaction subis par les agents. Cette démarche nous semble importante, car nous serons amenés au cours de notre thèse à modéliser le comportement de ces intermédiaires. Les intermédiaires gérant des moyens de paiement internalisent les coûts de transaction liés :

- A la présence d'asymétries d'informations entre acheteurs et vendeurs, ainsi qu'aux coûts de recherche (*«search costs»*) qui en résultent pour les consommateurs.
- A l'existence de coûts de transport et de risques pour les paiements à distance.
- A la présence d'effets de réseau associés à l'acceptation et à l'usage des instruments de paiement.

Nous fournissons dans les paragraphes suivants des explications relatives au mécanisme d'internalisation de chacun des coûts de transaction mentionnés ci-dessus.

- **La certification de l'instrument de paiement par un intermédiaire permet de réduire les asymétries d'informations entre l'acheteur et le vendeur sur sa valeur et son acceptation.**

[15] Voir Santomero (1984) pour une revue de cette littérature. Pour une synthèse, se référer à l'ouvrage de Laurence Scialom « Economie Bancaire », Collection Repères (2007).

Certains échanges ne peuvent se réaliser à cause de la présence d'asymétries informationnelles entre les acheteurs et les vendeurs. D'une part, le vendeur n'est pas informé sur la valeur de la contrepartie offerte par l'acheteur, qui bénéficie d'une rente informationnelle. D'autre part, l'acheteur n'a pas connaissance du bénéfice qu'obtient le vendeur à accepter son instrument d'échange. Si le vendeur refuse son instrument de paiement, l'acheteur doit subir le coût de la recherche d'un autre vendeur qui accepte sa contrepartie. *La certification de l'instrument de paiement* par une entité indépendante permet de réduire la rente informationnelle de l'acheteur sur la valeur de la contrepartie monétaire. L'apparition des pièces de monnaie frappées du sceau du roi en Lydie, au VIIème siècle avant notre ère, traduit les premières tentatives de certification de la valeur des instruments de paiement. Ce processus marque la séparation entre le marché des instruments de paiement et le marché des produits. Dans nos économies contemporaines, les Banques Centrales disposent d'un monopole sur l'émission de la monnaie scripturale et fiduciaire[16]. Les instruments de paiement permettant d'effectuer des transferts de monnaie fiduciaire, comme les chèques et les cartes, sont gérés par des intermédiaires financiers privés. Ces intermédiaires financiers peuvent être des firmes bancaires ou non bancaires. Les firmes prêtent une attention particulière aux dispositifs de surveillance permettant de limiter les risques de fraude, sous la supervision de la Banque Centrale et des instances de réglementation présentes dans chaque pays.

La certification de l'instrument de paiement s'accompagne d'une délimitation du *domaine d'acceptation*. Dans les économies contemporaines, les espèces sont universellement acceptées dans la limite géographique d'un Etat ou d'une Union Monétaire, comme la zone Euro. La loi oblige les commerçants à accepter les espèces[17], ce qui réduit *le coût de liquidité* auquel font face les consommateurs. Un consommateur informé de l'acceptation des espèces dans tous les commerces n'aura pas à subir les coûts de recherche d'un commerçant qui accepte cet instrument de paiement. Les autres instruments de paiement, comme le chèque ou la carte bancaire, fournis par des intermédiaires financiers privés, ne sont par nécessairement acceptés par tous les commerçants. Nous verrons néanmoins que les intermédiaires financiers ont conçu des stratégies d'alliance, qui leur permettent d'étendre la zone d'acceptation de l'instrument de paiement. Ces alliances ont conduit à la création de plates-formes de paiement pour les principaux instruments de paiement. Ces plates-formes définissent un certain nombre de règles de coopération garantissant que les instruments de paiement sont utilisés et acceptés dans les mêmes conditions

[16] Nous ne reviendrons pas dans cette introduction sur le processus de création monétaire. Pour plus de détails, le lecteur pourra se référer à Plihon (2007).
[17] Sous un certain plafond.

par tous les clients des institutions membres[18]. Par leur présence sur le marché, les plates-formes de paiement de détail internalisent une partie des coûts de recherche pour le consommateur d'un commerçant acceptant son instrument de paiement. Par ailleurs, elles permettent une diminution des coûts qui résulteraient d'une négociation bilatérale entre les banques de chaque transaction de paiement[19]. Les plates-formes de paiement offrent aux banques la possibilité de standardiser une partie de leurs échanges.

- **Les intermédiaires financiers internalisent les coûts de transport subis par les consommateurs en leur proposant des instruments de paiement qui permettent de payer à distance.**

Les intermédiaires financiers proposent des instruments de paiement qui réduisent les coûts des paiements à distance pour les consommateurs. Les coûts de transaction subis par les consommateurs pour les paiements à distance sont liés au déplacement physique, ainsi qu'aux risques associés au transport de l'instrument de paiement (dégradation, vol, perte etc…).

Les premiers exemples d'instruments de paiement permettant de payer à distance remontent au Vème siècle en Grèce. Des prêteurs d'argent (les trapézistes) et des changeurs (les collubistes) s'installent sur les foires et les marchés. Grâce à un document émis par une banque d'Athènes, par exemple, le porteur peut retirer une somme d'argent dans une banque de Sinope. Ce document fonctionnait de façon très similaire à nos chèques. De nos jours, les banques sont reliées entre elles par des infrastructures de réseaux complexes, qui leur ont permis de réduire les délais de paiement. Elles offrent aux consommateurs de nombreux instruments de paiement leur permettant de régler leurs achats à distance (chèque, virement, prélèvement ou carte).

- **Enfin, le développement d'une offre d'instruments de paiement standardisés permet aux consommateurs de bénéficier d'effets de réseau positifs associés à l'existence d'une zone d'acceptation importante.**

Les instruments de paiement sont des biens et des services caractérisés par des effets de réseaux. En effet, plus le nombre de vendeurs qui acceptent un instrument de paiement est élevé, plus sa valeur augmente aux yeux du consommateur (et réciproquement). La présence d'intermédiaires financiers permet aux agents de bénéficier des *effets de réseau positifs* associés à l'existence d'une zone d'acceptation importante de leurs moyens de paiement. Par ailleurs, il existe un certain nombre de complémentarités entre les autres services proposés par les

[18] Nous aurons l'occasion de présenter plus amplement la notion de plate-forme de paiement de détail dans la troisième partie.
[19] Nous verrons dans notre thèse que l'existence de commissions d'interchange multilatérales répond à cette logique.

intermédiaires financiers (crédit, assurance, gestion des comptes) et le service d'intermédiation sur les paiements. Ces complémentarités permettent aux banques de réaliser des économies d'échelle.

En synthèse, les arguments présentés dans cette partie montrent que les instruments de paiement ont une importance considérable dans le processus de l'échange, notamment par la réduction des coûts de transaction qu'ils engendrent. Les intermédiaires financiers internalisent une partie de ces coûts, en proposant aux consommateurs des instruments de paiement adaptés à leurs besoins.

Le développement de services de paiement de plus en plus élaborés a conduit à l'émergence d'une véritable industrie des paiements. Dans cette thèse, nous choisissons d'aborder la question de la tarification des systèmes de paiement de détail à travers le champ de l'économie industrielle. Nous justifions cette démarche dans le paragraphe suivant.

I.3. Le choix de traiter notre sujet en utilisant le champ de l'économie industrielle.

Nous choisissons dans notre thèse d'étudier le rôle des interchanges sur la tarification des systèmes de paiement en utilisant le champ de l'économie industrielle. Cette approche se distingue des théories macroéconomiques, notamment du champ de l'économie monétaire, qui considère le secteur bancaire comme un ensemble agrégé. Nous détaillons par la suite les raisons qui motivent notre démarche :

- L'économie industrielle fournit un cadre très utilisé pour traiter des questions d'économie bancaire.
- L'économie industrielle permet de modéliser la concurrence que se livrent les firmes pour fournir des services de paiement.
- Nous avons constaté que les interchanges avaient fait l'objet de nombreux débats de réglementation et de politique de la concurrence.

L'économie industrielle fournit un cadre pertinent pour traiter de nombreuses relatives à l'économie bancaire. En microéconomie industrielle, la firme bancaire est modélisée comme une entité indépendante, qui choisit ses stratégies de façon optimale, en tenant compte de l'environnement auquel elle fait face (tarification, investissements, concurrence etc…). De nombreux domaines de recherche de l'économie industrielle fournissent des théories qui s'appliquent particulièrement bien au secteur bancaire (économie des réseaux, théorie des contrats, économie de la réglementation). Par exemple, l'économie des réseaux permet d'étudier les questions relatives à la concurrence entre réseaux d'agences, ainsi que les coûts de changement (« *switching costs* ») auxquels font face les consommateurs lorsqu'ils souhaitent changer de banque. La théorie des contrats permet d'analyser la tarification optimale pratiquée par une banque pour un prêt en présence d'une information imparfaite sur la solvabilité de l'emprunteur. L'économie de la réglementation permet d'étudier les arguments en faveur d'une réglementation du taux des dépôts à vue.

Nous avons constaté que les firmes bancaires proposent une offre de services de paiement de plus en plus variée aux consommateurs. Par ailleurs, des acteurs non bancaires, comme les commerçants ou les opérateurs de téléphonie mobile, commencent à concurrencer les banques sur leur offre de services de paiement. Il est donc intéressant d'utiliser un cadre qui permette de modéliser la concurrence que se livrent ces firmes pour fournir des services de paiement. Par ailleurs, nous verrons que la théorie des marchés bifaces fournit des éléments pour comprendre les mécanismes qui régissent la concurrence entre plates-formes de paiement.

Enfin, les interchanges ont fait l'objet de nombreux débats de réglementation et de politique de la concurrence. Dans de nombreux pays, les autorités de la concurrence et les régulateurs se sont intéressés aux accords régissant les mécanismes d'interchanges (Affaire Visa 2002[20], Affaire MasterCard 2008 en Europe par exemple[21]), afin de déterminer s'ils n'avaient pas pour conséquence de restreindre la concurrence sur les marchés de détail bancaires. Les autorités de la concurrence ont aussi cherché à évaluer la contribution des interchanges au progrès économique. L'économie industrielle offre de nombreux outils qui permettent de trouver des éléments de réponse à ces questions.

Dans les paragraphes qui suivent, nous présentons les principaux résultats de la littérature microéconomique sur la modélisation de l'offre et de la demande d'instruments de paiements.

[20] Aff. Comp/29.379, JOCE 2002 n°L.318, p/17.
[21] Affaire T.111/08.

(1). La modélisation de la demande d'instruments de paiement

Les théories microéconomiques étudiant la demande d'instruments de paiement sont relativement récentes, probablement parce que les consommateurs utilisaient surtout des espèces pour régler leurs achats. Jusqu'au début des années quatre-vingt dix, la littérature économique n'a abordé la question de la demande d'instruments de paiement qu'à travers la modélisation de la demande de monnaie. Nous rappelons brièvement ces théories avant de nous intéresser à la demande d'instruments de paiement.

- *Analyse théorique de la demande de monnaie*

Les premières théories concernant la demande de monnaie mettent l'accent sur le caractère transactionnel de la monnaie. Pour les théoriciens de l'école classique (Smith[22], Say, Ricardo) et néoclassique (Marshall, Pigou), la monnaie n'est pas désirée pour elle-même mais parce qu'elle permet d'effectuer des transactions. L'équilibre sur le marché des biens est indépendant de l'équilibre sur le marché de la monnaie, ce qui suppose que les agents font une évaluation précise du prix de la monnaie. Les variations de la masse monétaire sont donc sans impact sur le niveau d'activité économique (théorie de la neutralité de la monnaie). Keynes est le premier économiste qui remet en cause cette conception de la monnaie. En montrant que toute l'épargne n'est pas nécessairement placée sous forme rémunérée, il met en évidence l'existence d'une demande de monnaie ne répondant pas à des objectifs transactionnels.

L'approche la plus ancienne de la circulation monétaire se fonde sur « la théorie quantitative de la monnaie », dont la première formulation remonte à Jean Bodin (1576). Jean Bodin remarque en effet que l'afflux de métaux précieux provoque une hausse des prix. Selon la théorie quantitative de la monnaie, il existe une relation de causalité entre la quantité de monnaie en circulation dans l'économie et le niveau général des prix. Cette relation se traduit par la célèbre équation de Fisher (1911), selon laquelle les variations de la quantité de monnaie en circulation dans l'économie sont proportionnelles aux variations du niveau des prix. Cependant, cette équation ne constitue pas une fonction de demande. Elle traduit plutôt un équilibre comptable. Cette équation exprime la quantité de monnaie nécessaire dans l'économie pour que les transactions circulent à une certaine vitesse. Elle ne correspond pas à la quantité de monnaie désirée par les agents. La notion de demande de monnaie apparaît avec les travaux de l'école de

---

[22] Pour Adam Smith par exemple, les richesses sont réelles. Elles ne sont pas mesurées monétairement mais par leur valeur, fondée sur le travail, sur laquelle la monnaie n'exerce pas d'influence. L'échange monétaire constitue un cas particulier de l'échange. Les prix naturels pour Adam Smith sont déterminés par la somme des coûts de production incluant la rémunération du capital et de la propriété foncière.

Cambridge. Contrairement à l'équation de Fisher, l'équation proposée par l'école de Cambridge (Marshall, Pigou) s'appuie sur les objectifs individuels des agents. Elle montre que les agents détiennent des encaisses monétaires pour effectuer des transactions, à cause d'une absence de synchronisation de leurs recettes et de leurs dépenses. Lorsque les agents subissent une modification de leurs encaisses réelles, ils cherchent à en retrouver le niveau requis en modifiant leur demande de biens.

Les premières théories microéconomiques concernant la demande de monnaie ont donc mis l'accent sur le caractère transactionnel de la monnaie. Keynes (1936) est le premier économiste identifiant de nouveaux déterminants de la demande de monnaie. Ses travaux ont largement inspiré les premières contributions microéconomiques à la modélisation de la demande de monnaie en tant qu'instrument de paiement. Selon Keynes, il existe trois motifs principaux de détention d'encaisses monétaires.

- *Le motif de transaction* : les agents détiennent de la monnaie pour pallier l'absence de synchronisation des dépenses et des recettes. Ce motif correspond à la formulation de la théorie quantitative adoptée par l'école de Cambridge.

- *Le motif de précaution* : les agents détiennent de la monnaie pour faire face à des dépenses imprévues.

- *Le motif de spéculation* : les agents détiennent de la monnaie pour acheter et vendre des obligations. En fonction de l'évolution des taux d'intérêt courants et de ceux qu'ils anticipent, les agents économiques arbitrent entre la détention d'obligations et la détention de monnaie (un actif non rémunéré, mais sans risques).

Keynes identifie un facteur supplémentaire influençant la détention d'encaisses monétaires, le degré de préférence pour la liquidité, fonction de l'état de confiance des individus dans l'avenir du système (anticipations sur l'évolution du marché, du prix des titres). Dans ce contexte, la détention de monnaie apaise les inquiétudes des agents face à un avenir incertain et non probabilisable. Dans un article paraissant après « la théorie générale de la monnaie, de l'intérêt et de l'emploi », Keynes ajoute ainsi un quatrième motif à la détention de monnaie, le *motif de financement*.

- *Le motif de financement :* les agents détiennent des encaisses monétaires pour réaliser des investissements en fonction des évolutions anticipées pour le niveau de l'activité économique.

Selon l'approche kéneysienne, la demande de monnaie n'est plus neutre. Il existe un lien entre le taux d'intérêt[23], la demande de monnaie et le niveau d'activité économique.

La théorie de Keynes a inspiré les premiers modèles microéconomiques sur la demande de monnaie. Ces modèles permettent d'analyser les décisions des agents de détention de monnaie sous forme de dépôts à vue ou sous forme d'espèces pour effectuer des transactions.

Sous une hypothèse d'imperfection du marché du crédit, Baumol (1952) montre que le montant d'espèces détenue *« pour motif de transaction »* décroît avec le niveau du taux d'intérêt, et croît avec le coût des retraits. L'encaisse optimale détenue à des fins de transactions lorsqu'il n'y a pas synchronisation des recettes et des dépenses est proportionnelle à la racine carrée du montant des transactions.

Tobin (1968) analyse plus généralement la demande de monnaie *« pour motif de spéculation »* dans le cadre des choix de portefeuille, la monnaie étant considérée comme un actif sans risque, non rémunéré tandis que d'autres actifs sont plus risqués mais rapportent plus aux agents. Il suppose que les agents sont averses au risque. La demande de monnaie de spéculation dépend donc de la préférence des agents pour la liquidité et de leur aversion pour le risque. Le portefeuille optimal de l'agent se compose à la fois de monnaie et de titres[24]. La demande de monnaie est donc formulée dans le cadre d'une stratégie de diversification du patrimoine.

- *Analyse de la demande d'instruments de paiement*

La diversification de l'offre d'instruments de paiement a complexifié le problème de modélisation de la demande des consommateurs. Les consommateurs doivent déterminer la quantité de monnaie détenue sous forme de dépôts à vue, ainsi que le montant des encaisses conservées sur soi pour régler des transactions en espèces. Ils doivent également choisir de s'équiper ou non d'instruments de paiement supplémentaires (comme le chéquier, la carte de paiement….), qui permettent de transférer des fonds. Ces instruments de paiement peuvent être délivrés automatiquement à l'ouverture du compte dans un bouquet de services fournis par la banque, ou faire l'objet d'un achat séparé. Le consommateur détermine le nombre d'instruments de paiement à détenir pour maximiser son utilité, en respectant sa contrainte de budget. Une fois que le consommateur est équipé d'instruments de paiement, il choisit de les utiliser pour régler

[23] Dans la théorie kéneysienne, le taux d'intérêt correspond au prix de renonciation à la liquidité. Il devient une variable monétaire.

[24] Le théorème de séparation de Tobin est le suivant : tous les agents, quelle que soit leur richesse initiale respective et leur attitude envers le risque, construisent leur portefeuille optimal comme une combinaison de l'actif sans risque (la monnaie) et le portefeuille du marché (ensemble des actifs disponibles sur le marché).

ses achats en comparant le bénéfice qu'il en retire à ses coûts de transaction. La demande d'usage d'instruments de paiements doit donc être distinguée de la demande de détention.

Récemment, la littérature économique s'est intéressée aux raisons qui poussent les consommateurs à détenir d'autres instruments de paiement que les espèces. Nous présentons ici quelques travaux auxquels nous ferons référence dans notre thèse. Selon Whitesell (1989), les consommateurs doivent supporter des coûts fixes et des coûts variables lorsqu'ils utilisent des instruments de paiement. Les coûts variables dépendent du montant de la transaction, et sont plus élevés pour les paiements en espèces. En ajoutant cette hypothèse au modèle de Baumol, Whitesell montre que les consommateurs utilisent les espèces pour les transactions de faible montant, et la carte de débit ou le chèque pour les transactions de montants plus élevés.

Face aux nombreuses innovations en matière de moyens de paiement (cartes prépayées, cartes de crédit, cartes de débit…), Santomero et Seater (1996) étudient le choix d'un agent représentatif confronté à l'offre de nombreux moyens de paiement. Ils réalisent une extension du modèle de Baumol en étudiant le cas d'un individu qui consomme différents types de biens qui peuvent être stockés et achetés au moyen d'une palette d'instruments de paiement. Leur modèle montre que le nombre d'instruments de paiement utilisés par le consommateur représentatif diminue avec son revenu. Par ailleurs, les consommateurs qui possèdent un revenu identique et des coûts de transaction similaires sont susceptibles de choisir des instruments de paiement différents en fonction du type de biens qu'ils souhaitent consommer et de la façon dont ils souhaitent répartir leurs dépenses. Enfin, les instruments de paiement ne possèdent pas les mêmes caractéristiques et ne sont pas acceptés par tous les commerces dans les mêmes conditions.

Les déterminants de la détention et de l'usage des instruments de paiement ont été largement testés sur des données empiriques[25]. Nous aurons l'occasion de faire référence à ces travaux dans cette thèse, et de proposer quelques statistiques descriptives sur des données françaises.

(2). La modélisation de l'offre d'instruments de paiement

L'offre d'instruments de paiement est assurée par les firmes qui proposent leurs services de paiement aux consommateurs et aux commerçants. Les firmes sont principalement bancaires, mais pas nécessairement (commerçants, opérateurs de téléphonie mobile etc…). La firme bancaire possède néanmoins un avantage concurrentiel dans la fourniture de services de paiement, car elle gère les écritures des comptes de dépôts des consommateurs. Elle peut également vendre des services de paiement liés à des produits de crédit ou d'assurance. Par ailleurs, les banques contrôlent par leurs réseaux d'agence et de distributeurs automatiques de billets l'approvisionnement des consommateurs en espèces.

En abordant l'économie des paiements par le champ de l'économie industrielle, on modélise les banques comme des entités qui choisissent les prix des instruments de paiement pour maximiser leurs profits. Le choix de la tarification des instruments de paiement est susceptible d'être soumis à des contraintes réglementaires (absence de tarification des retraits, ou des remises de chèques etc…). Les banques se concurrencent aussi sur les marchés de détail bancaires pour proposer des services de paiement aux consommateurs. Cependant, la plupart des banques coopèrent dans le cadre de plates-formes de paiement, qui leur permettent d'assurer la compatibilité de leurs réseaux, d'engranger des économies d'échelle, et d'allouer les coûts des transactions pour maximiser leur profit. Ces plates-formes ont pris une importance considérable avec le processus de dématérialisation des échanges monétaires. Nous aurons l'occasion de revenir sur ce champ de l'économie des paiements dans notre partie suivante.

Les modèles étudiant la tarification des instruments de paiements par les firmes bancaires sont relativement récents. Par exemple, Shy et Tarkka (1998) développent un modèle de tarification du porte-monnaie électronique dans un contexte de concurrence entre la carte de débit et les espèces. Les banques déterminent les prix payés respectivement par les commerçants pour l'acceptation des instruments de paiement et par les consommateurs pour l'usage qu'ils en font. Pour qu'un instrument de paiement soit utilisé, il faut qu'il y ait coïncidence du souhait d'usage du consommateur et de l'acceptation par le commerçant. Ce modèle montre que le porte-monnaie électronique peut se substituer aux espèces pour des transactions de faibles montants, pour lesquelles le commerçant refuse la carte de débit.

Dans la plupart des systèmes de paiement de détail, il existe deux niveaux d'intermédiation et donc de tarification. L'intermédiation entre les acheteurs et les vendeurs est assurée par les firmes (principalement bancaires) qui proposent des services de paiement. Ces firmes se concurrencent sur les marchés de détail bancaires. Des plates-formes de paiement (ou « systèmes de paiement ») interviennent à un second niveau pour assurer l'intermédiation entre les fournisseurs de services de paiement, faciliter le règlement des transactions, et favoriser la coopération.

---

[25] Voir Bounie et François (2006) pour une revue de la littérature.

Le fonctionnement des plates-formes de paiement par carte (ou systèmes de paiement par carte) a retenu notre attention de façon plus spécifique pour notre travail de thèse. En effet, ce sont principalement ces plates-formes qui déterminent le niveau et le mode de calcul des interchanges[26]. Dans la partie suivante, nous montrons en quoi une branche récente de la littérature en économie industrielle – la théorie des marchés bifaces – fournit un cadre intéressant pour étudier la tarification des plates-formes de paiement de détail, et notamment celle pratiquée au sein des systèmes de paiement par carte.

I.4. Le choix de traiter notre sujet en retenant les apports de la théorie des marchés bifaces.

Dans cette thèse, nous avons choisi de retenir la théorie des marchés bifaces pour modéliser la tarification des systèmes de paiement par carte. En effet, cette théorie va permettre de mettre en évidence le rôle des interchanges dans les systèmes de paiement par carte, en formalisant l'existence d'externalités entre les consommateurs et les commerçants. C'est ce que nous nous proposons d'expliquer par la suite.

(1). La théorie des marchés bifaces

La théorie des marchés bifaces part du constat que, sur de nombreux marchés (consoles de jeux vidéo, médias, centres commerciaux, sites de rencontre…), une plate-forme met en relation deux groupes distincts d'individus interdépendants, que nous notons *S* et *B* (conformément à la littérature économique, *S* pour Seller et *B* pour Buyer). La participation d'un groupe aux échanges dépend du nombre d'agents présents sur l'autre versant du marché. Par exemple, l'utilité obtenue par les agents du groupe *S* lorsqu'ils se raccordent à la plate-forme augmente avec le nombre d'agents du groupe *B*. Les marchés bifaces sont donc caractérisés par la présence d'effets de réseau croisés. La plate-forme de paiement choisit les prix d'accès payés respectivement par le groupe *B* et le groupe *S*, notés a^B et a^S.

Rochet et Tirole (2006) montrent néanmoins que la présence d'effets de réseau croisés n'est pas suffisante pour conclure à la présence d'un marché biface. Ils suggèrent une définition plus précise, selon laquelle le nombre d'interactions qui ont lieu entre les deux groupes d'agents

[26] Quand les interchanges ne sont pas décidés de façon bilatérale entre deux banques.

dépend non seulement du prix total ($a^B + a^S$), mais aussi de la structure des prix choisis par la plate-forme (a^B / a^S). Cette situation s'observe lorsque les deux groupes d'utilisateurs sont incapables de négocier entre eux pour internaliser la présence d'effets de réseau[27].

Il n'existe pas encore de théorie unifiée sur les marchés bifaces. Les premiers modèles (Armstrong (2006), Rochet et Tirole (2002, 2006), Caillaud et Jullien (2001, 2003)) ont été développés pour être appliqués à des cas spécifiques, comme celui de l'industrie des paiements par carte. Il existe néanmoins un consensus autour de trois principaux résultats (voir Armstrong (2006) :

- **La structure des prix pratiquée par la plate-forme influence le volume d'interactions entre les deux groupes d'agents.**

Généralement, les plates-formes sont amenées à pratiquer des structures de prix très asymétriques pour attirer le groupe d'utilisateurs le plus réticent aux échanges, ou bien pour attirer le groupe qui exerce l'externalité la plus forte sur l'autre versant du marché. En effet, par exemple, le groupe *S* ne peut pas effectuer de transactions sans la présence du groupe *B* (problème de la poule et de l'œuf[28]).

- **Les effets de réseaux croisés rendent la concurrence entre plates-formes particulièrement intense.**

La pression concurrentielle augmente du fait que, lorsqu'une plate-forme obtient des parts de marché supplémentaires d'un côté du marché, cela influence la participation de l'autre côté du marché. Ce mécanisme fournit donc une incitation supplémentaire pour les plates-formes à baisser les prix de chaque côté du marché.

- **Le nombre de plates-formes auxquelles les utilisateurs sont susceptibles de se raccorder influence la tarification (raccordement simple ou multiple).**

Les utilisateurs de chaque côté du marché peuvent se raccorder à une ou plusieurs plates-formes. Supposons qu'un groupe d'agents ne se raccorde qu'à une seule plate-forme (par exemple, les agents du groupe *B*), tandis que l'autre groupe (*S*) se raccorde à deux plates-formes. Les agents du groupe *B* peuvent choisir la plate-forme de leur choix pour interagir avec les agents du groupe *S*. Ces derniers sont contraints d'utiliser la plate-forme des agents « exclusifs » (le groupe *B*) s'ils souhaitent que la transaction se réalise. De leur point de vue, la plate-forme choisie

[27] Différentes raisons peuvent invalider le théorème de Coase : présence de coûts de transaction entre utilisateurs finaux, contraintes de tarification appliquées par la plate-forme (voir Rochet et Tirole 2006).

par les agents du groupe *B* constitue un « goulet d'étranglement », un point de passage obligé pour réaliser des transactions. Les plates-formes vont donc se concurrencer très fortement pour attirer les agents du groupe *B* tout en pratiquant des prix élevés sur les agents du groupe *S*.

Nous montrons dans le paragraphe suivant que cette théorie peut être particulièrement intéressante pour étudier le fonctionnement des systèmes de paiement de détail, notamment celui des systèmes de paiement par carte.

(2). L'application de la théorie des marchés bifaces aux systèmes de paiement par carte.

Les systèmes de paiement de détail ont pour particularité de traiter un grand nombre d'ordres de paiement pour des transactions de montant faible ou moyen[29]. Ils mettent en relation deux groupes d'utilisateurs distincts, les consommateurs et les commerçants, qui exercent les uns sur les autres des externalités croisées d'adoption et d'usage, ce qui correspond à l'une des caractéristiques des marchés bifaces.

- **L'externalité d'adoption :**

Lorsque les consommateurs choisissent de s'équiper d'un instrument de paiement proposé par une plate-forme, ils prennent en compte le nombre de commerçants qui l'acceptent. Et de même, les bénéfices que retirent les commerçants de l'acceptation d'un instrument de paiement augmentent avec la clientèle de porteurs qu'ils sont susceptibles d'attirer. Par conséquent, les demandes des côtés consommateurs et commerçants sont interdépendantes. Les systèmes de paiement de détail (et notamment les systèmes de paiement par carte) vérifient donc l'une des principales caractéristiques des marchés bifaces.

- **L'externalité d'usage :**

Un consommateur qui détient plusieurs instruments de paiement ne choisira pas nécessairement celui qui rapporte au commerçant le bénéfice le plus important. Il peut donc exercer une externalité négative sur le commerçant par ses décisions d'usage. De façon similaire, un commerçant peut choisir de refuser un instrument de paiement pour une transaction donnée. Ce type d'externalité persiste, même lorsque l'instrument de paiement a été adopté par tous les consommateurs et les commerçants.

---

[28] Voir Caillaud et Jullien (2003).

[29] Par opposition aux systèmes de paiement de gros.

Les systèmes de paiement par carte peuvent être classés principalement en deux catégories : les systèmes fermés et les systèmes ouverts. Cette classification est importante, parce qu'elle détermine la façon dont sont déterminés les prix payés par les utilisateurs du système de paiement. Les systèmes de paiement fermés, comme par exemple American Express, sont gérés par une entreprise, qui décide directement des prix payés par les porteurs et par les commerçants. Ce mode de fonctionnement correspond au modèle exposé par Rochet et Tirole (2006) pour présenter les spécificités des marchés bifaces. L'organisation des systèmes de paiement ouverts, comme Visa ou MasterCard, est plus complexe, parce qu'il existe un échelon intermédiaire entre la plate-forme et les utilisateurs finaux, ce qui implique la prise en compte de deux niveaux de tarification (voir figure 1 page suivante). En effet, les systèmes ouverts mettent en relation les banques des porteurs et les banques des commerçants. Chaque banque doit payer un prix pour devenir membre de la plate-forme de paiement. Sur les marchés de détail bancaires, les banques sont libres de choisir les prix respectifs payés par les porteurs et les commerçants. Néanmoins, la plate-forme peut influencer le volume de transactions effectuées sur les marchés de détail par l'intermédiaire d'une commission appelée « interchange ». Dans le cas des systèmes de paiement par carte, à chaque fois qu'un porteur utilise sa carte, la banque du commerçant, appelée « Acquéreur », verse une commission d'interchange à la banque du porteur, appelée « Emetteur ». L'interchange constitue un moyen pour la plate-forme de paiement d'influencer la structure des prix payés de chaque côté du marché en subventionnant éventuellement le côté des porteurs, au détriment du côté des commerçants.

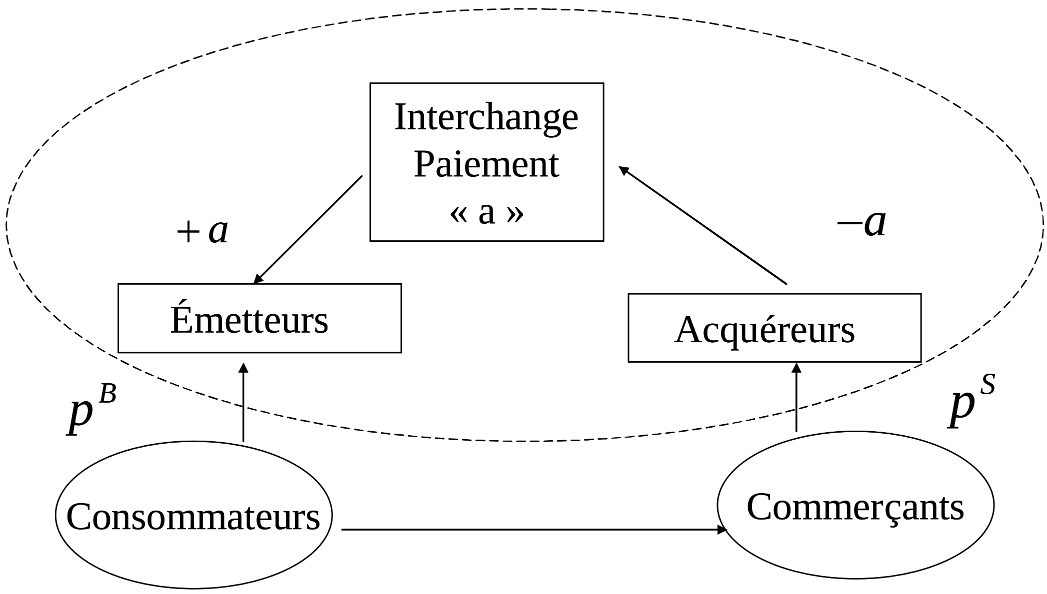
Depuis le début des années 2000, les interchanges ont fait l'objet de nombreux débats entre les différents acteurs des systèmes de paiement par carte (banques, commerçants, consommateurs et systèmes cartes) à l'occasion de tables rondes, d'enquêtes, de conférences, de procédures juridiques[30]. Dans ce contexte, deux questions sont principalement soulevées :

- **La distorsion de prix induite par les mécanismes des interchanges contribue-t-elle à une amélioration de l'efficacité de l'usage des instruments de paiement ?**
- **Quels sont ses effets sur les comportements de paiement des consommateurs ? Sur l'acceptation par les commerçants des instruments de paiement ? Sur la concurrence entre les acteurs de l'industrie ? Sur l'arrivée de nouveaux entrants ?**

Le schéma suivant présente les deux niveaux de tarification intervenant dans un système de paiement ouvert (les interchanges, et les prix payés par les consommateurs et les commerçants).

[30] Voir par exemple l'enquête sectorielle de la Commission Européenne « Interim Report on payment cards », 12 Avril 2006, ou encore le rapport de l'OCDE « Competition and efficient usage of payment cards », 2006.

Figure 1 : Organisation des systèmes de paiement ouverts.



Nous exposons dans le paragraphe suivant les raisons les problématiques ayant retenu notre attention pour traiter du sujet des interchanges et de la tarification des systèmes de paiement par carte.

I.5. Présentation des problématiques de la thèse.

Cette thèse s'inscrit dans la branche de la littérature relative à la théorie des marchés bifaces, appliquée à l'analyse de la tarification des systèmes de paiement par carte. Les économistes ont utilisé cette littérature pour analyser en particulier le rôle des interchanges dans le processus d'allocation des coûts d'une transaction de paiement par carte (Rochet & Tirole (2002), Rochet (2003)). Ils ont cherché à comprendre quels étaient les déterminants des interchanges, afin d'identifier une éventuelle divergence entre les interchanges choisis par les plates-formes de paiement, et les interchanges socialement optimaux. Cependant, les nombreuses questions soulevées au cours des débats sur les interchanges ont montré que cette branche de la littérature méritait d'être approfondie. Comme le souligne Robert Hunt (2003), *« The challenge to policymakers is to decide, based on the available information whether a network's pricing strategy and rules are likely to advance or retard economic efficiency ».*

Deux thèmes non abordés par la littérature économique nous sont apparus intéressants et pertinents à étudier dans le cadre de cette thèse.

- Le premier thème concerne le rôle des interchanges dans les stratégies d'investissement des acteurs des systèmes de paiement par carte.
- Le second thème concerne l'influence des interchanges sur les mécanismes de substitution entre la carte et les espèces.

(1). Le rôle des interchanges dans les stratégies d'investissement des acteurs des systèmes de paiement par carte.

Deux raisons nous ont conduits à choisir le premier thème que nous avons retenu pour notre thèse. Tout d'abord, la question du lien entre les interchanges et les investissements pratiqués par les acteurs d'une transaction de paiement n'a jamais été étudiée par la littérature. Pourtant, cette question a fait l'objet de nombreux débats entre banques, commerçants, systèmes de paiement et régulateurs. Certaines banques avancent qu'il est nécessaire de maintenir un niveau d'interchange élevé pour répondre aux nombreux investissements nécessaires au maintien ou à l'amélioration du service de paiement. Par exemple, les systèmes de paiement doivent élaborer des protocoles de plus en plus élaborés pour lutter contre la fraude, notamment pour les paiements sur Internet. Par ailleurs, dans certains pays, les banques doivent investir pour se mettre en conformité avec les nouvelles normes exigées par le projet de création d'un espace européen des paiements (SEPA)[31]. De leur côté, certains commerçants pensent que les mécanismes tarifaires pratiqués par les systèmes de paiement leur font subir une trop large part du coût lié aux investissements nécessaires à la maintenance d'une plate-forme de paiement interbancaire. Pour ces raisons, certains commerçants ont choisi de contourner les infrastructures de paiement interbancaires en émettant leurs propres cartes de paiement, les cartes privatives[32]. C'est pourquoi, nous nous attachons dans cette thèse à préciser les liens existant entre le niveau

[31] Single Euro Payments Area. Par exemple, dans un communiqué de presse en date du 3 décembre 2007 « Pérenniser la dynamique des systèmes de paiement par carte », l'association Eurofi parle des conséquences d'une suppression des interchanges sur la qualité du service de paiement. « En cas de suppression ou de forte réduction des interchanges, les banques pourraient être conduites à réduire leurs investissements dans la modernisation et la sécurisations des moyens de paiement ».

[32] La question de la possibilité d'un contournement des plates-formes de paiement interbancaires est présente dans les débats. Par exemple, en 2005 (Décision n°CA98/05/05 de l'OFT p:81) le conseil des commerçants britanniques avançait à l'OFT que « l'on ne peut raisonnablement penser que les commerçants sont en mesure de renoncer aux systèmes de cartes de paiement, les principaux dispositifs étant devenus pour eux, à certains égards, des « infrastructures essentielles » ».

des interchanges et les investissements réalisés par les acteurs d'une transaction de paiement. Nous abordons ce thème à travers les deux problématiques suivantes :

- **Comment l'interchange fixé par la plate-forme de paiement doit-il tenir compte des investissements réalisés par les banques pour améliorer la qualité du service fourni aux consommateurs et aux commerçants ?**
- **En quoi les interchanges peuvent-ils influencer les incitations des commerçants à investir dans leur propre infrastructure de paiement, pour émettre des cartes privatives ?**

(2). L'influence des interchanges sur les mécanismes de substitution entre la carte et les espèces.

Le deuxième thème étudié concerne la relation entre les interchanges et les mécanismes de substitution entre la carte et les espèces, dans un système de paiement par carte proposant à la fois des services de paiement et des services de retrait. Les services de retrait peuvent aussi faire l'objet du choix d'une commission d'interchange lorsque le système de paiement gère les règles relatives aux distributeurs automatiques de billets. L'interchange sur les retraits est payé par la banque émettrice de la carte à la banque gestionnaire du distributeur à chaque fois que le porteur de la carte effectue un retrait. Dans ce contexte, la plate-forme de paiement peut être amenée à choisir deux interchanges : un interchange « paiement » et un interchange « retrait ».

Ce sujet constitue une nouveauté par rapport à la littérature existante, qui traite la fourniture de services de paiement par carte, et de services de retraits dans les distributeurs de billets de façon complètement séparée. Or, la plupart des systèmes de paiement par carte en Europe (Système CB en France, systèmes espagnols, système géré par les banques italiennes par exemple…) proposent à leurs consommateurs d'utiliser leur carte bancaire pour retirer des espèces dans les agences des banques membres. Pourtant, les services de retrait d'espèces et de paiement par carte ont toujours été modélisés de façon séparée dans la littérature. Nous nous proposons donc d'étudier les liens entre les interchanges payés lors des transactions de paiement par carte, les interchanges sur les retraits et les mécanismes de substitution entre la carte et les espèces.

I.6. Vue d'ensemble de la thèse

L'objectif de cette thèse est de fournir des éléments de réponses aux deux problématiques que nous avons exposées dans le paragraphe précédent. Nous présentons dans les paragraphes qui suivent une vue d'ensemble de notre thèse.

Le premier chapitre de la thèse présente une analyse des éléments empiriques nécessaires pour comprendre l'organisation des paiements par carte en France et en Europe. Ce chapitre s'articule autour de trois articles, qui permettent d'analyser à partir d'exemples empiriques français et européens le fonctionnement de l'industrie des paiements par carte. Le premier article, qui s'intitule *« La détention et l'usage des instruments de paiement en France »* , dresse un panorama des comportements de paiement des Français à partir d'une base de données originale, construite en 2005 à partir d'un échantillon d'individus représentatifs de la population française. Cet article nous permet de constater l'importance de la détention et de l'usage des cartes de paiement en France. Nous proposons des statistiques descriptives qui fournissent de premières indications sur les comportements de paiement des individus. Nous montrons que les choix des individus en matière de détention et d'usage des instruments de paiement dépendent de leurs caractéristiques individuelles (revenu, diplôme, âge….) et des propriétés de la transaction (montant, type de commerce…). Dans le second article, intitulé *« L'économie des cartes de paiement en France »*, nous étudions plus particulièrement l'organisation des paiements par carte en France. Cet article descriptif nous permet de dresser une photographie de l'offre de cartes de paiement en France. Enfin, le troisième article, intitulé *« Payment Card Systems in Europe : Convergence or Disappearance ? »*, nous permet de comparer le cas français à celui des autres pays européens. Nous présentons en détail le projet de construction d'un espace européen unique pour les paiements, le SEPA. Ce projet est à l'origine de nombreux travaux économiques pour tenter de mieux cerner l'industrie des paiements, ainsi que les éléments qui justifient ou qui vont à l'encontre de l'intervention d'un régulateur dans ce secteur.

Le second chapitre de la thèse présente une revue de la littérature sur les interchanges des systèmes de paiement par carte. Dans un article qui s'intitule *« Interchange Fees in Payment Card Systems : a Review of the literature »*, nous construisons un cadre général qui permet d'exposer et de démontrer les principaux résultats de cette littérature. Nous retenons comme enseignement principal que les interchanges permettent de corriger l'externalité d'usage exercée par les consommateurs sur les commerçants, lorsqu'ils ne choisissent pas d'utiliser leur carte de paiement, alors que la transaction était socialement efficace[33]. L'efficacité du mécanisme de correction induit par les interchanges dépend de la nature de la concurrence entre les banques, de la concurrence entre les commerçants, ainsi que des hypothèses relatives à la formalisation d'une concurrence entre plates-formes.

Le troisième chapitre de la thèse est consacré au rôle joué par les interchanges dans les stratégies d'investissement des acteurs des systèmes de paiement par carte. Ce chapitre s'organise autour de deux articles qui permettent de répondre à chacune des deux problématiques que nous avons soulevées. Les titres des deux articles sont les suivants :

- *« Interchange fees and incentives to invest in quality of a payment card system ».*
- *« Private cards and the by-pass of payment systems by merchants ».*

Le premier article s'intéresse aux relations entre les interchanges et les investissements des banques. Nous supposons que les banques émettrices et acquéreurs peuvent réaliser des investissements qui ont un impact sur la qualité de service fourni par le système de paiement. La qualité du service de paiement (niveau de sécurité, vitesse de règlement de la transaction, informations etc…) est donc considérée dans notre modèle comme un bien public, dont l'amélioration dépend des investissements effectués par chacune des banques. Les consommateurs et les commerçants reçoivent un bénéfice marginal différent lié à la qualité du service, parce que leurs besoins ne sont pas identiques. En effet, les porteurs peuvent être par exemple très sensibles au risque d'usurpation d'identité, tandis que les commerçants seront très intéressés par la fourniture d'une garantie associée au service de paiement.

Nos résultats sont les suivants. Si la qualité du service est exogène, nous montrons que l'interchange optimal choisi par la plate-forme de paiement dépend du niveau de la qualité du service fourni. Nous étudions ensuite une situation dans laquelle les banques décident de leurs contributions aux investissements après le choix de l'interchange par le système de paiement. Le principal résultat de notre modèle est de montrer que les systèmes de paiement par carte peuvent avoir intérêt à diminuer le niveau de l'interchange pour stimuler les investissements des banques acquéreurs. Nous discutons aussi dans ce modèle de l'importance du choix d'une structure tarifaire adéquate pour les interchanges. En effet, si les banques ont la possibilité d'investir pour

[33] Une transaction est dite socialement efficace quand la somme des bénéfices obtenus par les consommateurs et les commerçants lorsque la carte est utilisée (plutôt qu'un autre instrument de paiement) est supérieure à la somme des coûts liée à cette même transaction.

améliorer la qualité de service fourni aux utilisateurs, le système de paiement a intérêt à choisir un tarif binôme plutôt qu'un interchange payé à chaque transaction.

Le second article étudie l'influence des interchanges sur les incitations des commerçants à contourner la plate-forme de paiement pour émettre des cartes privatives. Si le commerçant émet des cartes privatives, nous montrons que ce dernier pratique une tarification très agressive pour cet instrument de paiement. En effet, le commerçant est actif sur deux marchés : le marché des produits et le marché des transactions de paiement par carte. Ses incitations sur ces deux marchés le conduisent à pratiquer un prix plus faible que celui choisi par l'émetteur. En outre, il préfère encourager les consommateurs qui payent en espèces chez lui à régler par carte privative, car cela lui rapporte un bénéfice supérieur. Par ailleurs, sur le marché des produits, le commerçant attire les consommateurs de son concurrent en proposant des coûts de transaction réduits.

Le principal résultat de notre modèle est le suivant. Nous montrons que l'effet des interchanges sur les incitations des commerçants à investir pour émettre des cartes privatives dépend de la structure de marché. Ainsi, lorsque la banque émettrice et la banque acquéreur sont des monopoles, la plate-forme de paiement peut être amenée à diminuer le niveau de l'interchange pour dissuader les investissements du commerçant. Si les incitations à émettre des cartes privatives deviennent plus faibles quand l'interchange augmente, la plate-forme de paiement ne peut pas augmenter son interchange pour dissuader l'entrée, à cause de la contrainte de positivité des profits de l'acquéreur.

Le quatrième chapitre de la thèse est consacré aux liens entre les interchanges et les mécanismes de substitution entre la carte et les espèces. Ce chapitre comprend un article, qui s'intitule *"Optimal interchange fees for card payments and cash withdrawals"*.

L'originalité de notre travail consiste à proposer un modèle qui tient compte du fait que les cartes de paiement servent souvent aux consommateurs à effectuer des retraits d'espèces dans les distributeurs automatiques de billets. Or, dans la littérature, les activités de paiements et de retraits par carte sont toujours modélisées de façon séparée. Dans notre modèle, les réseaux des distributeurs automatiques de billets sont compatibles et la banque du porteur verse un interchange « retrait » à chaque fois que le consommateur effectue une transaction de retrait dans un distributeur de billets de son concurrent. Le segment acquisition est supposé parfaitement concurrentiel. Par ailleurs, nous utilisons un cadre dans lequel les consommateurs choisissent leur instrument de paiement en fonction du montant de la transaction. Les cartes sont utilisées pour les transactions de montants plus élevés, tandis que les espèces sont utilisées pour les transactions de faible montant.

Dans ce modèle, l'existence de transactions de retraits déplacés adoucit la concurrence sur le marché des dépôts. En effet, les banques arbitrent entre les revenus obtenus en affiliant des consommateurs, et les revenus obtenus lorsque les consommateurs du concurrent effectuent des retraits déplacés.

Deux cas peuvent être distingués en fonction des asymétries des réseaux de distributeurs automatiques de billets. Si les banques sont parfaitement symétriques, la plate-forme de paiement choisit l'interchange de monopole sur les retraits et un interchange égal à zéro pour les paiements par carte. En effet, un interchange plus faible pour les paiements par carte adoucit la concurrence sur le marché des dépôts, car il fait augmenter le volume de transactions de retraits déplacés effectués par les consommateurs. Lorsque les banques sont parfaitement symétriques, leurs objectifs sont identiques. Puisqu'elles obtiennent la moitié du marché des dépôts, elles cherchent à extraire le maximum de surplus des consommateurs sur les transactions de retraits déplacés. La plate-forme choisit donc un interchange « retrait » égal au prix de monopole.

Si les banques sont asymétriques, leurs objectifs ne sont plus parfaitement identiques. En effet, les comportements de paiement de leurs consommateurs sont différents. La banque dont le taux de retraits déplacés est le plus élevé a intérêt à favoriser les paiements par carte au moyen d'un interchange paiement plus élevé, et à ce que l'interchange sur les retraits déplacés soit relativement faible. Par conséquent, la plate-forme de paiement choisit des niveaux d'interchanges qui permettent de réaliser un arbitrage entre :

i. Les élasticités des parts de marché aux interchanges sur le marché des dépôts.
ii. Les revenus obtenus par les banques sur les transactions de retraits déplacés.

Dans les deux cas que nous étudions, nous montrons que l'interchange sur les paiements par carte est trop faible du point de vue du bien-être social, tandis que l'interchange sur les retraits est trop élevé. Une plate-forme qui gère à la fois des transactions de paiement par carte et des transactions de retrait est donc amenée à choisir parfois un interchange « paiement » trop faible. Ce résultat montre que la prise en compte des retraits d'espèces influence le niveau des interchanges obtenus sur les paiements. Il est donc important de tenir compte de l'approvisionnement en espèces dans la modélisation des systèmes de paiement par carte.

I.7. Références de l'introduction :

Dans notre thèse, nous fournirons les références par chapitre.

Aristote, « *Ethique à Nicomaque* », éditions Flammarion.

Armstrong, M. (2006): «Competition in Two-Sided Markets», The RAND Journal of Economics, vol. 37, pp. 668-691.

Baumol, W. (1952): «The transactions demand for cash: An inventory theoretic approach», The Quaterly Journal of Economics, vol. 66, n°4, pp. 545-556.

Baxter, W. (1983): "Bank Interchange of Transactional Paper: Legal and Economic Perspectives", *Journal of Law & Economics*, vol.26, n°3 (October), pp. 541-88.

Bodin, J. (1576): « Les Six Livres de la République», 1ère édition, Paris, réédition 1986, Paris Fayard, 6 volumes.

Bordes, Ch., Hautcoeur, P-C., Lacoue-Labarthe, D., Mishkin, F. (2007): «The economics of money, banking and financial markets», Pearson Education.

Bounie, D & François, A. (2006): «Les déterminants de la détention et de l'usage des instruments de paiement : éléments théoriques et empiriques«, Revue d'Economie Financière, n°83, mars, pp. 159-173.

Bryant, J. (1980): «A Model of Reserves, Bank Runs, and Deposit Insurance», Journal of Banking and Finance, n°4, pp.335-344.

Caillaud, B. & Jullien, B. (2001): «Competing Cybermediaries», European Economic Review, vol. 45, pp. 797-808.

Caillaud B. & Jullien B. (2003): «Chicken and Egg: Competition among Intermediation Service Providers», The RAND Journal of Economics, vol. 34, no. 2, June, pp. 521-552.

Coase, R.H (1937): «The Nature of the Firm», Economica, New Series, 4 (16), pp. 386-405.

Décision n°CA/98/05/05 de l'Office of Fair Trading "Investigation of the multilateral interchange fees provided for in the UK domestic rules of MasterCard UK Members Forum Limited", 6 septembre 2005, Affaire CP/0090/00/5.

Diamond, D. & Dybvig, P. (1983): "Bank Runs, Deposit Insurance and Liquidity", Journal of Political Economy, 91(3), pp. 401-409.

Freixas, X. & Rochet, J-C. "Microeconomics of Banking", the MIT Press.

Fisher, I. (1940): "The Velocity of Circulation of Money", in Gowles Commission for Research in Economics, Report of Sixth Annual Research Conference in Economics and Statistics, Chicago, pp.55-8.

Hunt, R. (2003): "An Introduction to the Economics of Payment Cards», Review of Network Economics, vol.2, pp.80-96.

Jevons, S. (1875): "Money and the Mechanism of Exchange", London: Appleton, chapters I-III; reprinted in Starr (1990).

Jensen, M.C. & Meckling, W.H (1976): "Theory of the firm: managerial behavior, agency costs and ownership structure", Journal of Financial Economics 3:305-360.

Keynes, J.M. (1968): "The General Theory of Employment, Interest, and Money", 1936, édition française, Payot.

Kiotaki, N. & Wright, R. (1993): "A Search-Theoretic Approach to Monetary Economics", American Economic Review, vol. 83, pp. 63-77.

Kocherlakota, N. (1998): "Money is Memory", Journal of Economic Theory, vol. 81, pp. 232-251.

Lannoye, V. (2005): « La monnaie et les banques, de la Mésopotamie à Manhattan», éditions Le Cri.

Leland, H.E & Pyle, D.H (1977): "Informational Asymmetries, Financial Structure, and Financial Intermediation", Journal of Finance, vol. 32, n°2, may.

MacAndrews, J. & Roberds, W. (1999): "Payment Intermediation and the Origins of Banking", Working Paper.

Plihon, D. (2008) :"La monnaie et ses mécanismes", Collection Repères, n°295.

Rochet, J-C. (2003): "The Theory of Interchange Fees: A Synthesis of Recent Contributions," *Review of Network Economics*, vol.2, n°2 (June), pp. 97-124.

Rochet, J-C. & J. Tirole (2002): "Cooperation Among Competitors: The Economics of Payment Card Associations", *RAND Journal of Economics*, vol.33, n°4 (winter), pp. 549-570.

Rochet, J-C. & J. Tirole (2006a): "Two-sided Markets: a Progress Report", *RAND Journal of Economics*, vol.35, n°3, pp. 645-667.

Santomero, A. & Seaters, J. (1996): "Alternative Monies and the Demand for Media of Exchange", Journal of Money, Credit and Banking, vol. 28, pp. 942-960.

Scialom, L. (2007) : "Economie bancaire", Collection Repères, n°268.

Shy, 0. & Tarkka, J. (2002): "The Market for Electronic Cash Cards", Journal of Money, Credit and Banking, vol. 34, pp. 299-314.

Tobin J. (1956): "The Interest-Elasticity of Transactions Demand For Cash", The Review of Economics and Statistics, vol. 38, no. 3 (August), pp. 241-247.

Wicksell, K. (1911): "Lectures on Political Economy", vol. 2, Money, translated by E. Classen, 2nd Ed., New York: Kelley, 1967.

Whitesell, W. (1989): "The Demand for Currency versus debitable Account: Note", Journal of Money, Credit, and Banking, vol. 21, n°2, pp. 246-251.

II. <u>CHAPITRE I :</u>
ANALYSE EMPIRIQUE DE L'INDUSTRIE DES CARTES DE PAIEMENT EN FRANCE ET EN EUROPE.

Ce chapitre présente une analyse empirique de l'industrie des cartes de paiement en France et en Europe. Dans le premier article, intitulé « *La détention et l'usage des instruments de paiement en France* », nous proposons une photographie de la détention et de l'usage des instruments de paiement en France. Cet article nous permet de déterminer quels facteurs influencent le choix des consommateurs de détenir et d'utiliser des cartes de paiement, plutôt que d'autres instruments de paiement. Dans le second article, qui s'intitule « *L'économie des Cartes de Paiement en France* », nous présentons l'organisation de l'industrie des paiements par carte en France, en analysant plus particulièrement les formes de coopération et de concurrence entre les acteurs qui offrent des services de paiement par carte. Nous montrons que l'offre de cartes de paiement doit évoluer pour s'adapter à la construction d'un espace européen unique des paiements (SEPA). Enfin dans le troisième article, « *Payment Card Systems in Europe : Convergence or Disappearance ?* », nous effectuons une comparaison de l'offre et des usages dans les différents pays européens. Nous présentons plus précisément les problèmes posés par la construction du SEPA.

<u>Articles :</u>

II.1 <u>La détention et l'usage des instruments de paiement en France.</u>

Article écrit avec David Bounie, Marc Bourreau et Abel François, publié dans la Revue d'Economie Financière, vol.91, mars 2008, p.53-76.

II.2. <u>L'Economie des Cartes de Paiement en France.</u>

II.3. <u>Payment Card Systems in Europe: Convergence or Disappearance?</u>

Article publié dans la revue "Communications and Strategies", vol.69, mars 2008, p.127-147.

La détention et l'usage des instruments de paiement en France *

David Bounie [a], Marc Bourreau [a,b], Abel François [a,c] et Marianne Verdier [a]

[a] *Télécom Paris, Département Sciences Économiques et Sociales*

[b] *CREST-LEI*

[d] *Université Robert Schuman, LARGE*

Article publié dans la Revue d'Economie Financière, vol. 91, mars 2008, p ; 53-76.

Résumé

L'objet de cet article est de proposer une photographie générale de la détention et de l'usage des instruments de paiement en France et de déterminer quels facteurs influencent les comportements de paiement des individus. Nous montrons qu'une grande majorité des Français dispose, outre les espèces, d'un chéquier et d'une carte de débit pour régler ses dépenses. Les instruments de paiement qui permettent de gérer une trésorerie (cartes de crédit, certaines cartes accréditives ou privatives) sont moins développés. L'âge, le revenu, le diplôme et la profession influencent les taux de détention pour le chèque et la carte de débit. L'usage des instruments de paiement dépend non seulement de l'âge et du revenu de l'individu mais aussi des caractéristiques de la transaction (valeur, type de commerce, etc.).

Detention and Use of Payment Instruments in France

In this article, we offer a general picture of the detention and the use of payment instruments in France, and we determine which variables influence consumer payment behavior. We show that a large majority of the French hold a checkbook and a debit card to pay for their expenses. The payment instruments, that enable consumers to manage their bank account by offering them access to credit, such as credit cards and private label cards, are less developed. We show that the variables age, income, diploma, and occupation influence the detention rates of the checkbook and the debit card. The use of payment instruments depends not only on age and income, but also on the characteristics of the transaction (its value, the type of store, its periodicity, etc…).

Mots clés : Paiement, Instruments de paiement.

Classification JEL: E41.

---

* Cette recherche a bénéficié du soutien financier du Groupement des Cartes Bancaires « CB ». Nous tenons à remercier tout particulièrement M. Yves Randoux, administrateur du Groupement. Les vues développées dans cet article ne sont pas nécessairement celles du Groupement des Cartes Bancaires « CB ».

1 Introduction

Depuis l'apparition de la carte de paiement dans les années soixante-dix, les comportements des Français en matière de détention et d'usage des moyens de paiement ont considérablement évolué[1]. Comme dans les autres pays européens, l'usage de la carte de paiement s'est développé au détriment du chèque et des espèces. La France est l'un des pays européens où les cartes de paiements sont les plus détenues et utilisées. Selon la Banque Centrale Européenne[2], en 2005, les Français effectuent en moyenne 83,6 paiements par carte par an, contre 50 en moyenne dans le reste de l'Union Européenne. Cependant, la France reste l'un des pays où l'usage du chèque persiste malgré la tendance à l'abandon de cet instrument de paiement dans un certain nombre de pays[3]. Les Français effectuent en moyenne 62,5 paiements par chèque par an, contre 15,3 en moyenne pour les Européens.

Les statistiques agrégées de la Banque Centrale Européenne permettent d'étudier l'évolution de la détention et de l'usage des instruments de paiement au niveau macroéconomique dans chaque pays européen. Dans notre article, nous adoptons une perspective différente : nous proposons une analyse de la détention et de l'usage des instruments de paiement en France à partir de données individuelles. Pour cela, nous avons construit une base de données originale à partir d'un échantillon représentatif de la population française. Ces données nous permettent de proposer une photographie de la détention et l'usage des instruments de paiements en France en 2005, tout en répondant à plusieurs questions qui ne pourraient être traitées avec des données macroéconomiques. Nous déterminons notamment comment la détention et l'usage des instruments de paiement varient en fonction des caractéristiques de l'individu, comme l'âge, le diplôme, le sexe ou le revenu, et en fonction des caractéristiques de la transaction comme, par exemple, la valeur de l'achat, ou le type de commerce dans lequel l'achat est effectué. Pour une étude économétrique plus approfondie, le lecteur pourra se référer à nos autres travaux[4].

---

[1] Dans l'article L311-3 du Code Monétaire et Financier, sont considérés comme moyens de paiement tous les instruments qui permettent à toute personne de transférer des fonds, quel que soit le type de support utilisé.

[2] Source : Blue Book 2006, Banque Centrale Européenne.

[3] En Allemagne, aux Pays-Bas, en Suède, en Finlande, en Autriche, la part des paiements par chèque dans le volume total de transactions est quasiment nulle.

[4] Bounie et François (2006b) analysent les facteurs qui influencent le choix d'un instrument de paiement particulier lors d'une transaction. Bounie, Bourreau et François (2006) étudient les facteurs qui influencent la détention, puis l'usage de la carte de débit.

Il n'existait à ce jour aucune étude économique de ce type sur la détention et l'usage des instruments de paiement en France. Cette contribution nous semble importante pour alimenter les réflexions des pouvoirs publics et des entreprises face aux prochaines évolutions réglementaires de l'industrie des paiements, exigées pour la mise en œuvre du projet SEPA[5]. Le projet SEPA prévoit la construction d'un espace européen des paiements, dans lequel les instruments de paiement paneuropéens (la carte, le Direct Debit, et le Credit Transfer et les espèces) pourront être utilisés partout en Europe dans les mêmes conditions. En outre, la détention et l'usage des instruments de paiement en France pourraient être amenées à considérablement évoluer du fait de l'apparition de nouvelles technologies, comme le paiement par mobile ou le sans contact.

Le reste de l'article est organisé comme suit. Dans un premier temps, nous présentons une analyse de la détention des instruments de paiement. Nous montrons que la carte de paiement et le chéquier sont détenus par une très grande partie de la population française, tout en soulignant l'existence de moyens de paiement alternatifs, comme les cartes privatives ou accréditives, ou les instruments de paiement qui permettent de gérer une trésorerie, comme les cartes de crédit. Nous identifions les caractéristiques socio-économiques des consommateurs qui ne détiennent pas la carte bancaire ou le chéquier, ainsi que ceux qui utilisent les moyens de paiement pour gérer leur trésorerie personnelle. Dans un second temps, nous présentons une analyse de l'usage des instruments de paiement. Nous montrons que l'usage des moyens de paiement dépend des caractéristiques socio-économiques des consommateurs et des caractéristiques de la transaction.

2 La détention des instruments de paiement

Quels sont les instruments de paiement les plus détenus par les Français ? Après une description des données utilisées, nous présentons des statistiques globales sur les taux de détention des principaux instruments de paiement. Nous cherchons à expliquer les différences de taux de détention par le contexte institutionnel et les caractéristiques socio-démographiques des individus. Enfin, nous étudions les profils des consommateurs qui utilisent les instruments de

---

[5] Single Euro Payment Area.

paiement pour gérer leur trésorerie personnelle (carte de paiement à débit différé et carte de crédit).

2.1 Méthodologie et base de données utilisée

Notre étude s'appuie sur un sondage, réalisé en deux étapes au cours des mois de mars à mai 2005 auprès de 1447 individus âgés de 18 ans et plus, représentatifs de la population française[6]. Les personnes interrogées ont toutes accepté au préalable de participer aux deux étapes du sondage. Lors de la première étape, elles ont répondu à un questionnaire. Ce premier sondage avait pour objectif de collecter des informations relatives aux services bancaires et aux instruments de paiement détenus par les individus ainsi que des données socio-économiques sur les personnes (revenu, profession, etc.). Lors de la deuxième étape, qui s'est déroulée sur huit jours, les personnes ont rempli un relevé quotidien de dépenses.

Dans cette partie, nous utilisons uniquement les données issues du questionnaire sur la détention des instruments de paiement. L'analyse des données des relevés de dépenses sera effectuée dans la section 3.

Nous avons retenu les variables qui avaient un effet sur la détention des instruments de paiement et qui sont prises en compte dans la littérature (cf. Humphrey, 1998 ; Bounie et François, 2006b).

Dans notre échantillon, 99,7% des individus ont au moins un compte bancaire, 22,9% ont deux comptes et 4,2% trois comptes ou plus[7]. Nos données montrent que les consommateurs détiennent moins d'instruments de paiement sur leur compte secondaire. En outre, ces comptes secondaires obéissent à une logique économique différente des comptes principaux[8]. Nous choisissons donc de nous concentrer sur la détention des instruments de paiement attachés au compte principal.

---

[6] L'échantillon a été constitué selon la méthode des quotas à partir de strates géographiques. Sa représentativité a été contrôlée à partir des variables suivantes : le sexe croisé avec la variable actif/inactif ; l'âge ; la catégorie socioprofessionnelle ; le type d'habitat.

[7] Les comptes bancaires considérés ici sont des comptes de dépôts et non des comptes d'épargne. Ces comptes peuvent être gérés par une même banque ou par des banques différentes. 29,2% des consommateurs possédant deux comptes les ont domiciliés dans la même banque. En revanche, parmi les 61 consommateurs qui ont trois comptes ou plus, 44% les ont domiciliés dans deux banques et 36% dans trois banques ou plus.

[8] Il peut s'agir, par exemple, du compte joint d'un ménage, alimenté à partir des comptes principaux des membres du ménage.

Nous nous intéressons aux instruments de paiement suivants : les espèces, le chèque, la carte de débit, la carte de crédit, les cartes privatives et accréditives, le porte-monnaie électronique[9], le virement, le prélèvement et le TIP (Titre Interbancaire de Paiement)[10].

Nous considérons qu'une carte de débit porte le logo « CB »[11] et permet de retirer et de transférer des fonds, sans paiement d'intérêts. Lorsque le solde du compte du consommateur est débité après chaque opération, la carte est dite à débit immédiat, par opposition aux cartes à débit différé, pour lesquelles l'ensemble des achats est débité périodiquement. Nous ne considérons pas les cartes de retrait dans cette étude, puisqu'elles ne permettent que de retirer des espèces aux distributeurs automatiques de billets (DAB) ou aux guichets automatiques de banque (GAB)[12].

Les cartes de crédit sont les cartes qui portent le logo « CB » et qui ouvrent au consommateur l'accès à une ligne de crédit.

Les cartes « accréditives » sont les cartes proposées par des établissements financiers spécialisés, comme « American Express » ou « Sofinco ». Les cartes « privatives » sont délivrées par des magasins associés à des banques ou des organismes financiers spécialisés. Lorsque le consommateur détient une carte privative, il peut parfois choisir au point de vente de régler ses achats immédiatement ou à crédit. En cas d'achat à crédit, l'opération n'est pas imputée sur son compte de dépôt à vue, mais sur une ligne de crédit permanent proposée par l'organisme émetteur de la carte. Les réseaux d'acceptation des cartes privatives sont généralement limités à une enseigne ou un groupe d'enseignes.

2.2 Quels sont les principaux instruments de paiement et quels sont leurs taux de détention ?

Le Tableau 1 présente, pour l'ensemble de l'échantillon (1.447 personnes), les taux de détention du chéquier, de la carte de débit, de la carte de crédit, des cartes accréditives et privatives, et du porte-monnaie électronique.

---

9 En France, le porte-monnaie électronique est commercialisé sous la marque Moneo, gérée par le consortium BMS (Billettique Monétique Service) auquel adhèrent les banques, mais également la SNCF, la RATP et France Télécom.

10 Il existe aussi des instruments de paiement non bancaires comme le chèque de voyage, le chèque de restaurant et le chèque vacances, que nous ne considérons pas ici.

11 Créé en 1984, le groupement des cartes bancaires « CB » gère le système interbancaire de paiement et de retrait par carte.

Tableau 1 : Taux de détention des instruments de paiement

Détention d'un instrument de paiement sur le compte principal	
Chéquier	86,8%
Carte de débit	80,9%
Carte de crédit	4,9%
Carte accréditive	11,4%
Carte privative	27,7%
Porte-monnaie électronique	9,0%

Deux instruments de paiement, le chéquier et la carte de débit, sont détenus par un grand nombre de consommateurs. Leurs taux de détention sont respectivement de 86,8% et de 80,9%. Les autres instruments de paiement sont beaucoup moins diffusés, qu'il s'agisse des cartes privatives ou accréditives, détenues par un tiers de notre échantillon, du porte-monnaie électronique, détenu par moins d'un consommateur sur dix[13], ou de la carte de crédit bancaire, détenue par 4,9% des individus.

Une petite fraction de consommateurs détient plusieurs cartes bancaires sur son compte principal : 7,8% possèdent deux cartes de débit et 5% ont une carte de débit et une carte de crédit bancaire. Certaines banques cherchent à encourager la détention de plusieurs cartes en accordant des rabais sur le prix de la deuxième carte de débit.

Le taux de détention relativement important (38,1%) des cartes accréditives ou privatives montre que ces instruments de paiement se sont à ce jour assez bien diffusés et qu'ils peuvent se substituer à la carte de débit pour une partie des transactions. Ces cartes présentent la spécificité d'offrir au consommateur la possibilité d'acheter à crédit, et d'effectuer des arbitrages de trésorerie. Dans notre population, 11,4% des consommateurs détiennent une carte accréditive d'un établissement spécialisé (comme American Express, Aurore, Cetelem, Cofinoga ou Sofinco) et 27,7% des consommateurs détiennent une carte privative (de magasin) qui leur permet de régler leurs achats.

---

12 Dans notre échantillon, 9,5% des individus qui ont répondu au questionnaire ont une carte de retrait sur leur compte principal. Le Code Monétaire et financier établit une distinction entre les cartes de paiement et les cartes de retrait (article L 132-1).

13 Ce chiffre doit être pris avec prudence dans la mesure où ne savons pas si la fonctionnalité du porte-monnaie électronique attachée à la carte de paiement a été activée ou non.

Dans ce qui suit, nous commençons par considérer les facteurs institutionnels pouvant expliquer les taux de détention observés.

2.3 Quels facteurs institutionnels expliquent la détention des instruments de paiement ?

En France, à la signature d'une convention de compte avec son client, le banquier doit mentionner les moyens de paiement associés au compte[14], ainsi que le mode de tarification de ces instruments de paiements. La banque n'est pas contrainte de délivrer certains instruments de paiement, comme le chèque, à tout consommateur[15].

Le fort taux de détention du chéquier s'explique surtout par la gratuité de sa mise à disposition imposée par l'article L.131-71 du Code Monétaire et Financier et par sa non facturation à l'usage (décision prise par la plupart des banques françaises mais qui ne résulte pas d'une obligation légale). La tarification de l'émission ou de la réception des chèques est une pratique peu courante, même si certaines banques l'ont introduite récemment, suite à la rupture de la règle tacite du « ni-ni » qui existait entre les établissements financiers (les banques ne tarifaient pas l'usage des chèques en contrepartie de l'absence de rémunération des dépôts à vue)[16]. Le contexte institutionnel et les stratégies des banques ont donc favorisé la diffusion du chéquier.

Les banques font généralement payer la détention des cartes de paiement, alors que leur utilisation est gratuite. Le fort taux de détention des cartes de paiement (*Cf.* Tableau 1) traduit le fait que la tarification de cet instrument est intéressante pour les consommateurs, au regard des services de paiement proposés (paiement au point de vente, télépaiement, paiement sur automate, retrait, etc.). En outre, les cartes de paiement permettent aux banques d'offrir des services

---

[14] D'après le Conseil de la Concurrence (avis n°05-A-08 en date du 31/03/2005), le taux de bancarisation en France est de 99% (sans distinction entre les comptes de dépôts et les comptes sur livrets). Au sein de notre échantillon, 99,7% des individus possèdent au moins un compte bancaire auquel sont rattachés des instruments de paiement, et 3 personnes n'en possèdent pas.

[15] Le banquier a le devoir de refuser la délivrance d'un chéquier aux mineurs de moins de 16 ans et aux personnes interdites bancaires ou judiciaires. Si le banquier refuse de délivrer un chéquier à une personne qui ne satisfait pas à ces conditions, il doit motiver sa décision (article L 131-71 du Code Monétaire et Financier). Le décret du 17 janvier 2001 instaurant le service universel bancaire n'impose aux banques que la délivrance de chèques de banque. Le chèque de banque a pour particularité de garantir au bénéficiaire l'existence de la provision pendant le délai légal de prescription du chèque, c'est-à-dire pendant un an et huit jours.

[16] Par exemple, les banques du groupe CIC prélèvent 50 centimes d'euro pour chaque opération, au-delà d'un quota de 15 opérations gratuites par trimestre pour un compte personnel, et de 25 opérations pour un compte joint. Les clients de moins de 25 ans et de plus de 60 ans ne sont pas concernés par ce dispositif.

complémentaires différenciés, ce que ne permet pas le chéquier. Par exemple, selon la gamme de la carte, les banques proposent différents plafonds pour les paiements et les retraits, et des services d'assurance variés, comme une assurance contre la détérioration ou le vol des objets achetés, ou encore une assurance contre la fraude. Pour ces différentes raisons, la diffusion des cartes de paiement a été soutenue par une politique de promotion active des banques, pour favoriser leur acceptation chez les commerçants.

Les cartes de paiement utilisées en France sont essentiellement des cartes de débit, ce qui n'est pas le cas dans d'autres pays européens. Le faible développement des cartes de crédit en France est lié à l'existence d'une réglementation stricte du crédit à la consommation. L'usure est interdite par les articles L313-3 à L313-6 du code de la consommation : il est interdit de prêter à des taux très élevés à des clientèles dites « sub-primes », c'est-à-dire qui présentent des risques très élevés[17]. Par ailleurs, le faible développement du marché des cartes de crédit peut être relié à l'existence d'un produit partiellement substitut et bon marché : les cartes de débit à paiement différé. En effet, les consommateurs peuvent utiliser les cartes à débit différé pour obtenir un délai de règlement de leurs achats, sans payer d'intérêts[18].

Le développement récent des cartes privatives s'explique par les stratégies des entreprises du secteur de la grande distribution. Pour ces acteurs non bancaires, l'instrument de paiement est envisagé comme un outil marketing de fidélisation du client[19].

Enfin, le porte-monnaie électronique est peu détenu (9% de notre échantillon). Le porte-monnaie électronique est une carte qui sert à régler des achats de montants inférieurs à 30 euros sans composition d'un code confidentiel[20]. Deux raisons peuvent expliquer cette faible pénétration : le service ne couvre l'ensemble de la population française que depuis fin 2003 et le nombre de commerçants équipés est encore limité. Comme pour les cartes de débit, les banques

---

[17] En France, seule la Banque de France dispose d'informations relatives aux personnes «interdites bancaires », dans le fichier central des chèques « FCC ». Sont interdites bancaires les personnes qui ont émis un chèque sans provision. Sauf régularisation, cette interdiction ne concerne que le chèque, pendant une période de cinq ans. L'interdiction bancaire ne concerne que l'émission de chèques. Elle ne remet pas en cause le droit de chacun de bénéficier d'un service bancaire de base, qui inclut notamment une carte à autorisation systématique. Dans les pays anglo-saxons, l'usure est généralement autorisée, mais il existe en contrepartie un fichier positif permettant au prêteur de se renseigner sur la situation globale d'endettement des personnes souhaitant emprunter

[18] Le délai varie entre 15 et 40 jours pour les paiements en débit différé. Les intérêts sont payés de façon forfaitaire, sans relation avec le montant utilisé.

[19] Les entreprises proposent des réductions personnalisées aux consommateurs. Les cartes privatives leur permettent également de collecter des données sur les achats des consommateurs et sur leurs fréquences de visite.

[20] Le porte-monnaie électronique peut être alimenté jusqu'à 100 euros.

sont confrontées à la problématique du développement d'un marché biface[21]. Certains consommateurs ne sont pas informés de la possibilité d'activer un porte-monnaie électronique sur leur carte de paiement[22] ; d'autres ne sont pas prêts à substituer aux espèces un instrument de paiement électronique dont l'activation est payante.

Par la suite, nous analysons les choix de détention des consommateurs, au niveau individuel, en fonction de leurs caractéristiques socio-démographiques. Nous cherchons à répondre à deux questions : quelles sont les caractéristiques et les contraintes des consommateurs qui ne détiennent pas de chéquier ou de carte de débit ? Quels sont les profils des consommateurs qui détiennent des instruments de paiement pour réaliser des arbitrages de trésorerie ?

2.4 Quels facteurs socio-démographiques expliquent la détention des instruments de paiement ?

Les forts taux de détention du chéquier (86,8%) et de la carte de débit (80,9%) nous conduisent à nous interroger sur les caractéristiques socio-démographiques des consommateurs qui ne détiennent pas ces instruments de paiement.

2.4.1 L'âge des consommateurs a-t-il une influence sur la détention du chéquier et de la carte de débit ?

En ce qui concerne l'âge, on constate que les tranches extrêmes de la population ont des comportements de détention spécifiques (*Cf.* Tableau 2). Le taux de détention du chéquier est particulièrement faible chez les plus jeunes, puisque 68,8% des 18-24 ans possèdent cet instrument de paiement, contre 87,2% pour la tranche des 25-64 ans. Les jeunes détiennent probablement moins de chéquier parce qu'ils dépendent encore de leurs parents pour le paiement des sommes élevées ou bien simplement parce qu'ils expriment une désaffection pour cet instrument de paiement (*Cf. infra*).

---

[21] Pour une présentation de la littérature sur les marchés bifaces dans l'industrie des paiements, voir Verdier (2006).

[22] L'activation coûte entre 0 et 12 euros, suivant la banque et le type de carte de paiement. Lorsque la fonctionnalité Moneo n'est pas disponible sur sa carte de paiement, le consommateur peut acquérir une carte spécifique Moneo auprès de sa banque. Selon la Fédération Bancaire Française, fin 2003, 30 millions de cartes bancaires étaient équipées de la fonctionnalité Moneo. Si Moneo est intégré à une carte de débit, le paiement par Moneo est automatique pour les montants inférieurs à 10 euros, et pour les paiements compris entre 10 et 30 euros, le consommateur peut choisir entre un paiement par carte et un paiement par Moneo.

Tableau 2 : Taux de détention du chéquier et de la carte de débit par classe d'âge

Tranche d'âge	Détention d'un chéquier		Détention d'une carte de débit	
	%	Effectif	%	Effectif
18 -24 ans	68,8%	117	80,9%	138
25 -64 ans	87,2%	849	83,5%	812
65 ans et plus	95,7%	290	72,5%	219
Total		1257		1170

En revanche, le taux de détention du chéquier est particulièrement fort chez les personnes âgées (95,7%). Ceci s'explique peut-être, d'une part, par l'habitude d'utiliser le chéquier, d'autre part, par une difficulté à utiliser les instruments de paiement électronique. Le chéquier se substitue à la carte de débit pour cette catégorie de la population, puisque c'est la classe d'âge qui présente le taux de détention d'une carte de débit le plus faible (72,5% contre 80,9% et 83,5% pour les tranches des 18-24 et 25-64 ans).

Enfin, il est intéressant de noter que le taux de détention d'un chéquier croît avec l'âge. Or, le chéquier a longtemps été le seul instrument de paiement disponible outre les espèces. Il est donc possible que les individus qui l'ont adopté au moment où la carte de débit n'était pas ou peu développée n'aient pas depuis modifié leurs choix d'instruments de paiement.

2.4.2 Le diplôme a-t-il une influence sur la détention du chéquier et de la carte de débit ?

On constate que les taux de détention du chéquier et de la carte de débit croissent avec le niveau de diplôme obtenu (*Cf.* Tableau 3). En effet, le taux de détention d'un chéquier varie de 74,9% pour les sans diplômes, à 94,5% pour les catégories de diplômes les plus élevées. Le taux de détention d'une carte de débit varie de 64,8% pour les non-diplômés, à 91,1% pour les étudiants du supérieur. Ces chiffres montrent que les personnes qui n'ont pas de diplôme détiennent plus le chéquier que la carte de débit.

Tableau 3 : Taux de détention du chéquier et de la carte de débit par catégorie de diplôme

	Détention d'un chéquier		Détention d'une carte de débit	
	%	Effectif	%	Effectif
Sans diplôme	74,9%	216	64,8%	141
Diplômes jusqu'au baccalauréat (compris)	86,8%	885	80,8%	714
Etudes supérieures	94,5%	346	91,1%	315
Total		1257		1170

La relation observée entre le taux de détention et le niveau de diplôme peut être expliquée soit par une capacité à utiliser d'autres instruments de paiement que les espèces (maîtrise de l'écriture dans le cas du chéquier, utilisation d'un instrument de paiement électronique dans le cas de la carte), soit par un effet de revenu (le revenu étant corrélé au niveau de diplôme).

2.4.3 Le revenu a-t-il une influence sur la détention du chéquier et de la carte de débit ?

Les taux de détention du chéquier et de la carte de débit croissent avec le revenu (Cf. Tableau 4)[23]. Pour la détention de la carte de débit par exemple, le taux passe de 79,1% pour les revenus compris entre 0 et 1000 euros à 96,9% pour les revenus supérieurs à 2000 euros.

[23] Le revenu est mesuré ici sur une base mensuelle nette. Il comprend les revenus du travail, les revenus financiers, les prestations sociales, etc.

Tableau 4 : Taux de détention du chéquier et de la carte de débit par tranche de revenu[24]

Tranche de revenu	Détention d'un chéquier		Détention d'une carte de débit	
	%	Effectif	%	Effectif
0-1000 euros	79,1%	410	73,2%	379
1000-2000 euros	92,1%	511	86,4%	480
Plus de 2000 euros	96,9%	174	90,7%	163
Total		1095		1022

Cette relation croissante entre taux de détention d'un instrument de paiement et niveau de revenu peut s'expliquer soit par la contrainte budgétaire auquel fait face un consommateur soit par une exclusion des consommateurs à certains instruments de paiement. En effet, d'une part, plus les revenus du consommateur sont bas, plus sa disposition à payer pour un instrument de paiement est faible ; on s'attend donc bien à ce que le taux de détention croisse avec le revenu. De l'autre, les personnes qui disposent de faibles revenus peuvent être interdits de chéquier ou de carte de paiement en raison de leur « insuffisance » financière passée[25].

2.5 Qui sont les consommateurs qui détiennent des instruments de paiement qui permettent des arbitrages de trésorerie ?

Différents instruments de paiement ont été conçus pour permettre aux consommateurs d'effectuer des arbitrages de trésorerie : les cartes de crédit, les cartes privatives ou accréditives, et les cartes de paiement à débit différé[26].

Seulement 4,9% des individus de notre échantillon détiennent une carte de crédit bancaire. Cependant, les consommateurs peuvent avoir accès à des lignes de crédit lorsqu'ils utilisent une carte accréditive ou une carte privative. Si l'on considère toutes ces possibilités, le pourcentage d'individus qui possèdent au moins une carte de crédit bancaire ou non bancaire s'élève à 39,8%

---

[24] Les catégories « Ne sais pas » et « Refus de répondre » sont exclues du tableau.

[25] Une loi du 31 décembre 1991 sur la réglementation des chèques stipule que le banquier qui a refusé le paiement d'un chèque pour défaut de provision suffisante peut enjoindre au titulaire du compte de restituer toutes les formules en sa possession et de ne plus émettre de chèques.

[26] Les paiements fractionnés par chèque ou par carte, quand ils sont permis par le commerçant, constituent un autre moyen de gestion de trésorerie, que nous ne prenons pas en compte dans notre analyse

dans notre échantillon (51,1% en incluant aussi les individus qui possèdent au moins une carte de paiement à débit différé). Les cartes privatives représentent 73% des cartes de crédit bancaire ou non bancaire (401 cartes dans l'échantillon), les cartes accréditives 25,7% (164 cartes), et les cartes de crédit bancaires 10,8% (71 cartes)[27].

Les cartes de paiement à débit différé sont un produit compétitif pour les consommateurs à la recherche d'une facilité de trésorerie. En effet, l'écart de prix par rapport à la cotisation payé pour une carte de paiement à débit immédiat est faible[28].

Il est intéressant de souligner que le taux de détention d'une carte à débit différé croît avec la tranche d'âge. Les cartes accréditives et privatives semblent être plus détenues par les 25-64 ans, ce qui correspond à la période de gestion d'une famille[29].

Les taux de détention des cartes à débit différé et des cartes de crédit croissent également généralement avec le revenu (*Cf.* Tableau 5)[30]. Cette relation est particulièrement nette pour les cartes à débit différé puisque le taux de détention est environ trois plus élevé pur la classe des revenus supérieurs à 2000 euros par rapport à la classe des revenus inférieurs à 1000 euros.

Plusieurs explications peuvent être avancées. Premièrement, la détention d'instruments de paiement permettant de gérer au mieux une trésorerie est réservée à ceux qui peuvent en supporter le coût. Deuxièmement, elle répond à des besoins de consommation spécifiques liés au revenu. Troisièmement, les banques sélectionnent les consommateurs sur dossier pour leur offrir accès au crédit, ce qui limite la détention de cartes offrant des facilités de trésorerie pour les personnes à bas revenu.

---

[27] Il y a 349 cartes à débit différé associées au compte principal. Si l'on inclut ces cartes à débit différé dans les chiffres précédents, on obtient : 35,4% de cartes de paiement à débit différé, 40,7% de cartes privatives, 16,6% de cartes accréditives, 7,2% de cartes de crédit bancaires.

[28] Par exemple, au Crédit Mutuel d'Ile-de-France, le montant de la cotisation pour une carte Visa à débit immédiat s'élève à 32,32 Euros, contre 40,40 Euros pour une carte à débit différé.

[29] Nos données montrent aussi que le taux de détention de cartes privatives augmente avec la taille du foyer.

[30] La faiblesse des taux de détention des cartes de crédit ne nous permet pas cependant de commenter plus en avant cette observation.

Tableau 5 : Taux de détention d'une carte de débit différé/crédit par tranche de revenu[31]

Tranche de revenu (euros)	Carte à débit différé		Carte de crédit		Carte accréditive		Carte privative	
	%	Effectif	%	Effectif	%	Effectif	%	Effectif
0-1000	13,9	72	2,5	13	8,2	43	23,6	122
1000-2000	21,2	118	4,6	26	12,2	68	28,5	159
Plus de 2000	41,3	73	9,2	16	18,4	33	38,5	69
Total		308		55		144		350

Pour résumer, en France, les cartes à débit différé sont assez répandues, tandis que les cartes de crédit, qu'elles soient bancaires, privatives ou accréditives, sont plus rares. Cette situation devrait probablement évoluer, lorsque les banques développeront des cartes à double fonctionnalité débit – crédit, comme il en existe dans d'autres pays européens (Royaume-Uni, Espagne, etc.).

3 L'usage des instruments de paiement

Nous venons d'analyser la détention des instruments de paiement des français. Dans cette section, nous étudions l'usage des instruments de paiement en fonction des caractéristiques individuelles et des caractéristiques liées aux transactions.

3.1 Méthodologie

Nous utilisons la même base de données que dans la première partie et les données des carnets de dépenses remplis par une partie de l'échantillon d'origine[32]. Un carnet de dépenses contient toutes les informations relatives aux achats qu'une personne a effectués sur une période de huit jours[33]. Chaque achat est caractérisé par six informations : la valeur de l'achat, le type de bien ou de

[31] Nous excluons de ce tableau, les personnes qui ont répondu « Ne sais pas » à la question sur le revenu ainsi que les personnes qui ne souhaitaient pas répondre à la question (soit 194 personnes au total).

[32] Sur les 1.447 personnes de l'échantillon initial, 1.392 ont renvoyé leur carnet de dépenses.

[33] Sont exclus de ce relevé les dépenses professionnelles (frais de déplacement,…) et les paiements des dépenses récurrentes (factures, etc.). Les informations relatives aux dépenses récurrentes ont été collectées directement à partir du questionnaire.

service acheté, le type de commerce dans lequel l'achat a été effectué, le type de contact (face-à-face, Internet, etc.), les contraintes dans le choix de l'instrument de paiement et enfin l'instrument de paiement utilisé.

Au total, 16.692 achats ont été réalisés pour une valeur totale de 541.583 euros[34]. En moyenne, un individu a effectué 12 achats sur la période des huit jours. Les paiements ont été principalement réalisés à l'aide des espèces (62,5%), de la carte de débit (21%) et du chèque (13,8%) (*Cf.* Tableau 6)[35]. En volume, les espèces sont l'instrument de paiement le plus utilisé, suivi de la carte de débit et du chèque. En revanche, en valeur, la carte de débit et le chèque sont plus utilisés que les espèces.

Tableau 6 : Répartition des transactions par instruments de paiement

	Volume		Valeur (euro)	
	%	Nombre	%	Montant
Pièces et billets	62.5	10 172	24.2	111 487
Carte de débit	21.0	3 408	35.7	164 752
Chèque	13.8	2 240	33.1	152 668
Autres	2.8	451	6.6	30 523
IP non renseigné	0.03	421	0.4	1 765
Total transactions	100	16 271	100	461 195

NB : La catégorie « Autres » correspond aux cartes de paiement spécialisées, aux tickets restaurant et à Moneo.

Comme 97,2 % des paiements ont été réalisés en espèces, par carte de débit ou par chèque, nous restreignons notre analyse aux arbitrages entre ces trois instruments de paiement. Dans la suite, nous ne considérons que les individus qui possèdent, outre des espèces, un chéquier et une carte de débit.

34 Nous avons exclu de nos résultats 26 achats dont le montant est supérieur à 1.000 euros. Nous pensons que ces dépenses, peu fréquentes sur notre période d'observation, ne sont pas représentatives des dépenses des consommateurs et pourraient biaiser les résultats.

35 Les transactions par carte accréditive ou privative sont beaucoup moins fréquentes (1,5%).

3.2 L'âge des consommateurs a-t-il une influence sur l'usage des instruments de paiement ?

Le Tableau 7 ci-dessous décrit l'usage des instruments de paiement par les français en fonction des classes d'âge. Même si les espèces sont l'instrument de paiement dominant pour chaque classe d'âge, les plus jeunes et les plus vieux les utilisent plus : le taux d'usage est de 60,4% pour les 18-24 ans et de 66,1% pour les plus de 65 ans contre 56,8% pour la tranche intermédiaire. Le calcul des rapports de cotes (*odds ratio*) qui permet de contrôler les effets de proportion, affine ce constat (*Cf.* Tableau 8). La probabilité d'utiliser des pièces et billets pour un individu de plus de 65 ans est respectivement 1,48 et 1,28 fois plus élevée que pour un individu âgé de 25-64 ans et de moins de 25 ans.

Tableau 7 : Usage des instruments de paiement par classe d'âge

		18-24 ans	25-64 ans	65 ans et +	Total
Pièces et billets		570	5546	1229	7345
	%	*60,4%*	*56,8%*	*66,1%*	*58,5%*
Chèque		100	1543	266	1909
	%	*10,6%*	*15,8%*	*14,3%*	*15,2%*
Carte de débit		255	2683	365	3303
	%	*27,0%*	*27,5%*	*19,6%*	*26,3%*
Total transactions		944	9772	1860	12557

Test d'indépendance de Pearson ; H0 : indépendance ; $\chi^2 = 76,87$.

L'âge influence également l'usage du chèque et de la carte bancaire de débit. La probabilité d'usage du chèque est plus élevée pour la classe d'âge des 25-64 ans par rapport aux deux autres catégories (*Cf.* Tableau 8), mais la probabilité est plus élevée pour les individus âgés de plus de 65 ans que pour ceux âgés de moins de 25 ans. De même, la probabilité d'usage de la carte de débit est pratiquement équivalente entre les moins de 25 ans et les 25 – 64 ans et est largement supérieure à celle des plus de 65 ans.

Mais l'âge n'a pas nécessairement le même effet sur la détention et sur l'usage du chèque et de la carte de débit. Ainsi la probabilité de détention d'un chéquier est strictement croissante avec l'âge. Autrement dit, la probabilité de détention pour la catégorie des 25-64 ans est supérieure à celle des moins de 25 ans alors même que la probabilité d'usage de cette dernière catégorie est plus faible. De même, la probabilité de détention de la carte de débit pour les 25-64 ans est plus élevée que pour les individus plus jeunes alors même que la probabilité d'usage des deux catégories est similaire.

Tableau 8 : *Odds-ratio* sur la détention et les transactions par classe d'âge

	18-24 ans				25-64 ans				65 ans et +			
	Détention	Dét.	Transac.	Transac.	Dét.	Dét.	Transac.	Transac.	Dét.	Dét.	Transac.	Transac.
	25 - 64 ans	+ 65 ans	25 - 64 ans	+ 65 ans	25 - 64 ans	+ 65 ans	25 - 64 ans	+ 65 ans	25 - 64 ans	+ 65 ans	25 - 64 ans	+ 65 ans
Pièces et billets	-	-	1,16	0,78	-	-	0,86	0,67	-	-	1,28	1,48
Chèque	0,32	0,10	0,63	0,71	3,11	0,31	1,58	1,12	10,10	3,25	1,41	0,89
Carte de débit	0,84	1,61	0,98	1,52	1,19	1,92	1,02	1,55	0,62	0,52	0,66	0,65

NB : Un *odds ratio* supérieur à 1 signifie que les individus d'une classe d'âge sont plus susceptibles que les individus des autres classes de détenir ou utiliser un instrument de paiement donné ; un *odds ratio* inférieur à 1 signifie le contraire. Par exemple, il y a 1,16 fois plus de chances pour qu'une transaction réalisée par les 18-24 ans soit réglée en espèces par rapport à une transaction effectuée par la classe des 25-64 ans.

Ces résultats illustrent que les décisions de détention et d'usage d'un instrument de paiement répondent à des motivations différentes. Une implication intéressante pour les banques est que le développement de la détention et de l'usage des instruments de paiement devraient reposer sur des stratégies d'incitation différentes pour les consommateurs (programmes de fidélisation, etc.).

3.3 Le revenu des individus influence t-il l'usage des instruments de paiement ?

Le Tableau 9 montre que l'usage des instruments de paiement dépend du revenu[36]. Le pourcentage de transactions réalisées par chèque tend à diminuer avec le revenu, tandis que le pourcentage de transactions réalisées par carte de débit tend à augmenter avec le revenu. Les classes de revenu inférieures à 1500 euros ont un usage plus important des espèces et du chèque et moins important de la carte que la moyenne ; les classes de revenu supérieures à 1500 euros utilisent plus la carte et moins le chèque. L'analyse des *odds ratio* confirme ce point (tableau 12) et précise l'ampleur des différences à proportion contrôlée. Si les différences d'usage entre les catégories de revenu en ce qui concerne les pièces et billets sont faibles, elles sont beaucoup plus importantes pour la carte de débit et le chèque.

Tableau 9 : Usage des instruments de paiement par classe de revenu

	0-1000	1000-2000	Plus de 2000	NSP/Refus	Total
Pièces et billets	2294	3088	1014	949	7345
	58,2%	*56,2%*	*52,8%*	*58,6%*	*56,6%*
Chèque	644	845	210	210	1909
	16,3%	*15,4%*	*10,9%*	*13,0%*	*14,7%*
Carte de débit	889	1382	631	401	3303
	22,6%	*25,2%*	*32,8%*	*24,8%*	*25,5%*
Autres	115	179	66	60	420
	2,9%	*3,3%*	*3,4%*	*3,7%*	*3,2%*
Total transactions	3942	5494	1921	1620	12977

Test d'indépendance de Pearson ; H0 : indépendance ; $\chi^2 = 499{,}66$[37].

En outre, nous observons que pour les classes de revenu inférieures à 1000 euros, les *odds ratio* de détention sont inférieurs à ceux de l'usage (Tableau 10). Ce constat s'inverse au-delà de 1000 euros où les *odds ratio* de détention sont toujours supérieurs à ceux de l'usage. Cela dénote une préférence marquée des classes de revenu inférieures pour l'usage du chèque.

[36] Le test d'indépendance du χ^2 permet de rejeter l'hypothèse nulle selon laquelle l'usage des instruments de paiement est indépendant du revenu.

[37] Le test d'indépendance est calculé sur les trois instruments de paiement et les trois classes de revenu ; nous avons donc exclus les « sans réponse » et les « refus ».

Tableau 10 : *Odds ratio* sur la détention et les transactions par classes de revenu

	0-1000 euros				1000-2000 euros				Plus de 2000 euros			
	Détention	Dét.	Transac.	Transac.	Dét.	Dét.	Transac.	Transac.	Dét.	Dét.	Transac.	Transac.
	1000 à 2000	>2000	1000 à 2000	>2000	1000 à 2000	>2000	1000 à 2000	>2000	1000 à 2000	>2000	1000 à 2000	>2000
Pièces et billets	-	-	1,08	1,25	-	-	0,92	1,15	-	-	0,80	0,87
Chèque	0,33	0,12	1,07	1,59	3,07	0,38	0,93	1,48	8,16	2,66	0,63	0,68
Carte de débit	0,43	0,28	0,87	0,60	2,34	0,65	1,15	0,69	3,57	1,53	1,68	1,46

3.4 La détention d'un instrument de paiement a-t-elle un effet sur l'usage des autres instruments de paiement ?

Nous avons voulu vérifier si le fait de détenir un instrument de paiement pouvait avoir un effet sur l'usage des autres instruments de paiement. Cette question est d'autant plus pertinente et importante qu'elle permet de fournir des éléments de réponse aux recherches sur la substituabilité entre les instruments de paiement (Bolt et Humphrey, 2006). En effet, à l'exception de quelques rares pays qui tarifient les paiements à l'acte (Norvège), l'absence de prix d'usage dans les paiements rend impossible le calcul classique des élasticités prix croisées entre les instruments de paiement et donc ne permet pas d'évaluer la substituabilité entre les instruments de paiement. Une manière alternative de mesurer la substituabilité entre les instruments de paiement pourrait consister à comparer les comportements de paiement des individus qui détiennent les instruments de paiement par rapport aux personnes qui ne les détiennent pas. Nous avons donc calculé un ensemble de rapports de cotes sur les transactions réalisées par les détenteurs d'un instrument de paiement et les transactions des individus qui ne détiennent pas l'instrument de paiement en question (*Cf.* Tableau 11). Quatre conclusions peuvent être formulées.

Tableau 11 : *Odds ratio* sur l'usage des instruments de paiement

Tableau 16 : *Odds ratio* sur l'usage des instruments de paiement

	Usage		
	Chèque	Carte de débit	Pièces et billets
Porteur vs non porteur CB	0.51	-	0.29
Porteur vs non porteur chèque	-	2.02	0.13
Porteur vs non porteur CSM	1.04	0.96	0.74
Multi vs simple porteur CB	1.14	1.81	0.56

NB : Le tableau se lit de la manière suivante : il y a 0,51 fois moins de chance qu'un individu qui détient une carte de débit et un chèque réalise une transaction en chèque qu'un individu qui ne détient pas de carte de débit.

Premièrement, les individus qui détiennent une carte de débit (et un chéquier) réalisent moins de transactions en chèque (*odds ratio* de 0,5) et en espèces (*odds ratio* de 0,3) que les individus qui ne détiennent pas de carte de débit. Deuxièmement, les individus qui détiennent un chèque (et une carte de débit) réalisent plus de paiements en carte de débit (*odds ratio* de 2) que les individus qui ne détiennent pas de chèque (mais une carte de débit) et moins de paiements en espèces (*odds ratio* de 0,1). Troisièmement, le fait de détenir une carte de débit d'un établissement financier spécialisé ou d'un magasin a peu d'impact sur l'usage de la carte de débit ou du chèque. En effet, les non porteurs de ces cartes font autant de paiement en carte de débit (*odds ratio* de 0,96) ou en chèque que les porteurs de ces cartes (*odds ratio* de 1,04). En revanche, le fait de détenir une carte de paiement d'un établissement financier spécialisé ou d'un magasin semble avoir un effet négatif sur l'usage des pièces et billets (*odds ratio* de 0,5). Enfin, on peut s'intéresser aux comportements de paiement des multi-porteurs de carte de débit par rapport aux individus qui ne détiennent qu'une carte de débit. Nous constatons que les multi-porteurs font globalement plus de transactions en chèque (*odds ratio* de 1,1) mais également et surtout en carte de débit (*odds ratio* de 1,8) que les porteurs uniques. En revanche, il y a 0,56 fois moins de chance qu'une transaction faite par un multi porteur carte de débit soit payée en pièces et billets que pour une transaction faite par un simple porteur.

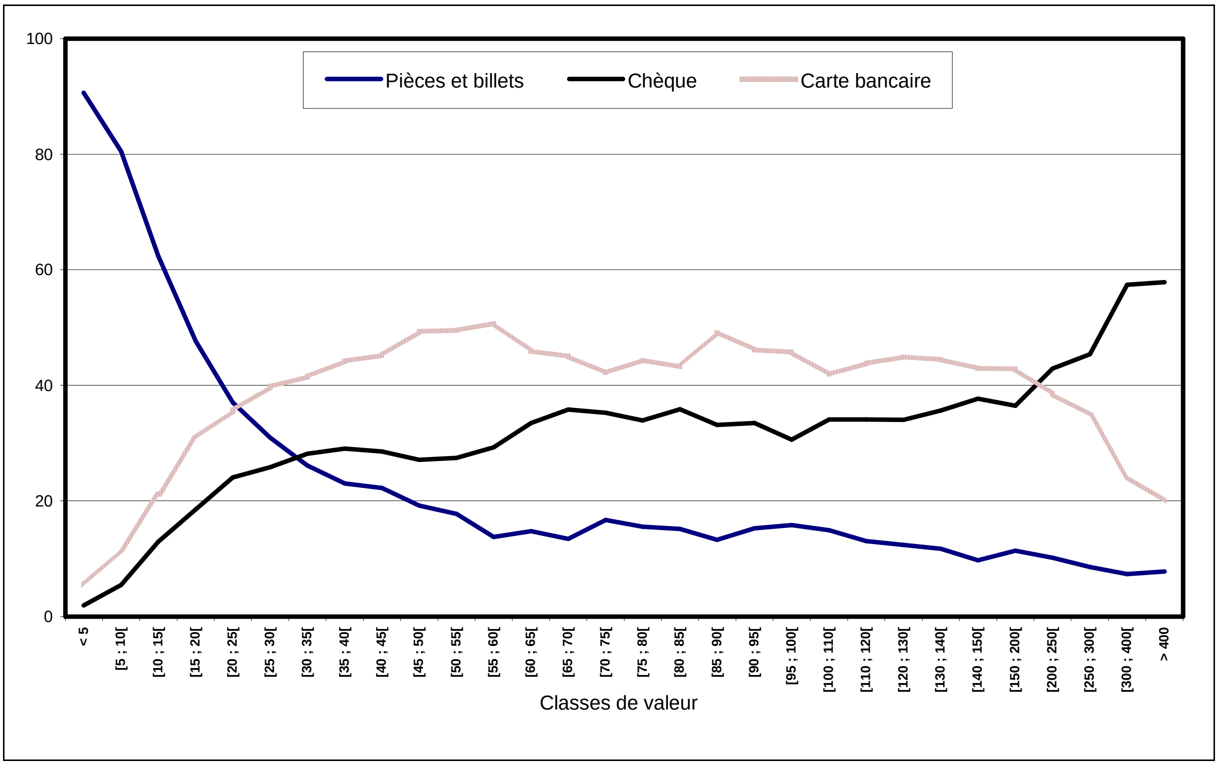
Ces enseignements permettent de conclure, d'une part, que la carte de débit est un substitut au chèque, d'autre part, que la carte de débit et le chèque sont des substituts des espèces et, enfin, que la carte privative, le chèque et la carte de débit sont des biens neutres.

Dans les sections qui suivent, nous étudions comment les caractéristiques de la transaction impacte également l'usage des instruments de paiement.

3.5 La valeur des achats influence-t-elle le choix des instruments de paiement ?

Le Graphique 1 présente la répartition du nombre de transactions par classe de valeur pour la transaction. Cette figure montre que le choix de l'instrument de paiement dépend de la valeur de l'achat. Les espèces sont utilisées plus fréquemment que le chèque ou la carte de débit pour les achats de faible montant : 85% des transactions de valeur comprise entre 0,1 euro et 10 euros sont réglées en espèces. Néanmoins, l'usage des espèces diminue rapidement pour les achats de montant plus élevé. La part de marché de la carte de débit dépasse celle des espèces pour des valeurs de transaction supérieures à 23 euros environ. Pour des montants compris entre 23 euros et 200 euros, la carte de débit est l'instrument de paiement le plus utilisé. Le taux d'utilisation de la carte croît jusqu'à 50 euros et diminue après cette valeur. Au-delà de 200 euros, la proportion des paiements réalisés par chèque dépasse celle de la carte de débit.

Graphique 1 : Répartition des paiements en fonction des classes de valeur de transaction[38]



Note : Les fréquences présentées sont les moyennes mobiles sans pondération sur 7 classes.

Comment peut-on expliquer que l'usage des instruments de paiement dépende de la valeur de la transaction ? Plusieurs réponses peuvent être apportées. D'un point de vue général, les consommateurs supportent des coûts fixes (indépendants de la valeur de la transaction) et variables (dépendants de la valeur de la transaction) lorsqu'ils utilisent un instrument de paiement. Dans le cas des espèces, Whitesell (1989, 1992) considère que le coût fixe est nul et qu'il ne subsiste qu'un coût variable, lié au taux d'intérêt. En revanche, l'utilisation de la carte de débit et du chèque implique un coût fixe non nul et un coût variable[39]. Pour chaque transaction, les consommateurs arbitrent entre les différents instruments de paiement à leur disposition en fonction du coût d'usage de ces instruments. Ceci permet d'expliquer pourquoi les espèces sont très utilisées pour régler des transactions de faible montant (absence de coût fixe et faible coût

---

38 Les intervalles des classes de valeur ne sont pas constants. Afin de lisser les courbes, nous avons utilisé des moyennes mobiles : nous avons calculé pour chaque classe la moyenne simple des six fréquences autour de la classe (trois avant et trois après).

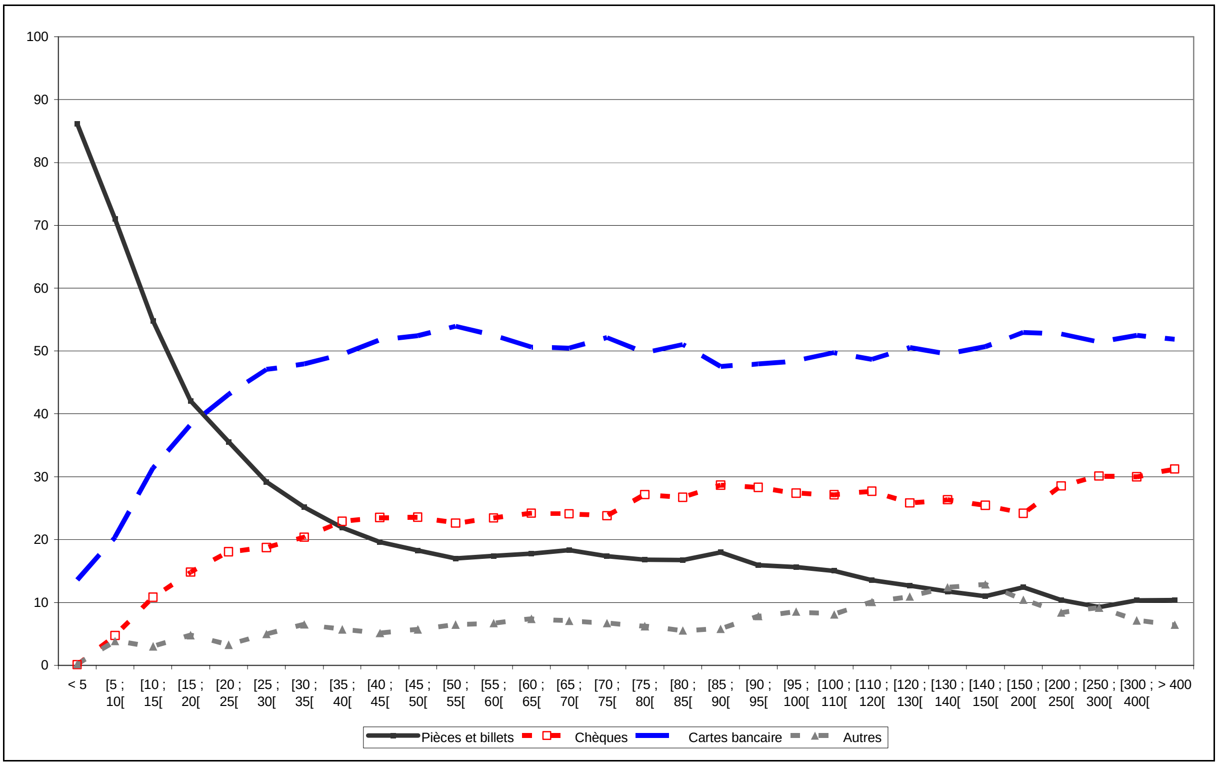
39 Le coût fixe par transaction pour un chèque par exemple est le temps nécessaire pour le remplir (coût fixe indépendant de la valeur du paiement). Il est à noter qu'il peut exister des bénéfices variables liés à l'usage des instruments de paiement. Par exemple, les programmes de fidélisation attachés à la carte de débit permettent de diminuer le tarif de la carte.

d'opportunité) et moins utilisées pour les transactions de montants élevés (coût d'opportunité élevé lié au risque de vol, etc.).

Un autre élément de réponse est que le domaine d'acceptation de certains instruments de paiement dépend de la valeur de la transaction. Cette relation s'explique de plusieurs manières. Tout d'abord, de nombreux commerçants imposent des planchers ou des plafonds pour le paiement par carte ou par chèque. Par exemple, la carte de débit est rarement acceptée pour les faibles montants. Par ailleurs, les banques des consommateurs imposent des plafonds qui limitent l'usage de la carte de débit pour les montants importants et la réglementation en vigueur plafonne les paiements en espèces à 3.000 euros. Enfin, on observe que la part des « administrations », des « services à domicile » et des « autres commerces » (hors petits commerces et magasins de quartier) dans les achats réalisés croît avec le montant de la transaction. Comme ce type de commerce accepte très peu la carte, ceci tend à diminuer l'usage de la carte pour les montants élevés[40]. Pourtant, on constate que lorsque la carte de débit est proposée dans les grandes et moyennes surfaces pour régler des achats de montants élevés (*Cf.* Graphique 2), cette dernière domine le chèque et ce, quel que soit le montant des achats.

[40] Des travaux récents du Groupement des Cartes Bancaires confirment que les professions de santé, les services publics, les professions en déplacement, etc. sont sous-équipées en lecteurs de carte bancaire. Ainsi, seuls 13% des médecins et 23% des dentistes disposent par exemple d'un terminal de paiement par carte « CB ». Pour plus d'informations, le lecteur consultera le site web du Groupement des Cartes Bancaires (http://www.cartes-bancaires.com).

Graphique 2 : Usage des instruments de paiement dans les grandes et moyennes surfaces



3.6 Le type de commerce influence-t-il l'usage des instruments de paiement ?

Le Tableau 12 montre que plus de la moitié des transactions en volume sont réalisées dans les petits commerces et magasins de quartier (56%). En revanche, ce sont dans les grandes surfaces que les paiements sont les plus importants en valeur (33% du montant total des dépenses).

Tableau 12 : Répartition des paiements par type de commerce

Type de commerce	Volume (%)	Valeur (%)	Valeur moyenne (euro)
Commerces de proximité	56,3	25,1	12,2
Grandes surfaces	20,9	33,2	43,6
Grands magasins	7,9	14,3	50
Autres	6,7	10,9	45,0
Autres types de petits commerces	4,9	8,4	47,1
Administrations	2,6	6,1	63,7
Services à domicile	0,7	2,1	90,7

NB : La catégorie « Autres types de petits commerces » regroupent les cabinets, professions médicales, artisans, etc.

Le Tableau 12 montre également que la valeur moyenne d'une transaction est très variable d'un type de commerce à l'autre. Comme le choix d'un instrument de paiement dépend de la valeur de la transaction, on peut s'attendre à ce que les moyens de paiement privilégiés diffèrent selon le type de commerce. C'est ce que montre le Tableau 13 : 83% des transactions réalisées dans les petits commerces et magasins de quartier sont réglées en espèces ; plus de 40% des transactions effectuées dans les grands magasins et les grandes surfaces sont payées par carte de débit ; enfin, 57% et 39 % des paiements pour les services à domicile et les administrations sont réalisés par chèque.

Tableau 13 : Usage des instruments de paiement par type de commerce (en %)

Type de commerce	Pièces et billets	Chèque	Carte de débit	Autres	Total
Petits commerces et magasins de quartier	83.1	6.1	9.6	1.2	100
Grands magasins	29.1	21.9	45.0	4.0	100
Autres types de commerce	34.4	33.7	31.3	0.6	100
Grandes Surfaces	35.2	18.2	41.2	5.4	100
Services à domicile	21.1	56.9	12.8	9.2	100
Administration	38.2	39.1	10.6	12.2	100
Autres	50.1	26.1	21.1	2.7	100

Test d'indépendance de Pearson ; H0 : indépendance ; $\chi^2 = 6^E03$.

L'influence du type de commerce sur l'usage des instruments de paiement[41] peut s'expliquer par exemple par la valeur des paniers d'achat dans ces commerces mais également par les stratégies d'acceptation et d'offre de la carte de paiement des commerçants qui peuvent contraindre les choix des instruments de paiement des consommateurs. Dans notre étude, nous avons ainsi cherché à mesurer ces contraintes en donnant la possibilité aux consommateurs d'identifier les transactions pour lesquelles leurs premiers choix d'instrument de paiement n'étaient pas acceptés par les commerçants[42]. Ces contraintes ont concerné 9,6% des transactions

[41] Un test d'indépendance de Pearson entre les instruments de paiement et les types de commerce confirme que nous pouvons rejeter l'hypothèse nulle d'indépendance entre les variables. Nous concluons en conséquence que les usages des instruments de paiement ne sont pas indépendants des types de commerce. Le test est construit sur la liste des sept classes initiales d'instruments de paiement proposés à l'échantillon.

[42] Trois situations peuvent restreindre le choix d'un instrument de paiement pour le consommateur : i) lorsque le type de contact restreint le consommateur à un moyen de paiement (distributeurs de boissons qui n'acceptent que les pièces, paiement sur Internet uniquement par carte bancaire…) ; ii) lorsque le commerce dans lequel l'individu effectue l'achat restreint l'utilisation d'un moyen de paiement (refus de la carte bancaire); iii) lorsque le montant de l'achat exclut le moyen de paiement que le consommateur souhaite utiliser (certains commerces refusent les paiements par carte bancaire en dessous d'un certain plancher).

qui ont été réglées principalement en espèces (58,2% des transactions) et dans les petits commerces (40,6% des transactions)[43]. Nous observons aussi que la probabilité qu'une transaction soit contrainte est plus faible lorsque le paiement est effectué en face-à-face plutôt que sur un automate ou à distance, ce qui suggère que le type de contact (face-à-face, Internet, automate, etc.) peut influencer l'usage des instruments de paiement.

4 Conclusion

Notre analyse a permis de mettre en évidence les spécificités de la détention et de l'usage des instruments de paiement en France. Le marché français se caractérise par un fort taux de détention du chéquier et de la carte de paiement, une moindre détention des cartes privatives ou accréditives, et un faible développement des cartes de crédit au profit des cartes à débit différé. Nos données montrent que l'âge, le revenu, le diplôme, et la profession influencent les taux de détention des consommateurs. Les espèces sont l'instrument de paiement le plus utilisé, suivi de la carte bancaire et du chèque. Notre étude montre que la valeur de la transaction influence le choix de l'instrument de paiement. Les espèces sont principalement utilisées pour les paiements de faibles montants, tandis que la carte bancaire est privilégiée par les consommateurs pour les transactions de valeurs comprises entre 23 et 200 euros, les achats de montants élevés étant réglés par chèque. Nous montrons aussi que l'âge et le revenu des individus influencent l'usage des instruments de paiement.

Cependant cette photographie de la détention et de l'usage des instruments de paiement pourrait considérablement évoluer dans les trois prochaines années en raison de plusieurs facteurs : la construction d'un espace européen unique pour les paiements dans le cadre du SEPA (Single European Payment Area), l'apparition de nouvelles technologies de paiement, et le changement des modes de consommation des français.

La mise en œuvre du SEPA est le principal changement qui devrait toucher l'industrie des moyens de paiements en France. En effet, d'ici 2008, les banques doivent proposer aux consommateurs des moyens de paiement européens, qui seront utilisables par les consommateurs dans les mêmes conditions dans tous les pays de la zone SEPA : des cartes de paiement « SEPA

[43] La répartition du nombre de paiements contraints en fonction des valeurs de transaction montre que la contrainte est sensiblement identique pour l'ensemble des valeurs de paiement comprises entre 0,1€ et 250€. Au-delà de 250€, le nombre de paiements contraints est plus important.

», des virements « SEPA », et le prélèvement « SEPA » (débit direct). Ces moyens de paiement doivent se substituer progressivement aux moyens de paiement nationaux d'ici 2010. En ce qui concerne la détention et l'usage des moyens de paiement, les nouvelles réglementations européennes devraient accélérer le déclin du chèque, puisqu'il ne fait pas partie des moyens de paiement définis dans le cadre du « SEPA ». Néanmoins, il n'est pas prévu pour l'instant que le chèque soit supprimé en France en 2010, et il pourra toujours être utilisé pour régler des achats effectués en France. Le développement de la détention et de l'usage de la carte de paiement devrait se poursuivre, puisque les particuliers pourront effectuer des transactions chez un plus grand nombre de commerçants en Europe, dans le cadre de leurs déplacements touristiques ou professionnels. En outre, l'intensification de la concurrence sur les marchés de détail bancaires devrait favoriser la baisse des prix pour les consommateurs, et donc l'augmentation du nombre de cartes détenues. Enfin, les consommateurs pourront plus facilement régler leurs dépenses récurrentes à l'étranger avec la mise en place du débit direct. Notons enfin que le « SEPA » aura probablement plus d'impact sur les usages des entreprises, qui réalisent des volumes d'échanges importants avec des partenaires européens, que sur les usages des consommateurs, même si la mobilité de la population augmente en Europe.

Par ailleurs, l'apparition de nouvelles technologies de paiement, comme le paiement sans contact par téléphone mobile, pourrait avoir des conséquences sur l'usage des cartes de paiement. En particulier, de nouveaux acteurs non bancaires, comme les opérateurs de téléphonie mobile, ou les fournisseurs d'accès internet, seront capables de proposer de nouvelles offres de services aux consommateurs, ce qui pourrait influencer les usages, et la part de marché de chaque instrument. L'adoption et l'usage de ces nouveaux instruments de paiement dépendra d'une part des évolutions sociologiques, d'autre part de la tarification adoptée par les fournisseurs de services de paiement. Par ailleurs, l'évolution des modes de consommation des français, notamment la croissance du commerce en ligne, pourrait favoriser la diffusion d'autres instruments de paiement, comme les systèmes de paiement de personne à personne.

5 Références

Baumol W., 1952, « The Transaction Demand for Cash – An Inventory Theoretic Approach », *Quarterly Journal of Economics*, 66 (Nov.): 545-56.

Bolt, W., Humphrey, Uittenbogaard, 2006, « The Effect of Transaction Pricing on the Adoption of Electronic Payments: A Cross-Country Comparison », FRB Philadelphia Working Paper No. 05-28.

Bounie David et Abel François, 2006a, « Les déterminants de la détention et de l'usage des instruments de paiement: éléments théoriques et empiriques », *Revue d'Economie Financière*, n°83, mars, 159-173.

Bounie David et Abel François, 2006b, « Cash, Check or Debit Card: the Effects of Transaction Characteristics on the Use of Payment Instruments », *Telecom Paris Economics Working Paper, 06/05/ESS*.

Bounie David, Marc Bourreau et Abel François, 2006, « Les déterminants de la détention et de l'usage de la carte débit : une analyse empirique sur données individuelles françaises », *mimeo*.

Hancock Diana et David Humphrey, 1998, Payment transactions, instruments, and systems: A survey », *Journal of Banking & Finance*, 21, 1573-1624.

Rapport d'information du Sénat, 2006, *Accès des ménages au crédit en France*, n° 261.

Verdier Marianne, 2006, « Retail Payment Systems: What do we learn from Two-Sided Markets? », *Communications & Strategies*, n°61, 37-51.

Whitesell Willem., 1989, « The Demand for Currency Versus Debitable Accounts », *Journal of Money, Credit, and Banking*, 21 (2), 246-251.

L'économie des Cartes de Paiement en France

Marianne Verdier[1]

Septembre 2008

Résumé

Cet article propose une description économique de l'industrie française des cartes de paiement, et en particulier du système de paiement par carte « CB », qui est le plus utilisé en France. Les cartes de paiement sont des instruments de paiement électroniques, permettant aux consommateurs de régler leurs achats chez les commerçants équipés de terminaux de paiement, de payer à distance, ou de retirer des espèces dans les distributeurs automatiques de billets. Nous présentons tout d'abord les deux principales activités nécessaires à la gestion des transactions, l'émission des cartes de paiement, et l'acquisition des transactions, ainsi que le fonctionnement des systèmes de paiement par carte. Ensuite, nous montrons que l'industrie des cartes de paiement est marquée par l'existence d'interactions concurrentielles complexes, d'une part entre les membres d'un même système de paiement, et, d'autre part, entre les systèmes de paiement. Enfin, nous présentons les évolutions potentielles de l'industrie, qui dépendront de l'apparition sur le marché de nouveaux instruments de paiement, ainsi que de l'entrée d'acteurs non bancaires, et de la construction de l'Europe des paiements, dans le cadre du SEPA.

Mots clés : Cartes de paiement, systèmes de paiement, banques, SEPA.

Codes JEL : L1, L8.

[1] Département SES, Telecom ParisTech. Mail : Marianne.verdier@gmail.com. Je tiens à remercier tout particulièrement le Groupement des Cartes Bancaires pour son soutien.

1) Introduction

A l'approche de la mise en œuvre de l'Europe des paiements et du SEPA[2], proposer un article de description de l'industrie française des cartes de paiement[3], et en particulier du système de paiement par carte bancaire « CB », peut sembler incongru. La détention et l'usage des cartes de paiement se sont fortement développés au cours des vingt dernières années, et les Français se sont familiarisés avec cet instrument de paiement. Pourtant, l'économie de ce secteur, qui s'apprête à connaître de grands changements, reste relativement méconnue. L'objectif de cet article est donc de dresser une photographie de l'industrie des paiements par carte en France en 2007, afin de comprendre les interactions et les stratégies économiques de ses acteurs, pour mieux apprécier les évolutions possibles.

On estime à 81,5 millions le nombre de cartes de paiement qui circulent en France en 2007[4]. Parmi ces cartes, il existe environ 55,7 millions de cartes que l'on qualifie d' « interbancaires », parce qu'elles reposent sur la coopération d'un grand nombre de banques pour effectuer des transactions[5]. La carte de paiement du système « CB » est la principale carte de paiement interbancaire[6], puisqu'elle est détenue par 91% des Français[7]. Il existe aussi des cartes de paiement privatives, qui reposent sur la coopération d'un nombre réduit d'acteurs, pas nécessairement bancaires. Ces cartes sont aussi largement répandues en France (25,7 millions selon l'Observatoire des Cartes de Paiement en 2007), mais beaucoup moins utilisées : 22,91 milliards d'Euros ont été réglés au moyen de cartes privatives en 2007, contre 364,8 milliards au moyen de cartes de paiement interbancaires, principalement des cartes « CB »[8].

De nombreuses études témoignent du développement de l'usage des cartes par rapport aux autres instruments de paiement en France. Par exemple, selon Bounie et al. (2008), les cartes

---

[2] Single Euro Payments Area.
[3] Selon l'article L. 132-1 du Code monétaire et financier « constitue une carte de paiement toute carte émise par un établissement de crédit ou par une institution mentionnée à l'article L. 518-1 et permettant à son titulaire de retirer et de transférer des fonds».
[4] Source : Observatoire de la sécurité des cartes de paiement.
[5] Les modalités de la coopération seront discutées dans l'article. Ce chiffre comprend les cartes « CB » et Monéo.
[6] Il existe aussi une autre carte de paiement interbancaire, la carte Monéo, support du porte-monnaie électronique, qui est détenue ou activée par environ 1,2 million de porteurs. Certaines cartes « CB » sont dotées de la fonctionnalité porte-monnaie électronique, qui peut être activée par le porteur, généralement sous réserve du paiement d'une cotisation à la banque émettrice de la carte.
[7] Source : Etude réalisée par l'ENST pour le Groupement des Cartes Bancaires à partir d'un sondage réalisé auprès de 1447 individus représentatifs de la population française en 2005.
[8] Source : Observatoire des Cartes de Paiement. Notons que ces statistiques omettent une partie des cartes privatives circulant en France. D'autres études estiment le nombre de cartes privatives à environ 38 millions.

de paiement « CB » sont plus utilisées en valeur par les particuliers que les espèces ou le chèque (36% de la valeur totale des paiements contre 33% pour le chèque et 24% pour les espèces)[9]. Il n'existe cependant pas d'article qui offre une grille de lecture économique des interactions entre les acteurs des paiements par carte en France, ce que nous nous proposons de réaliser.

Nous nous interrogeons donc sur le fonctionnement de cette industrie. Comment les paiements par carte sont-ils organisés? Quels sont les acteurs de l'industrie des paiements par carte et leurs stratégies? Quels sont les mécanismes économiques qui ont permis le développement des paiements par carte? Quelles sont les évolutions susceptibles d'affecter le fonctionnement de ce secteur?

Dans un premier temps, nous décrivons l'organisation des paiements par carte en France d'un point de vue économique. La carte de paiement est un instrument de paiement électronique, dont les fonctionnalités expliquent la présence d'externalités[10] de réseau à l'équipement et à l'usage. Ces externalités sont en partie internalisées par une ou plusieurs plates-formes de paiement, appelées « systèmes ». Pour la littérature économique, l'industrie des paiements par carte constitue un exemple de « marché biface ». En effet, les plates-formes de paiement interviennent dans les échanges qui ont lieu entre deux groupes d'utilisateurs distincts, les consommateurs et les commerçants. Les consommateurs et les commerçants exercent des externalités les uns sur les autres par leurs décisions d'utilisation et d'acceptation des cartes.

Dans notre deuxième partie, nous décrivons l'organisation des différents systèmes de paiement par carte actifs en France, et la concurrence entre « plates-formes » de paiement. Nous montrons que l'industrie des paiements par carte se caractérise par la coexistence de concurrence et de coopération entre les acteurs. Les banques coopèrent au sein des systèmes de paiement interbancaires, comme le système « CB », pour favoriser la croissance de la part de marché des cartes par rapport aux autres instruments de paiement, tandis qu'elles se concurrencent sur les marchés de détail bancaires pour proposer aux consommateurs et aux commerçants de nouveaux services. Il existe aussi une concurrence entre systèmes de paiement.

---

[9] Source : Bounie, Bourreau, François, Verdier (2008) à partir de l'étude ENST citée ci-dessus. Les espèces restent l'instrument de paiement le plus utilisé en volume (63% des paiements, contre 21% pour la carte bancaire et 14% pour le chèque). Etude réalisée sur données individuelles. Il existe aussi des statistiques au niveau macroéconomique disponibles sur le site de la Banque de France.

[10] En économie, on dit qu'un agent A exerce une externalité sur un agent B lorsqu'une action de A influence positivement ou négativement l'utilité de B, sans que cela ne se traduise par une variation des prix. Une industrie est marquée par l'existence d'externalités de réseau lorsque la valeur de la détention ou d'usage d'un produit augmente avec le nombre de détenteurs ou d'utilisateurs.

Enfin, dans notre dernière partie, nous utilisons notre description de l'organisation des paiements par carte en France pour apprécier les évolutions, déclenchées par l'apparition de nouveaux moyens de paiement, et la construction d'une Europe des moyens de paiement dans le cadre du SEPA[11].

2) L'organisation des paiements par carte en France

Après une brève présentation des caractéristiques des cartes de paiement, nous présentons les deux activités nécessaires à la réalisation de transactions de paiement par carte – les activités d'émission et d'acquisition- et le rôle des systèmes de paiement par carte. Cette séparation des deux activités nécessaires à la réalisation d'une transaction est effectuée pour la clarté de l'exposé. Néanmoins, nous conserverons à l'esprit que l'industrie des paiements par carte constitue un exemple de « marché biface », dans lequel les stratégies mises en œuvre de chaque côté du marché ne peuvent être étudiées de façon isolée.

a) La carte : un instrument de paiement électronique

En France, la plupart des cartes de paiement possèdent la particularité d'être dotées d'une puce[12], permettant de stocker et de transmettre des informations sur les opérations initiées par le porteur et sur la carte[13]. La France a été l'un des pays précurseurs en matière d'usage de la puce électronique pour les paiements par carte, puisque le système de paiement interbancaire « CB » a organisé le déploiement de la carte à puce en 1992, tandis que de nombreux pays européens sont restés fidèles à l'usage de la piste magnétique jusqu'au début des années 2000.

---

[11] Single Euro Payments Area.

[12] Les émetteurs achètent les cartes à des industriels qui les fabriquent en gros dans des sites hautement sécurisés. Les fournisseurs de puce vendent les tranches de sicilium ou wafers aux encarteurs. Deux sociétés dominent le marché (Oberthur et Gemalto). Elles fabriquent les modules qui sont insérés dans les cartes à partir des tranches de silicium fournies par les fabricants de puces. La date 1992 correspond à la généralisation de l'usage de la puce dans le système « CB ».

[13] Auparavant, les cartes de paiement étaient munies d'une piste magnétique, qui nécessitait souvent une connexion permanente entre le commerçant et son banquier (systèmes on line). La puce possède l'avantage d'être dotée de mémoire, ce qui n'impose pas de connexion constante entre le terminal et sa banque pour vérifier la validité de la carte (procédé off line). Si l'invention de la puce électronique remonte aux années 50, Roland Moreno peut être considéré comme l'inventeur du concept de la carte à puce (carte à mémoire), dont le premier brevet a été déposé en 1974. La plupart des autres pays européens sont restés longtemps fidèles à l'usage de la piste magnétique, car les économies générées par la carte à puce en matière de lutte contre la fraude n'étaient pas suffisamment importantes pour compenser le coût de sa mise en place. En outre, l'adoption de la puce en France a été appuyée par les pouvoirs publics, qui détenaient à l'époque plusieurs banques nationalisées.

La capacité de stockage et de transmission d'informations électroniques constitue la principale spécificité des cartes par rapport aux autres instruments de paiement, comme le chèque ou les espèces. En effet, les émetteurs de cartes peuvent paramétrer cet instrument de paiement ou de retrait en fonction des besoins du consommateur, ce qui est impossible pour les autres instruments de paiement. Par exemple, la banque émettrice peut choisir de limiter le montant des paiements à un plafond relativement élevé, qui conviendra aux personnes réalisant de fortes dépenses. L'émetteur peut aussi décider d'imposer une vérification du solde du compte du consommateur à chaque opération, comme pour les cartes à « autorisation systématique ». La carte est donc un instrument de paiement qui se prête à une politique marketing de segmentation de la clientèle et de différenciation des produits[14]. Les banques proposent aux consommateurs différentes gammes de cartes en fonction des services qui leurs sont associés. Ces services ne sont pas seulement liés à la fonction « paiement ». Par exemple, la carte « Visa Infinite » propose à une clientèle très haut de gamme des services de location de voitures de luxe, de réservation d'hôtels de prestige, ou d'organisation de voyages (services de concierge). Cette caractéristique des cartes explique le fait que le marché de l'émission ait suscité un attrait pour les acteurs non bancaires, ce qui se traduit par la croissance du nombre de cartes privatives gérées par des magasins. Pour les enseignes qui émettent des cartes privatives, la carte n'est pas seulement un instrument de paiement, mais aussi un outil de gestion de la relation client, qui permet de mieux connaître le comportement des consommateurs, afin de leur proposer de nouvelles offres de services. Par exemple, la carte Accord du groupe Auchan permet d'obtenir des réductions sur des voyages, ou de téléphoner moins cher.

La carte est aussi un instrument de paiement qui permet de retirer des espèces et d'effectuer des opérations sur les Distributeurs Automatiques de Billets, lorsque les deux services sont proposés par la banque. Par exemple, en 2007, les retraits d'espèces correspondaient à 18,9% du volume de 7,26 milliards de transactions effectuées avec la carte « CB ».[15]

La carte est aussi adaptée à l'émergence de nouveaux modes de consommation, comme le commerce électronique, à conditions que les systèmes de paiement mettent en place un certain nombre de mesures et de règles sécuritaires qui permettent de développer cet usage. Par exemple, dans le système « CB », le consommateur peut régler ses achats en ligne par la simple

[14] Nous verrons cependant que les possibilités de différenciation des cartes bancaires en France ont été limitées par une règle préconisant l'absence de co-marquage sur la carte, pour construire un instrument de paiement neutre.
[15] Source : Chiffres clés « CB ».

transmission de son numéro de carte bancaire, de la date d'expiration, et des trois chiffres inscrit au dos de la carte, appelés « cryptogramme visuel ».

b) L'émission de cartes de paiement

Dans cette partie, nous présentons les émetteurs de cartes de paiement, ainsi que les différents types de cartes émises. Toute entreprise voulant émettre des cartes de paiement doit acheter un support à des sociétés appelées encarteurs, qui chargent les cartes, les personnalisent, les sécurisent, et élaborent une politique de distribution. Les banques payent les coûts liés au traitement des transactions et aux risques d'impayés.

Les cartes peuvent être classées en trois catégories en fonction de l'organisme d'émission: les cartes « interbancaires », les cartes privatives et les cartes accréditives.

Les cartes de paiement « interbancaires » sont émises par des établissements de crédit, qui coopèrent dans le cadre d'une association de paiement pour échanger des flux. Les principales cartes de paiement interbancaires en France sont les cartes du système « CB », et les principaux émetteurs sont le groupe Crédit Agricole, BNP Paribas, la Société Générale, le Crédit Mutuel, le Groupe Caisse d'Epargne et la Banque Postale. Ces cartes permettent à leur titulaire d'effectuer différents types de transactions, selon le contrat passé avec sa banque: des retraits d'espèces dans les Distributeurs Automatiques de Billets (DAB), des paiements à débit immédiat, à débit différé ou à crédit. En France, la plupart des cartes bancaires sont associées à la détention d'un compte en banque. Historiquement, la Carte Bancaire a été créée en France à partir de la volonté d'un groupe de banques de lutter contre la fraude en proposant un instrument de paiement qui se substitue au chèque. Sous l'impulsion du gouvernement, cette initiative a abouti en 1984 à la création du système « CB », « Cartes Bancaires », géré par un groupement d'intérêt économique constitué de plus de 150 banques[16]. Les émetteurs doivent respecter un certain nombre d'obligations et de principes, définis par le GIE « CB », comme les règles portant sur la garantie du paiement pour le commerçant et l'irrévocabilité de l'ordre de paiement par carte. En contrepartie, les cartes portant le logo « CB » sont acceptées par tous les autres membres du système, ce qui constitue le principe de l'interbancarité. Jusqu'à présent les cartes émises dans le système « CB » ont aussi respecté un principe de neutralité du moyen de paiement : les cartes ne pouvaient pas servir d'outil marketing et le visuel de la carte bancaire devait respecter les normes définies par le système « CB ». En particulier, les cartes du système « CB » ne pouvaient pas être co-marquées[17]. Cette caractéristique ne répondait pas à une tradition bancaire française de neutralité du banquier par rapport aux transactions commerciales faites par son client. Néanmoins, le groupement des Cartes Bancaires a décidé de lever l'interdiction du co-marquage des cartes du système « CB » en 2007.

Les cartes privatives sont distribuées par des entreprises ou des commerçants, qui ont parfois recours à l'appui d'une société financière, comme Cetelem, Finaref, Cofinoga, Cofidis, Sofinco, S2P pour le groupe Carrefour, ou la banque Accord pour le groupe Auchan. Ces cartes sont généralement acceptées dans un nombre limité d'enseignes, et ont pour but de fidéliser la clientèle, en proposant aux consommateurs des solutions de paiement à crédit, et des services complémentaires.

Les cartes accréditives sont des cartes non bancaires émises par les réseaux internationaux comme Diners ou American Express. Ces cartes proposent de nombreux services, et sont destinées à une clientèle présentant un fort pouvoir d'achat ou aux grandes entreprises. Ces réseaux pratiquent fréquemment des stratégies de co-marquage, soit avec des grandes entreprises, soit avec des banques. Par exemple, la carte co-marquée par American Express et Air France permet aux consommateurs de bénéficier de miles pour leurs prochains voyages dès qu'ils payent avec leur carte American Express. American Express a aussi signé des accords avec de nombreuses banques du système « CB », comme le Crédit Lyonnais ou la Société Générale, pour émettre des cartes qui lui permettent d'offrir un service de retrait dans les distributeurs automatiques de billets à ses clients.

Une carte est aussi caractérisée par le type de transaction que peut effectuer le consommateur lorsqu'il l'utilise. **Les cartes de retrait** permettent seulement d'effectuer des retraits d'espèces dans les DAB. **Les cartes de paiement** offrent au consommateur la possibilité de régler ses achats et de retirer des espèces. Si le paiement est à débit immédiat, en principe, les montants des paiements sont débités du compte du consommateur sous les 24 heures. Si le paiement est à débit différé, les débits sont regroupés et affectés au compte périodiquement. Les cartes de crédit sont généralement associées à un crédit permanent. Le montant disponible sur le crédit est vérifié à

---

[16] Le GIE « CB » comporte 36 banques de droit étranger.

[17] Le co-marquage repose sur la cohabitation de deux marques sur un même support carte, celle de l'établissement financier, et celle de l'entreprise promotrice. Il existe d'autres pratiques dérivées du co-marquage. Par exemple, le co-badging consiste à mettre sur une carte deux réseaux d'acceptation. Le co-marketing lorsque l'émetteur et le promoteur de la carte sont différents. Cette dernière pratique est autorisée dans le système « CB ».

chaque opération. Les cartes portant les logos Visa ou MasterCard peuvent être utilisées pour effectuer des transactions dans les réseaux internationaux.

En France, les cartes bancaires « CB » sont généralement des cartes de débit. En effet, contrairement à d'autres pays européens, les cartes de crédit bancaires sont peu répandues en France, d'une part à cause des réglementations du crédit à la consommation, et d'autre part à cause d'une volonté des banques de privilégier les cartes de débit. En effet, les cartes de paiement à débit différé constituent une forme de crédit bon marché, puisque généralement, la cotisation n'est pas beaucoup plus chère que pour une carte de paiement à débit immédiat[18]. Il existe donc un effet de substitution entre le paiement par carte de crédit et le paiement par carte à débit différé. Les cartes de crédit du système « CB » ne représentent que 6% des cartes bancaires « CB ». En revanche, les cartes privatives ou accréditives offrent très souvent au consommateur la possibilité d'acheter à crédit.

Tableau 1: taux de détention des cartes de paiement en France[19]

<table>
<tr><th></th><th colspan="2">Taux de détention[20]</th></tr>
<tr><td rowspan="3">Carte bancaire de débit « CB »</td><td>Carte bancaire de débit « CB » (toutes cartes)</td><td>81,1%</td></tr>
<tr><td>Carte bancaire à débit immédiat</td><td>73,7%</td></tr>
<tr><td>Carte bancaire à débit différé</td><td>26,9%</td></tr>
<tr><td>Carte de retrait</td><td colspan="2">9,5%</td></tr>
<tr><td>Carte bancaire de crédit</td><td colspan="2">4,9%</td></tr>
<tr><td>Carte accréditive ou privative</td><td colspan="2">33,1%</td></tr>
<tr><td>Carte de crédit au sens large :
carte de crédit bancaire ou carte privative ou carte accréditive.</td><td colspan="2">35,9%</td></tr>
</table>

c) L'acquisition des transactions

Dans cette partie, nous présentons l'activité d'acquisition de transactions, qui est réalisée principalement par des banques et des entreprises du secteur informatique.

---

18 L'écart de prix de la cotisation pour ces deux types de cartes dépend de la banque considérée. Il avoisine généralement les 10 Euros.

19 Source : Etude réalisée par l'ENST et le Groupement des Cartes Bancaires à partir d'un échantillon de 1447 individus représentatifs de la population française. Pour plus de détails sur la détention des cartes, le lecteur pourra se reporter à Bounie, Bourreau, François, Verdier (2006).

Les banques acquéreurs s'occupent de traiter les flux des transactions à partir du terminal de paiement des commerçants. Elles collectent et transmettent les demandes d'autorisation, et gèrent les garanties de paiement. Souvent, les banques acquéreurs s'appuient sur la logistique proposée par des entreprises spécialisées, les processeurs d'acquisition, comme les sociétés Atos Worldline ou Experian. Le commerçant peut soit louer le terminal de paiement à la banque acquéreur, soit l'acheter[21]. La banque s'occupe généralement de la maintenance. En principe, pour les petits commerçants, l'acquéreur de la transaction et la banque qui gère les comptes du commerçant sont identiques. En revanche, les grands commerçants possèdent parfois plusieurs banques acquéreurs.

Les principaux acquéreurs pour les transactions payées par cartes « CB » sont le Crédit Agricole, le Crédit Mutuel, et le groupe Banques Populaires. Les acquéreurs des flux de transactions réalisées par cartes privatives sont souvent identiques à leurs émetteurs. Selon l'enquête sectorielle réalisée par la Commission Européenne[22], la France est le deuxième pays qui présente le degré de concentration le plus bas du segment acquisition, avec 80 acquéreurs actifs sur le marché. Pourtant, selon la Commission, seulement quatre acquéreurs réalisent plus de 50% du chiffre d'affaire total du marché.

d) Les systèmes de paiement par carte

Dans cette partie, nous présentons le déroulement des transactions par carte, qui nécessitent la mise en relation de l'émetteur de la carte et de l'acquéreur de la transaction, si ces derniers sont différents. Nous montrons que l'existence de systèmes de paiement interbancaires, comme le système « CB », génère des économies d'échelle, et permet une gestion efficace des transactions ayant lieu entre un grand nombre de banques différentes.

Les transactions de paiement par carte nécessitent la transmission et le traitement d'informations par voie électronique entre le porteur, l'émetteur de la carte, l'acquéreur de la transaction, et le terminal de paiement du commerçant. Le fait que la carte soit un instrument de paiement électronique est un élément structurant de cette industrie. En effet, les points

[20] Pour les cartes bancaires, nous nous intéressons à la carte détenue sur le compte principal.
[21] Les principaux constructeurs de terminaux de paiement sont les sociétés Moneyline, Ingenico, Thales, Sagem…Les principaux constructeurs de DAB sont les sociétés NCR, Diebold et Wincor Nixdorf.

d'acceptation de la carte doivent être reliés aux émetteurs et aux acquéreurs par une infrastructure de réseau, ce qui implique la présence d'externalités à l'équipement et à l'usage. En ce qui concerne l'équipement, plus les points d'acceptation de la carte sont nombreux, plus la valeur des cartes émises est importante. De même, plus les cartes émises sont nombreuses, plus il est intéressant pour un commerçant de disposer d'un point d'acceptation connecté au réseau. En ce qui concerne l'usage, un commerçant peut exercer une externalité négative sur le consommateur en refusant d'accepter un paiement par carte. La présence d'externalités de réseau justifie la présence de systèmes de paiement, qui jouent le rôle de plates-formes d'intermédiation entre les émetteurs et les acquéreurs.

Deux types d'organisation sont possibles. Soit l'émetteur et l'acquéreur sont identiques. Dans ce cas, **le système de paiement par carte est dit fermé ou à trois coins**[23]. Dans les systèmes fermés, les prix payés par les porteurs et les commerçants sont directement décidés par le système de paiement. C'est le cas des systèmes de paiement par carte accréditifs comme American Express ou Diners, et des systèmes privatifs, comme celui de la carte Aurore. Nous verrons que ce type d'organisation permet de déployer des stratégies commerciales plus fines, car le système de paiement peut jouer sur sa présence conjointe sur les segments émission et acquisition.

Si les émetteurs et les acquéreurs ne sont pas identiques, ces derniers sont mis en relation par **un système de paiement ouvert**. La présence d'un système de paiement par carte ouvert permet de réduire les coûts de transaction payés par un émetteur et un acquéreur différents, grâce à l'utilisation d'une infrastructure de réseau et de règles communes d'interconnexion, comme c'est le cas pour le système « CB » en France. En revanche, les membres d'un système ouvert comme le système « CB » décident librement des prix pratiqués sur les marchés de détail bancaires pour les cotisations payées par les porteurs et les commissions payées par les commerçants. Le système « CB » fonctionne sur le principe de l'interbancarité : les 51,2 millions de porteurs de cartes « CB » peuvent retirer et payer dans les 1,1 million de points d'acceptation « CB »[24]. Le GIE « CB », qui définit les obligations minimales devant être respectées par ses membres pour assurer le bon déroulement des transactions, est né en 1984 à l'issue de la fusion de deux systèmes concurrents : le système Carte Bleue et le système Carte Verte[25]. Le groupement

---

[22] Source: p:85 « Interim Report I Payment Cards » sector inquiry under article 17 regulation 1/2003 on retail banking.

[23] Pour une typologie des systèmes de paiement de détail, voir Verdier (2006) : « Retail Payment Systems : what do we learn from Two-Sided Markets ? », Communication & Strategies n°61, mars 2006.

[24] 80% des transactions réalisées dans le système CB sont des transactions de paiement (Source « CB »).

[25] Le système Carte Bleue a été créé en 1971 par le Crédit Lyonnais, la Société Générale, la Banque Nationale de Paris, le Crédit Industriel et Commercial de France, et le Crédit Industriel et Commercial. Il avait signé un partenariat

« CB » gère aussi l'infrastructure de réseau nécessaire à l'interconnexion de ses membres (le e-rsb®)[26], et la lutte contre la fraude[27] . La sécurité des transactions constitue la clé de voûte du système « CB ». Le groupement « CB » prend de nombreuses mesures préventives pour maintenir le niveau de fraude à des taux très bas, comme l'analyse des risques, la détermination des architectures sécuritaires[28], l'évaluation des systèmes de sécurité des membres, et la coopération avec les systèmes internationaux. Lorsque des opérations frauduleuses sont constatées, le groupement « CB » coopère avec la police pour les enquêtes, et peut suspendre les commerçants présentant des taux de fraude anormalement élevés.

Pour mieux comprendre le déroulement d'une transaction de paiement par carte, nous étudions l'exemple d'une transaction effectuée dans le système « CB ». Lorsque le porteur tape son code confidentiel sur le terminal de paiement du commerçant ou le point de retrait, une application utilisant des clés RSA et DES[29] vérifie que la carte peut être acceptée et que ce numéro correspond bien à celui stocké dans la puce. La transaction peut ensuite faire l'objet d'une demande d'autorisation à l'émetteur de la carte. Dans ce cas, la transaction est transmise à la banque émettrice par l'intermédiaire du réseau géré par le système « CB ». Cette dernière contrôle alors que la transaction est possible, soit que les plafonds ne sont pas dépassés, et que la carte n'est pas en opposition. Le déclenchement de la demande d'autorisation peut être paramétré dans la puce de la carte par l'émetteur, comme pour les cartes à autorisation systématique ou de façon aléatoire par les terminaux de paiement.

En France, le système « CB » est le système le plus utilisé pour les transactions de paiement par carte. Cependant, le système « CB » est aussi relié aux systèmes Visa et MasterCard par des accords de « co-badging », ce qui permet aux détenteurs de cartes « CB » « co-badgées » d'effectuer des transactions dans ces autres systèmes, dont les points d'acceptation sont très développés à l'étranger. L'accord de « co-badging » comporte deux règles principales. D'une part, toutes les cartes émises par les membres des systèmes Visa et MasterCard sont acceptées dans les

---

à l'international avec Visa. Le système Crédit Agricole, proposant la carte verte, s'appuyait pour les transactions internationales sur MasterCard. Il existait en réalité trois systèmes concurrents avant que le système du Groupe des Banques Populaires, baptisé « Intercartes », ne décide de fusionner avec le GIE Carte Bleue en novembre 1982.

[26] Le système CB est un système semi-on-line. Environ 30% des transactions de paiement font l'objet d'une demande d'autorisation. En revanche, tous les retraits sont soumis à une demande d'autorisation.

[27] Le système CB fixe les règles pour la compensation des transactions, qui est gérée par le Système Interbancaire de Télécompensation (SIT).

[28] La cryptographie constitue un élément essentiel de l'architecture sécuritaire du système. La puce de la Carte Bancaire dialogue avec les terminaux de paiement des commerçants et les distributeurs automatiques de billets. Les données échangées sont cryptées par des suites d'algorithmes complexes, qui ne peuvent être déchiffrées qu'avec des clés secrètes. Chaque nouvelle génération de puce fait l'objet de tests poussés, menés par le Groupement des Cartes Bancaires.

points d'acceptation « CB ». D'autre part, le GIE « CB » autorise ses membres à émettre des cartes « CB » portant les logos Visa ou MasterCard, qui pourront être utilisées pour régler des transactions hors du système « CB ». Désormais, les cartes émises par les membres « CB » sont pratiquement toutes « co-badgées », puisque seulement 6% des cartes de paiement « CB » ne portent pas le logo Visa ou MasterCard. Le GIE Carte Bleue et la société anonyme Europay[30] France servent respectivement d'interfaces techniques entre le système « CB » et les sociétés Visa et MasterCard. Par exemple, lorsqu'un porteur d'une carte Visa effectue une transaction dans le système « CB », la transaction est transmise au GIE Carte Bleue, qui la transfère sur le réseau VisaNet. Europay et Carte Bleue représentent aussi les banques membres du système « CB » auprès de Visa et de MasterCard respectivement. Par ailleurs, elles fournissent aux émetteurs des licences qui leur permettent d'émettre des cartes Visa et MasterCard.

Ce panorama de l'organisation des paiements par carte en France, et en particulier du système « CB », montre que les acteurs sont amenés à la fois à coopérer pour construire des infrastructures de paiement communes, et à se concurrencer sur les marchés de détail bancaires pour proposer de nouveaux services aux consommateurs et aux commerçants. Dans la partie suivante, nous analysons plus précisément les interactions stratégiques entre les acteurs des systèmes de paiement par carte d'une part, et entre les systèmes de paiement d'autre part.

3) Le fonctionnement des systèmes de paiement par carte : entre concurrence et coopération.

a) Une coopération interne nécessaire au développement de l'usage des cartes.

La mise en place d'un système de paiement par carte performant nécessite une coopération étroite entre les banques, pour réaliser des investissements et développer des infrastructures qui leur permettront de se rendre des services. Par exemple, dans le système « CB », les banques émettrices doivent gérer la maintenance des infrastructures de réseau nécessaires à la réception des demandes d'autorisation, et renseigner les bases de données qui permettent d'identifier les cartes en opposition. Les banques acquéreurs doivent surveiller les terminaux de paiement des commerçants, et repérer les anomalies éventuelles qui pourraient résulter de transactions frauduleuses. Dans le système « CB », la coopération entre banques est rendue possible par

---

[29] Les clés RSA et DES permettent de déchiffrer des algorithmes cryptographiques.

l'existence d'un mécanisme tarifaire de rémunération des services interbancaires : les commissions d'interchange[31]. Lors d'une transaction de paiement, l'acquéreur paye à l'émetteur une commission d'interchange, appelée Commission Interbancaire de Paiement (CIP). Cette commission comprend une partie fixe, destinée à rémunérer les coûts de l'émetteur en matière de traitements informatiques, et un pourcentage appliqué aux montants des transactions échangées et aux montants des transactions frauduleuses[32]. Cette partie variable est destinée à rémunérer les services de sécurité fournis par l'émetteur. De même, lorsque le consommateur retire des espèces dans un DAB, la banque émettrice de la carte rémunère la banque gestionnaire du DAB par une Commission Interbancaire de Retrait (CIR). La Commission Interbancaire de Paiement a été validée par la Conseil de la Concurrence[33], et les deux commissions d'interchange ont fait l'objet d'une lettre de classement de la Commission Européenne[34].

Dans le cadre du système « CB », les banques réfléchissent aussi aux améliorations à apporter à la carte bancaire pour favoriser le développement de son usage. Par exemple, l'innovation du cryptogramme visuel pour réduire les risques de fraude sur Internet a permis la croissance de l'usage de la carte pour les paiements en ligne. De même, l'acceptation de la carte d'achat public dans les administrations a nécessité la création de bases comportant suffisamment de données pour gérer les demandes d'autorisation.

b) Le résultat des stratégies de coopération : le positionnement des cartes par rapport aux autres instruments de paiement.

Grâce à ces stratégies de coopération, la carte constitue un instrument de paiement très utilisé par les consommateurs[35] et largement accepté par les commerçants[36]. Une étude menée par

---

[30] Les sociétés MasterCard Europe et Europay France ont signé un accord d'intégration de leurs activités en France effectif à partir du premier avril 2008.

[31] Notons que la définition que nous proposons ici pour les commissions d'interchange, est celle du système « CB ».

[32] Cette dernière composante, appelée « Taux Interbancaire de Cartes en Opposition », est bilatérale. Elle est calculée par couple de banques. Par transaction frauduleuse, on entend la transaction faite avec une carte mise en opposition.

[33] Décision n°90-D-41 du 30 octobre 1990 suite à l'injonction formulée dans la décision n°88-D-37 du 11 octobre 1988.

[34] Selon la revue Cards International du 4 Novembre 2005, la France possède l'un des taux d'interchange les plus bas d'Europe, à 0,5% en moyenne. Dans le système Visa, les commissions d'interchange sont fixes pour les cartes de débit ou variables pour les cartes de crédit.

[35] Pour plus de détails, voir Bounie, Bourreau, François, Verdier (2008).

[36] C'est dans les administrations et chez les professionnels de la santé que le taux d'acceptation est le plus faible (voir avec CB pour avoir des chiffres).

l'ENST et le groupement « CB »[37] sur un échantillon de 16 692 transactions réalisées sur une période de huit jours par 1392 individus montre que la carte bancaire de débit est l'instrument de paiement le plus utilisé en valeur (pour 35,7% des transactions contre 24,2% pour les espèces et 33,1% pour le chèque)[38]. La part de marché de la carte de débit bancaire dépasse celle des espèces pour des valeurs de transaction supérieures à 23 euros. Pour des montants compris entre 23 et 200 euros, c'est l'instrument de paiement le plus utilisé. A partir de 200 euros, le chèque devient l'instrument de paiement privilégié par les consommateurs.

Par ailleurs, les stratégies de coopération sont profitables pour les banques, puisque les économies d'échelle réalisées par la création d'infrastructures communes contribuent à faire baisser les coûts de traitement des transactions payées par carte. Les efforts des banques pour coopérer en matière de lutte contre la fraude sur les cartes « interbancaires » se traduisent par un taux de fraude très bas, qui s'élève à 0,062% du volume de transactions en 2007[39].

Cependant, si les banques coopèrent pour favoriser le développement de la part de marché de la carte et la réduction des coûts de transaction, elles se concurrencent vivement sur les marchés de détail bancaires.

c) La concurrence sur le marché de l'émission

Le marché de détail de l'émission des cartes met en concurrence principalement les banques, les entreprises de la grande distribution, et les organismes accréditifs internationaux comme American Express. Historiquement, les marchés de détail bancaires sont marqués en France par la division entre banques commerciales, groupes mutualistes et caisses d'épargne[40]. Les clientèles de chaque établissement de crédit sont plutôt segmentées, même si les banques cherchent à diversifier de plus en plus leurs portefeuilles de clients en proposant différentes gammes de produits. La concurrence que se livrent les banques sur le marché de l'émission des cartes s'inscrit dans le cadre d'une relation plus générale avec le consommateur, puisque la détention d'une carte bancaire est nécessairement associée à la détention d'un compte en banque. A l'ouverture d'un

[37] Etude menée sur un échantillon de 16 692 transactions réalisées sur une période de huit jours par 1 392 individus. Pour plus de détails sur les résultats, voir Bounie, Bourreau, François, Verdier (2008).

[38] Les espèces sont l'instrument de paiement le plus utilisé en volume (pour 62,5% des transactions, contre 21% pour la carte de débit et 13,8% pour le chèque).

[39] Source : Observatoire National des Cartes de Paiement. Le montant moyen d'une transaction frauduleuse est de 130 euros. Pour les transactions nationales, le taux de fraude s'élève à 0,029% du volume, et pour les transactions internationales à 0,37%. Le taux de fraude pour les transactions nationales payées par carte privative est légèrement plus faible (0,042%) que pour les transactions nationales interbancaires, mais le montant moyen d'une transaction frauduleuse est plus élevé (432 euros en 2007).

[40] Le taux de bancarisation des français s'élève à 96% (source étude « Baromètre ouverture et fermeture de compte » TNS Sofres).

compte, la banque propose généralement un bouquet de services à son client, comprenant la délivrance d'un chéquier et d'une carte de paiement. Néanmoins, la carte de paiement est l'un des principaux outils de différenciation dont dispose la banque pour se démarquer de ses concurrents, puisqu'il n'est pas possible de proposer des services associés au chèque, par exemple. Les banques émettrices se font donc concurrence pour proposer une gamme donnée de services de paiement par carte au meilleur prix. Les consommateurs payent généralement une cotisation annuelle pour leur carte de paiement, et, selon la banque, des frais fixes à chaque retrait dans un distributeur géré par une banque concurrente[41]. En revanche, les transactions effectuées par carte « CB » ne sont pas facturées au consommateur. Nous proposons dans le tableau suivant quelques prix indicatifs des différentes gammes de cartes bancaires.

Tableau 2: Cotisations annuelles pour les cartes (Ordre de grandeur en mars 2007).[42]

Type de carte	Echelle de prix
Carte à débit immédiat	23-35 euros Coût moyen 29 euros.
Carte à débit différé	34-42 euros Coût moyen 39 euros
Carte de débit prestige internationale	45-130 euros Coût moyen 111 euros
Carte de débit très haut de gamme	140-315 euros Coût moyen 260 euros
Cartes non bancaires (American Express, Diners)	De 40 euros pour la carte blue à 520 euros pour la carte Platinum (American Express)

Les offres de cartes privatives « low costs » développées par les entreprises de la grande distribution ont entraîné une réaction de la part des banques. Par exemple, le Crédit Agricole a lancé une carte de paiement à autorisation systématique qui est facturée 14,9 euros aux consommateurs[43]. Les banques ont aussi mis en place des pratiques de « cash back », qui

[41] La tarification des retraits déplacés a été introduite par BNP Paribas, puis par la Société Générale, puis par d'autres banques. La tarification des « retraits déplacés » n'intervient généralement qu'après un certain nombre de retraits défini par la banque. La tarification des retraits déplacés varie généralement entre 0,7 et 1,5 euros par retrait. Statistiquement, un client « CB » effectue 27 retraits par an (chiffre à vérifier chez CB), et grâce aux franchises, il a peu de chances d'être affecté par cette tarification.
[42] Source : testepourvous.com.
[43] Offre « l'autre carte ».

consistent à rembourser au consommateur une partie de sa cotisation en fonction du volume d'achats réalisés avec sa carte.

Notons que la concurrence sur le marché de l'émission s'exerce à plusieurs niveaux. Ainsi, la concurrence que se livrent les banques membres du système « CB » pour obtenir de nouveaux clients est une concurrence intra-système. Cependant, il existe aussi une concurrence entre les systèmes de paiement sur le marché de l'émission, que l'on peut qualifier de concurrence inter-système. Par exemple, le système « CB » est en concurrence avec les systèmes de cartes privatifs comme celui géré par le réseau Aurore. Les systèmes Visa et MasterCard sont aussi concurrents pour l'émission de cartes internationales. Par ailleurs, la concurrence peut aussi s'exercer selon la dimension « détention », et selon la dimension « usage ». Le fait qu'une carte soit très détenue ne signifie pas nécessairement qu'elle sera très utilisée, en particulier lorsque le consommateur peut choisir entre plusieurs cartes de paiement. L'industrie des cartes de paiement est donc marquée par l'existence d'interactions concurrentielles complexes, entre les systèmes de paiement d'une part, et les membres des systèmes d'autre part.

d) La concurrence entre les acquéreurs

Sur le marché de détail de l'acquisition, les banques se concurrencent pour proposer des services d'acceptation aux commerçants. Sur le segment des petits commerçants, la relation entre la banque acquéreur et le commerçant s'inscrit dans le cadre d'une relation client globale, dans laquelle la banque propose un ensemble de services qui comprend l'acceptation des cartes. Le commerçant peut soit louer soit acheter un terminal de paiement électronique à sa banque[44]. L'achat d'un terminal de paiement standard peut coûter entre 300 et 400 euros[45]. En cas de location, le prix payé par le commerçant dépend des fonctionnalités dont dispose le terminal de paiement.

Tableau 3: Prix de location des terminaux de paiement (Ordre de grandeur)[46].

Type de terminal	Frais mensuels de location
Terminal fixe	10-15 euros

[44] Selon le groupe Ingénico, 80% des terminaux de paiement sont loués par les commerçants. Les terminaux ont une durée de vie de 7 ans et les contrats de location durent généralement trois ans.
[45] Source : magazine « La Provence » 19/10/2005.
[46] Source : Commerce magazine, et Ingénico.

Terminal portable avec liaison infrarouge	21 euros
Terminal portable avec liaison radio	30 euros
Terminal permettant au commerçant de se déplacer chez le client.	47 euros

A chaque fois qu'un consommateur paye un achat de bien ou de service par carte, le commerçant peut payer en principe une commission à sa banque qui s'applique généralement en pourcentage au montant de la transaction. La commission commerçant moyenne en France varie de 0,6% à 0,8% de la transaction, et peut dépendre du taux de fraude du commerçant[47].

Sur le segment des grands commerces, un commerçant peut être en relation avec plusieurs banques pour répondre à l'ensemble de ses besoins en services financiers. En effet, les volumes de transactions par carte réalisés par les grands commerçants sont très importants. Par exemple, les hypermarchés et les supermarchés représentent près de 33% du volume des transactions payées par carte en France[48].

Les banques acquéreurs ont besoin de ces volumes pour rentabiliser leurs plates-formes de traitements monétiques. Par conséquent, les grands commerçants mettent souvent en concurrence plusieurs acquéreurs pour gérer l'acceptation des transactions que leurs clients payent par carte. La concurrence sur ce segment du marché de l'acquisition est une concurrence en prix très intense, qui se traduit par la faiblesse des commissions commerçants, et par la baisse de la rentabilité de l'activité d'acquisition.

Nous avons séparé pour notre analyse la concurrence sur le marché de l'émission de celle qui s'exerce sur le segment acquisition. En réalité, ces deux segments sont liés par l'existence de stratégies commerciales cohérentes, qui sont pratiquées notamment par les systèmes de paiement à trois coins pour concurrencer les systèmes à quatre coins, en augmentant le volume de transactions. Les systèmes de paiement à trois coins ou systèmes fermés, comme American Express, possèdent un avantage concurrentiel sur les systèmes à quatre coins, parce qu'ils peuvent intervenir simultanément sur les prix payés par les porteurs de cartes et sur les commissions payées par les commerçants pour définir leur stratégie commerciale. En revanche,

[47] Source : magazine Cards International du 4 Novembre 2005. Il faut noter que le mode de facturation des commissions payées par les commerçants peut varier d'une banque à l'autre (tarification au volume comprenant une partie fixe, forfait mensuel etc…) . En Anglais, on parle de « Merchant Service Charge » (MSC) pour faire référence à la commission payée par le commerçant.

[48] Source : étude réalisée par la SOFRES pour le Groupement CB (2005).

les systèmes ouverts à quatre coins dépendent des politiques marketing pratiquées par les banques émetteurs et acquéreurs. Cet exemple montre que la concurrence entre systèmes peut s'exercer simultanément sur les segments de l'émission et de l'acquisition.

e) L'impact des Distributeurs Automatiques de Billets sur la concurrence entre banques.

Grâce aux Distributeurs Automatiques de Billets (DAB), les banques sont en mesure de proposer des services de retraits d'espèces aux détenteurs de cartes. La présence d'un réseau de DAB important est un élément qui augmente la valeur de la détention d'une carte pour le consommateur. La carte bancaire constitue le principal moyen utilisé par le consommateur pour se procurer des espèces puisque 82% des retraits d'espèces sont effectués dans les DAB[49]. Statistiquement, un porteur de carte « CB » effectue 25,3 retraits par an, d'un montant moyen de 68,5 Euros[50].

Dans le système « CB », les réseaux de DAB de chacun des membres sont compatibles et interopérables[51] : une carte émise par une banque peut être utilisée dans un distributeur installé par une autre banque pour retirer des espèces. Les banques du système « CB » peuvent également choisir d'ouvrir leurs DAB à d'autres systèmes, comme American Express. Les établissements bancaires se font concurrence pour installer des DAB, parce que leur présence augmente la valeur et le nombre des services fournis à leurs clients. Les banques qui installent de nouveaux DAB exercent une externalité sur les banques émettrices en augmentant la valeur de la carte pour le porteur. Réciproquement, les banques émettrices exercent aussi une externalité sur les banques qui détiennent des DAB dès qu'elles vendent une carte à un porteur supplémentaire. En effet, ce porteur réalisera des transactions avec sa carte qui permettront d'amortir le coût des DAB pour les banques qui en détiennent. Il faut cependant noter que les banques ne cherchent pas nécessairement à implanter les DAB de telle sorte que le nombre de retraits soit maximal. Les choix de localisation des DAB résultent d'un arbitrage entre le nombre de retraits espérés et les taux de panne prévisionnels.

---

[49] Source : étude ENST réalisée pour le Groupement CB (2005).
[50] Source : Groupement CB, chiffres 2005.
[51] Il existe une vaste littérature économique qui étudie les incitations des banques à partager des réseaux de DAB, et les prix pratiqués à l'usage. Pour une revue de la littérature, voir MC Andrews (2003).

Le système « CB » possède une faible densité de DAB, par rapport à d'autres systèmes de paiement européens. En effet, la Société Générale évalue à 650 le nombre de DAB par million d'habitants en France, contre 1340 en Espagne ou 995 au Portugal. Il y avait 44 620 DAB en France à la fin du premier trimestre 2005. Un DAB coûte entre 40 et 50 mille Euros par an en maintenance. Les banques cherchent à rentabiliser leurs DAB en proposant de nouveaux services comme l'enregistrement des RIB des bénéficiaires pour les virements à distance, le développement des possibilités de recharger son mobile, ou encore les services de remises de chèques. De plus en plus, les DAB deviennent des GAB (Guichets Automatiques de Banques), qui permettent aux banques de réaliser des économies sur les coûts de gestion d'agences.

Tableau 4: postes de coûts sur les DAB[52].

Poste de coût sur les DAB	Coûts
Equipement	13%
Installation	12%
Sécurité	7%
Maintenance	31%
Location du site	25%
Charges centrales	12%

Le secteur des cartes de paiement est donc marqué par l'existence d'interactions concurrentielles complexes : une concurrence « intra-système » entre banques et institutions financières sur les segments de l'émission ou de l'acquisition, ou pour l'implantation de DAB, et une concurrence « inter-systèmes », plus difficile à modéliser, du fait de l'asymétrie des stratégies pratiquées par les systèmes à trois coins et les systèmes à quatre coins.

4) Les évolutions récentes et potentielles de l'industrie.

Dans cette partie, nous montrons que les interactions concurrentielles dans le secteur des paiements par carte risquent d'être affectées par l'apparition de nouveaux moyens de paiement et par l'entrée de nouveaux acteurs sur le marché, favorisée notamment par le SEPA.

[52] Source : Société Générale.

a) La concurrence de nouveaux instruments de paiement

Nous avons montré que la part des paiements par carte en France avait augmenté en valeur et en volume, parce que la carte de paiement est un instrument de paiement électronique, qui permet aux banques de fournir des services différenciés aux consommateurs. La carte de paiement est également adaptée à l'émergence de nouveaux modes de consommation comme le commerce en ligne.

Cependant, d'autres instruments de paiement électroniques, comme le paiement par téléphone mobile, pourraient entrer en concurrence avec les cartes de paiement. Ainsi, un système de paiement par SMS a déjà été lancé en Belgique (Pay2me), et par les Caisses d'Epargne en France, tandis qu'un système de paiement par mobile qui s'appuie sur la technologie des puces sans contact (NFC[53]) est actuellement testé à Strasbourg, dans le cadre d'un partenariat entre NRJ Mobile, Sagem, et le CIC Crédit Mutuel. Si une transaction de paiement peut être aussi véhiculée par les réseaux des opérateurs mobiles, on pourrait assister à une intensification de la concurrence entre les réseaux qui permettent de traiter les transactions, et à l'entrée de nouveaux acteurs non bancaires sur le marché.

Néanmoins, la carte de paiement possède plusieurs avantages concurrentiels importants par rapport au téléphone mobile, et plus généralement par rapport aux autres instruments de paiement électroniques. D'une part, l'industrie des paiements par carte bénéficie d'une base installée de porteurs suffisamment importante pour rendre l'entrée d'un nouvel instrument de paiement plus difficile, et d'autre part, un niveau de qualité et de sécurité similaire ne pourra être atteint sans investissements conséquents. En ce qui concerne le premier avantage concurrentiel, si un groupe de banques ou d'autres entreprises souhaite développer l'usage d'un nouvel instrument de paiement électronique, il doit inciter à la fois les consommateurs et les commerçants à adopter une nouvelle technologie, comme ce fut le cas pour les cartes de paiement. Le développement d'une nouvelle base installée de consommateurs est particulièrement coûteux pour les marchés « bifaces », puisqu'il faut attirer deux types d'utilisateurs distincts pour faire décoller le marché (ce qui soulève une problématique de type « chicken and egg »[54]). La confiance dans un système de paiement dépend de sa durée d'existence, de sa stabilité et du nombre d'utilisateurs qu'il possède. Par ailleurs, en ce qui concerne la sécurité, les mobiles devraient être équipés d'une nouvelle génération de cartes SIM, qui permette de sécuriser les transactions à niveau au moins similaire à celui des cartes de paiement.

---

[53] Near Field Communication.

[54] Comme pour tout marché « biface », le système de paiement doit réussir à coordonner les anticipations de deux groupes d'utilisateurs distincts (cf Caillaud et Jullien (2003)).

L'entrée de nouveaux acteurs concurrents de la carte de paiement pourraient être facilitée sur le segment des paiements par Internet, parce que certains consommateurs hésitent encore à utiliser leur carte pour des raisons de sécurité[55]. Il existe déjà d'autres solutions de paiement pour les micro-paiements sur Internet. Par exemple, les consommateurs peuvent payer certains achats par SMS, en composant un numéro surtaxé[56]. Les consommateurs peuvent aussi choisir d'utiliser le système Internet Plus qui consiste à répercuter les sommes payées par le client sur la facture que lui envoie chaque mois son Fournisseur d'Accès Internet, ou encore le système des cartes prépayées, achetées chez un buraliste, qui préservent l'anonymat. Ces moyens de paiement présentent l'inconvénient de comporter des commissions s'élevant à près de 40% de la transaction pour le site Internet. Le portefeuille électronique PayPal, mis en œuvre par le site de vente aux enchères eBay, ne présente pas cet inconvénient, mais l'utilisation de la carte de paiement est nécessaire pour le recharger.

Si les banques souhaitent préserver les systèmes de paiement par carte, elles devront donc renforcer leur avantage concurrentiel pour faire face à l'apparition de nouveaux instruments de paiement électroniques proposés par des acteurs non bancaires, ce qui nécessitera des choix d'investissements stratégiques. Les banques peuvent aussi choisir de devancer les acteurs non bancaires, en proposant elles-mêmes de nouvelles technologies de paiement. Néanmoins, leur marge de manœuvre sera probablement réduite par un ensemble de contraintes réglementaires, dont la principale est la mise en œuvre d'un espace européen des paiements unique.

b) L'évolution des systèmes de paiement par carte avec le SEPA

L'Union Européenne a entrepris la construction d'un espace de paiements unique européen, « Single European Payments Area » - SEPA. D'ici 2010, lorsque le SEPA sera en vigueur[57], chaque transaction réalisée avec un instrument de paiement européen devra être traitée dans les mêmes conditions dans tous les pays européens. Les banques européennes réfléchissent au déploiement d'une carte de paiement européenne dans le cadre du « SEPA Card Framework »

---

[55] Source : le courrier de la Monétique. Selon une étude réalisée par Visa, 85% des consommateurs l'utilisent pour payer leurs achats en ligne, cependant 11% des internautes ne l'utilisent pas car ils ont des doutes sur la sécurité.
[56] La loi n'autorise pas les SMS surtaxés à plus de 3 euros.
[57] En 2008, toutes les banques doivent accepter les moyens de paiement « SEPA ». Entre 2008 et 2010 aura lieu une phase transitoire, dans laquelle les moyens de paiement nationaux et SEPA seront acceptés.

(SCF[58]), ou à la mise en œuvre de solutions de paiement alternatives. En effet, pour que les consommateurs européens puissent utiliser leurs cartes dans les mêmes conditions partout en Europe, les systèmes de paiement par carte, qualifiés de « Card Schemes » dans le SCF, doivent élaborer des normes communes pour devenir compatibles, et interopérables. Aujourd'hui, par exemple, il est encore fréquent qu'un consommateur porteur d'une carte « CB » se rendant en Belgique ne puisse pas effectuer de retrait avec sa carte dans un distributeur du système Banksys. Des règles seront donc appliquées pour définir les obligations minimales que devront respecter les « Card Schemes », les émetteurs et les acquéreurs. Par exemple, toutes les cartes émises devront être équipées d'une puce et satisfaire à la norme EMV (Europay Visa, MasterCard), en respectant néanmoins les obligations définies par chacun des systèmes. Les commerçants pourront choisir leur acquéreur dans la zone Euro sans aucune restriction.

Le panorama que nous avons dessiné de l'industrie des cartes de paiement en France sera nécessairement modifié par la construction de l'Europe des paiements. En effet, l'organisation des paiements par carte est différente dans chaque pays européen, en fonction de son histoire, et des modes de consommation de ses habitants. Par exemple, la carte de paiement est beaucoup moins utilisée en Allemagne, ou en Espagne, qu'en France ou dans les pays Scandinaves[59]. Et comme cela peut être le cas pour de nombreuses industries de réseau, les habitudes des consommateurs changent plus lentement, à cause de la présence d'effets de cliquet[60] dans les choix d'adoption et d'usage. Ceci soulève la question de l'harmonisation du fonctionnement des systèmes de paiement par carte en Europe. Plusieurs hypothèses sont envisageables. Soit les systèmes internationaux Visa et MasterCard seront utilisés pour les transactions nationales, comme c'est déjà le cas en Grande-Bretagne. Le service de paiement proposé dépendra alors uniquement du jeu de la concurrence entre Visa et MasterCard. La littérature sur l'économie des réseaux montre que la dynamique du marché conduit souvent à des situations dans lesquels un ou deux acteurs finissent par dominer le marché, parce que l'existence de produits techniquement incompatibles est un équilibre instable (phénomène de tipping)[61]. Dans un scénario alternatif, les systèmes existant conserveront leurs infrastructures, tout en élaborant des accords

---

[58] Le SCF a été approuvé par l'EPC en septembre 2005.

[59] Dans une étude menée par la SOFRES pour le groupement CB en 2005, à la question « Quel moyen de paiement privilégiez-vous pour régler vos achats ? », 61% des Français interrogés répondent « la carte bancaire », tandis que 61% des Allemands et 67% des Espagnols répondent « les espèces ».

[60] En économie, on parle d'effet de cliquet lorsqu'il existe des rigidités qui empêchent les agents de revenir à une situation antérieure. Dans le cas des cartes de paiement, les consommateurs très habitués à utiliser leur carte ne sont pas prêts à l'utiliser moins.

[61] Selon Besen et Farrell (1994), dans les industries de réseau, il existe souvent un standard dominant (tipping). On cite souvent à titre d'exemple la domination du standard VHS sur son concurrent Betamax, qui a été éliminé du marché.

d'interconnexion qui rendront leurs systèmes interopérables. Dans ce cas se pose la délicate question de la rémunération des services interbancaires, et du mode de calcul des commissions d'interchange. Certains systèmes de paiement européens ont déjà décidé de relier leurs réseaux dans le cadre du projet « EAPS »[62]. Soit les systèmes nationaux opteront pour un co-marquage avec les systèmes internationaux, comme c'est déjà le cas pour le système « CB ». Cette option risque de présenter l'inconvénient de ne pas être en conformité avec le principe du SEPA, selon lequel les transactions effectuées en Europe doivent être traitées dans les mêmes conditions. Enfin, il existe aussi un dernier scénario, dans lequel certaines banques européennes s'associeraient pour créer un nouveau système de paiement interbancaire à l'échelle européenne. Cette réflexion a été entamée récemment par plusieurs banques européennes, dont la Société Générale, la Deutsche Bank, IGN&ABN AMRO[63].

L'organisation du système « CB » de paiement par carte influencera probablement les orientations stratégiques prises par les banques françaises et européennes, puisque 35% des volumes de transaction par carte de la zone SEPA sont réalisés dans le système « CB »[64]. En outre, le système CB fournit un exemple d'un système de paiement de qualité, sûr et peu coûteux pour les banques. Les banques françaises membres du système « CB » considèreront les coûts de changement (switching costs) liés au choix d'abandonner un système national fiable pour un système international qu'elles ne contrôlent pas, et qui nécessitera des mises à jour techniques plus nombreuses. Shy (2001) montre que les coûts de changement ont deux effets opposés sur la concurrence que se livrent les entreprises. Pour les consommateurs qui sont déjà captifs d'une technologie, les entreprises peuvent se permettre d'augmenter leurs prix, tant que les consommateurs n'ont pas intérêt à changer. Pour les consommateurs non captifs, les entreprises se concurrencent de façon intense, pour proposer de nouveaux services qui rendront les consommateurs captifs dans le futur. Selon cette théorie, l'avenir des systèmes de paiement par carte en Europe dépendra de la concurrence sur les marchés où l'adoption et l'usage de la carte sont faiblement développés.

---

[62] Pour avoir une liste des systèmes participants au projet EAPS, voir : http://www.card-alliance.eu/Documents/November_2007_01.pdf.
[63] Le projet en cours est principalement d'initiative franco-allemande et a pour nom de code « Monnet ».
[64] Source : Banque Centrale Européenne, Blue Book (2005).

5) Conclusion :

L'industrie française des cartes de paiement a longtemps bénéficié d'une avance technologique sur les autres pays européens, notamment grâce à l'utilisation de la puce, et à l'existence d'un système de paiement par carte interbancaire sûr et peu coûteux, le système « CB ». La détention et l'usage de ce moyen de paiement se sont considérablement développés en France, si bien que l'industrie des cartes semble avoir atteint une phase de maturité en termes d'équipement. Les acteurs de l'industrie continuent à créer de la valeur ajoutée pour les consommateurs en proposant de nouveaux services associés au paiement, souvent au moyen de partenariats avec des entreprises d'autres secteurs, si bien que le volume de transactions devrait continuer à augmenter dans les prochaines années.

Cependant, l'évolution des modes de consommation, ainsi que l'amorce d'un processus de convergence sur les usages au niveau européen risquent de modifier considérablement le modèle d'organisation économique et industrielle que nous avons présenté dans cet article. S'il est difficile d'effectuer des projections sur l'avenir de l'industrie, on peut raisonnablement penser que la concurrence entre les banques et les acteurs non bancaires va s'intensifier. Les obligations réglementaires en matière de gestion des risques qui devront être respectées par les différents acteurs, que ce soit dans le cadre du SEPA ou du projet Bâle 2, [65] seront l'une des clés du jeu concurrentiel, parce qu'elles détermineront les niveaux d'investissement à réaliser pour sécuriser les systèmes, et les coûts de migration d'un système à un autre.

[65] L'accord de Bâle 2 constitue un dispositif prudentiel destiné à mieux mesurer les risques bancaires.

<u>Références bibliographiques:</u>

Bounie D., Bourreau M., François A. (2006) : « Les déterminants de la détention et de l'usage de la carte de débit : une analyse empirique sur données individuelles françaises ». Mimeo.

Bounie D., Bourreau M., François A., Verdier M. (2008) : « La détention et l'usage des instruments de paiement en France », Revue d'Economie Financière, vol. 91, Mars, 53-76.

Caillaud B., Julien B. (2003): « Chicken and Egg: Competition among Intermediation Service Providers », the RAND Journal of Economics, vol. 34, n°2, June, 521-552.

Verdier M. (2006): « Retail Payment Systems: What do we learn from Two-Sided Markets? », Communication & Strategies n°61, 37-51.

Payment Card Systems in Europe: Convergence or Disappearance?

Marianne Verdier (*)
Telecom ParisTech

Article publié dans la Revue COMMUNICATION&STRATEGIES, vol.69, mars 2008, p.127-147.

Abstract

This article provides a descriptive overview of the payment card industry in Europe and compares the various forms of organization of payment card systems in European countries. This synthesis helps to understand the paradoxes and the challenges entailed in the creation of the Single Euro Payments Area.
Key words: SEPA, payment cards, payment systems, banks, payment instruments.

1. Introduction

Since January 2002, the Eurozone countries have adopted a common currency. The consumers – be they firms or individuals – can now pay throughout Europe using similar coins and notes. However, the conditions under which the other payment instruments are used in each European country remain disparate. To date, each country has its own legal framework and technical standards. This variance in the organization of payments is to be explained by history: most payment infrastructures have been created by the national banking communities in each of the countries. In the view of the European authorities, the lack of common European payment instruments builds an obstacle to the unification of financial markets, and to the development of monetary exchanges between firms. The creation of common payment instruments for the Eurozone countries is part of this objective. Consequently, the European Central Bank and the European Commission have given the impetus to a project of harmonization of conditions of payment instrument usage, viz. the SEPA project (Single Euro Payments Area).

The aim of this article is to provide an economic description of the industry of payment cards in Europe and to understand how the objectives of the SEPA will make this picture evolve. The

(*) I wish to thank "le Groupement des Cartes Bancaires" CB for its helpful support.

payment cards industry provides a good case study of a networks industry which organization has been understudied. Up to now, no published articles are available which identify the economic business models for card payments in European countries. In the view of the author this analysis is essential so as to be able to assess the economic consequences of SEPA for cardholders, for merchants and for banks. The article also demonstrates that it is still very difficult to predict the evolutions which might be brought about by the SEPA, because the regulatory context remains uncertain. The main actors in the industry pursue different objectives, which may be contradictory.

The rest of the article is organized as follows. Firstly, an overview is provided of the possession and usage of payment cards in Europe, which enables an assessment of the development of payment cards with respect to other payment instruments[1]. An analysis of the organization of the issuing and acquiring activities is then given along with a study of the role of the main players in the industry. A comparative table is used to explain the various forms of organizations of the payment card systems that have been established in each country. Finally, the article describes the main lines of the SEPA project, and provides assumptions about its impact on card payments.

2. Possession and usage of payment cards in Europe

To obtain a picture of the European payment cards industry, a good starting point is the presentation of a few statistics about payment card possession and usage in Europe. The figures reveal significant discrepancies between the various countries. Payment cards are widely used when the possession rates are high, when the number of acceptance points is high, and also, when consumers are not accustomed to using other electronic payment instruments such as direct debits or credit transfers.

▪ Possession

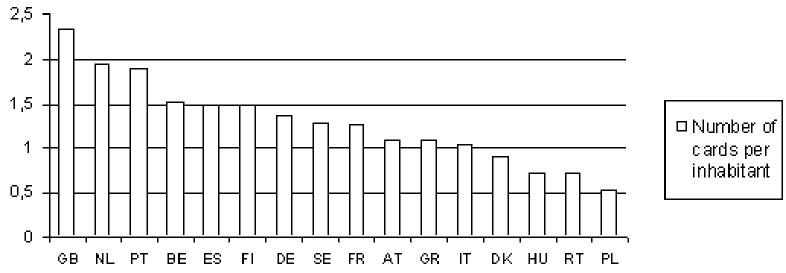
Each European consumer holds on average 1.35 payment cards[2]. Only the recent members of the European Union such as Poland count fewer cards than their number of inhabitants.

[1] Payment card usage depends on the number of acceptance points, since this is a two-sided industry (see Verdier 2006 for a presentation of the relevant literature).

[2] Payment cards do not include cash withdrawal cards.

However the differences in the possession rates do not reflect the differences in usage habits. For instance, in Germany, the number of cards per inhabitant is high, but there is relatively less use of payment cards as opposed to other countries such as Denmark or France.

Figure 1 - Number of cards per inhabitant



Source: BCE Blue Book, 2005

- **Payment card usage**

In Europe, the payment card is the most widely used payment instrument in terms of volume. The usage of payment cards has grown at the expense of the check, which some countries like the Netherlands suppressed altogether when the Euro was introduced[3]. The electronic purse is used for 0.5% of payments in volume. In 2003, each European consumer made on average 46 payments by card, compared with 44 credit transfers, 38 direct debits, and 16 checks. However, these figures hide significant discrepancies between the different countries.

In Luxembourg, Portugal, Denmark, Greece and Sweden, payment cards account for more than a half of the transaction volume[4], while in Germany, in Austria or in the Czech Republic, cards are used to pay less than 15% of the expenses[5]. In these countries, consumers prefer to use credit transfers, which represent less than half of the transaction volume[6].

---

[3] Checks are used in Italy (15.6%), in the UK (18.2%), in Portugal (21%), in Greece (24.2%), in Ireland (25.1%), and in France (31.1%). In other countries, the usage of checks has fallen to less than 4% of the total number of payments.

[4] 2003 share of card payments in terms of transaction volumes: Luxembourg (60%), Portugal (58.4%), Denmark (56.5%), Greece (53.5%), and Sweden (57.7%).

[5] 2003 share of card payments in terms of transaction volumes: Germany (15%), Austria (11.3%), Czech Republic (8.35%).

[6] In 2003 share of credit transfers: Germany (43%), Austria (50.9%), Czech Republic (54.1%).

Table 1 - Relative weight of scriptural payment instruments in the transaction volume

Credit transfers	28.45%
Direct debits	24.86%
Cards	32.10%
Checks	13.30%
E-purse	0.5%
Other	0.8%

Source: (BCE Blue Book, 2003)

However, these statistics on scriptural payments say nothing about cash usage in European countries. The increase in the volume and the value of cash withdrawals (respectively + 5.9% and + 7.1% between 2000 and 2004) suggests that cash usage has not decreased in Europe. In Germany, two thirds of the transactions are still paid with cash[7]. The Germans and the Greeks make the largest amounts of cash withdrawals, both in terms of volume and in terms of value.

Finally, if one looks at the weight of each country in the total transaction volume paid by card in 2005, one can note that half of all card payments are made in France and in the UK, which account for 22.7% and 27.2% respectively of the total number of transactions.

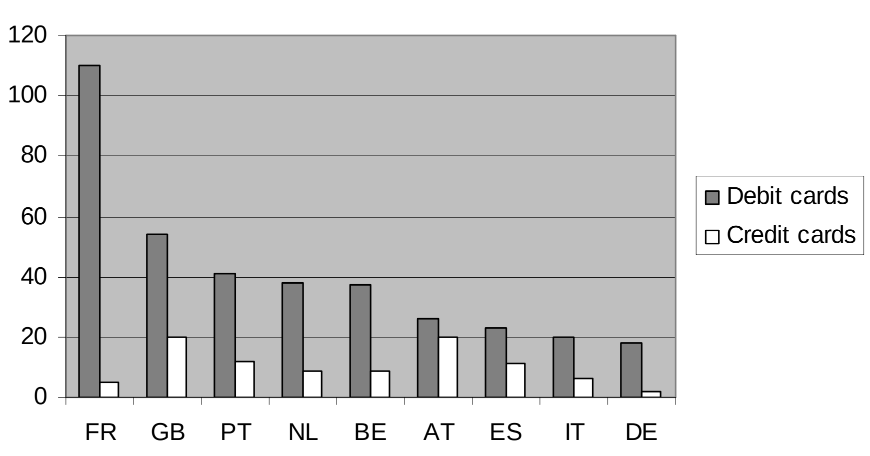
Payment cards are widely used to pay for transactions of medium value. The average amount of a payment card transaction in Europe is 59.3 euros[8]. The smallest amounts (8 Euros in average) are paid cash or by e-purse. The largest amounts are paid rather by direct debit (434.8 Euros), credit transfer (16,357.7 Euros) or by check (1,280 Euros). The average amount of a card payment varies from one country to the other. The discrepancies observed are due to differences in consumer habits and living standards. For instance, the average amount of a card transaction is generally smaller in the countries where the purchasing power is weaker, and for which the average amount of a transaction is smaller, as is the case in Poland (30.6 Euros). However, one can also assume that a greater average value for card payments reveals a preference for cash to pay for small amounts. For instance, in Greece, the average value of a card payment is 109 Euros, while in Finland or in Sweden, this value is respectively 36.1 and 40.9 Euros. Consequently, one also needs to examine the ratio between the total value of card transactions and the Gross Domestic Product. In the United Kingdom, card payments account for 26% of GDP, followed

[7] Source: German Central Bank.
[8] Source: BCE Blue Book, 2005.

by Portugal (18.2%), Denmark (17.2%), Finland, France and Sweden (around 15%), while in Germany and in Austria, this ratio is lower than 7%.

The differences between European countries are also related to the type of payment cards that are held and used. There are mainly three types of payment cards in Europe: debit cards, which account for 50.7% of payment cards, charge cards (16%), and credit cards (33.2%). Many consumers use their credit cards as a deferred debit card and repay their bills at the end of each month. The UK is the largest issuer of credit cards: 45% of credit cards in circulation in Europe are issued by banks that are established in the UK. Payment cards are used to obtain credit mainly in the UK and in Austria.

Figure 2 – Number of card payments per card per year, relative usage of debit cards *versus* credit cards



(*) Including deferred debit cards.

Source: ECB

It should also be noted that European consumers use their payment cards mainly in their country of residence, since cross-border transactions account for less than 3% of the volume of card payments in Europe. It is important to keep this figure in mind to assess the economic consequences of the SEPA.

3. The issuing and the acquiring activities

This section begins by showing that the issuing and the acquiring activities are closely interrelated, since the payment cards industry is a two-sided market. An analysis is then given of the organization of each side of the market.

- **The payment card industry as a two-sided market**

Economic literature has shown that the payment cards industry is a "two-sided" market, wherein payment card systems act as intermediaries between the cardholder on the one side and the merchant on the other side. In such markets, it is impossible to understand how one side is organized without looking at the other side, because of membership and usage externalities. The presence of membership externalities refers to the fact that the number of cardholders increases with the number of merchants equipped with payment terminals, and vice versa. There are also usage externalities because the cardholder can choose to pay with the payment card that generates the highest cost for the merchant, and sometimes, the merchant cannot refuse such a choice. Also, the merchant can choose to refuse payment cards, even if it is the preferred payment instrument for the consumer.

To start a payment card business, banks have to engage either in the issuing activity, or the acquiring activity or both. Because of network externalities, if the bank becomes an issuer, the profitability of its activity will depend on the number of acceptance points for its cards. If it becomes an acquirer, its profitability will depend on the transaction volume, which is decided by the cardholders. Because of this, banks decided to establish partnerships to develop the usage of cards and to benefit from network effects and economies of scale. That is why in most European countries, they started to build payment card associations, which enable consumers to use their payment cards in the same security conditions at all retail outlets. They act as intermediaries between banks, which, in exchange of membership fees, take advantage of common infrastructures and rules for card transactions.

The European authorities use two notions to qualify payment card associations in Europe: "domestic payment schemes", such as the CB system in France[9], or ServiRed in Spain, and "international payment" card schemes such as Visa and MasterCard. But in the author's view, this classification is now ambiguous. Originally, "domestic" payment card systems were created by banking associations to process card transactions in a given country. However, these systems have opened up to all banks, regardless of country of establishment. Banks have also started to sign up merchants abroad, thus illustrating that this notion of "domestic" payment system is now irrelevant. But, as we will see, the notions of "domestic" payment card scheme and "international" payment card scheme are at the heart of the discussions about the SEPA. The "international" schemes, Visa and MasterCard, were created in the United States, and then

[9] For a presentation of the French payment cards industry, see VERDIER (2007). The CB system is not the only payment card system in France.

extended their activities to the rest of the world by managing cross-border transactions, but also "domestic" transactions, as in Austria or in the UK for instance. Though the payment card industry is a two-sided market, each side of the market is described separately in the following sections. This artificial distinction is made to understand better the nature of this business.

- **The issuing of payment cards and the cardholder side**

Payment cards can be issued either by banks or by financial institutions, merchants, or other commercial organisations. In Europe, the majority of payment cards are issued by banks. The card issuer chooses the networks in which the card can be used by the cardholders, and manages the risks associated to cardholding and usage. The cards that can be used by the cardholders in several acceptance networks are said to be co-badged. Today, in Europe, bank-issued payment cards frequently carry the logo of the "domestic" card payment system, and that of Visa or MasterCard, since these networks are mainly used for cross-border transactions. This is due to the fact that some "domestic" payment systems have signed agreements with Visa and MasterCard to extend their acceptance network. Sometimes the card issuer also chooses to sign a business partnership with some merchants in order to offer rewards to loyal consumers. The payment card is then said to be co-branded if it carries the brand of a merchant. A cardholder can hold one or more payment cards, which can be used in different acceptance networks. If a cardholder possesses at least two cards from two different systems, it is said to "multihome". The economic literature has shown that multihoming is an important feature of platform competition which influences the prices on both sides of the market (ROCHET & TIROLE, 2003).

Some card payment systems such as Diners Club, American Express, or JCB issue travel and entertainment charge cards. They are defined as closed-loop or proprietary networks since they decide directly which prices are paid by the cardholder and by the merchant. The issuers of travel and entertainment charge cards generally offer a wide range of services to consumers which have a high purchasing power. In most cases, private label cards are issued by financial institutions or by large retailers. For these institutions, payment cards are often a convenient means to develop their offer of consumer credit. They offer consumers a large variety of ways to reimburse their debt. The normal fall-back method is that the consumer pays through a series of fixed monthly repayments. An example is the Aurore card from the company Cetelem[10]. In France and in Spain especially, large retailers issue cards through subsidiaries which are credit organizations (for example the Banque Accord for the supermarket chain Auchan). On the issuing side, there are

[10] With its 13 million cards, Aurore is the largest private label card scheme in Europe.

also non-bank institutions, called "issuing processors", such as Atos Origin, TSYS, or Experian, which provide issuing banks with technical solutions and services such as account handling functions.

The pricing of card payments differs greatly across Europe. There are mainly four types of cardholder fees: an annual fee per card, a card issuance fee, a fee per transaction, and the current account statement and billing information fee. Some issuers resort to "cash back" practices: i.e. they reimburse to the customers a portion of the cardholder fee according to the number of transactions they make. It appears that the annual cardholder fee is the most common way of charging card services to consumers in Europe.

- **The acquisition of transactions and the merchant side**

Payment card acquiring is the business of establishing contracts with merchants for card acceptance, and dealing with the transactions made at such merchants' payment terminals. When the cardholder presents a card to the merchant to purchase goods or services, the acquirer collects the card number and the transaction amount. If the transaction is "on line", the acquirer forwards this information through the card association network to the issuer, with a request for an authorization (otherwise, the transaction is said to be off-line). The acquirer also deals with fraud and responds to merchants' problems with card processing.

Nowadays, banks can also outsource some of their acquiring functions to third party processors, such as First Data Corporation, or Atos Origin. By processing transactions for many banks, such third party processors enjoy large economies of scale, and today these firms control most of the processing business.

The responsibility of signing up merchants in "open-loop" payment systems remains with the banks, who design contracts that are compatible with the rules of a given card payment system. Acquiring banks install payment terminals, which are bought or leased by the merchants. They also monitor the behaviour of the merchants, especially as regards risk management. Small merchants are frequently in relation with only a single bank, which provides them with various services, card payments aside. This explains the fact that cross-border acquiring remains limited. Acquirers have to respect several sets of rules, which differ from one card scheme to the other. However, these discrepancies are likely to disappear with the standardization projects of SEPA which are described in the following section.

Processors have started to expand geographically. For instance, First Data is established in the United States, the UK, the Netherlands, Italy, Germany, Greece, Slovakia, Latvia, Hungary, Sweden, Norway, and even in Russia. The non-bank companies have gained increased importance in the payments industry. There is a trend towards mergers of companies which process card transactions. Some third party processors have even merged with ACHs (Automated Clearing Houses), for example Interpay and Transakstionsinstitut [11] in 2006, or Link and Voca[12], SSB and SIA[13] in 2007.

Generally, merchants pay a fixed annual fee for the installation and the maintenance of the payment terminal. They also pay a merchant service charge for each transaction either to their bank or to the payment system if it is a proprietary system. According to the Interim Report published by the European Commission in April 2006, the merchant service charges (MSC) paid by the merchants who accept the so-called "domestic" debit cards varied between 0.075% and 1.1975% in 2004. The average MSC is higher for the credit cards than for the debit cards, and higher for the smaller retailers. The number of POS terminals exceeds one million in France, in Spain, and in Italy[14]. Popular destinations for tourists, such as Greece, are particularly well-equipped with acceptance points, in relation to their number of inhabitants. The number of POS terminals increases with the number of cardholders, because of membership externalities. Also, as pointed out by ROCHET & TIROLE (2002), strategic merchants are ready to accept cards even if they are costly, because this increases their market share if the consumers are informed about card acceptance.

4. Payment card schemes in Europe

In the view of the European Central Bank, payment card systems generally consist of five subsystems, which may sometimes be integrated, viz. the card issuing subsystem, the transaction acquiring subsystem, the clearing and settlement subsystem, the card use subsystem, plus acceptance and transaction communication services. The overall card scheme management system is the main pillar that supports the architecture of the five subsystems.

[11] Interpay is a Dutch company and Transaktionsintitut is a German company, a Netzbetreiber. The new entity is active under the name of « Equens », and in 2006 it has dealt with 7 billion transactions, which represents a market share of over 10% of the Euro zone.

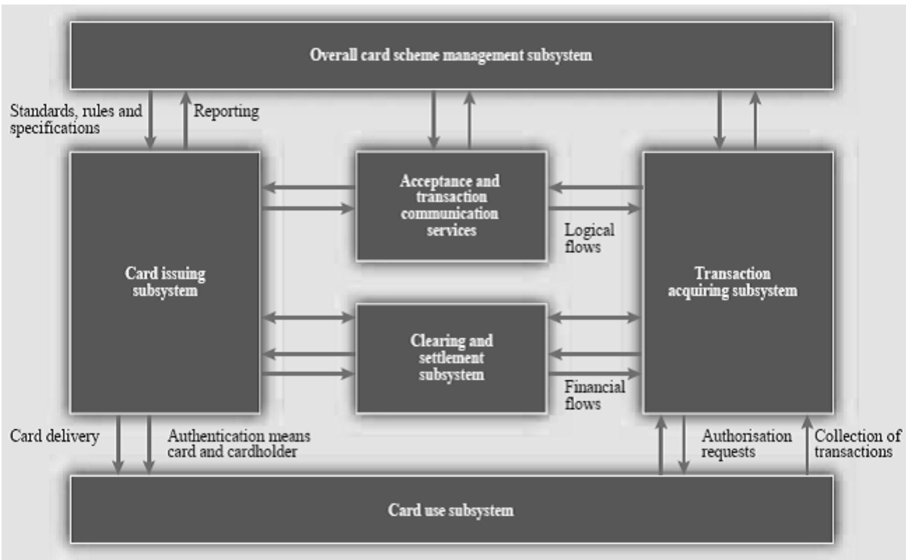
[12] The Vocalink entity provides a pan-European clearing service.

[13] The Italian companies SSB and SIA merged their card processing activities.

[14] Number of payment terminals: Spain (1.109 million), France (1.095 million), Italy (1.045 million).

As was mentioned previously, payment platforms organize the interactions between the two sides of the market: the issuing and the acquiring side. A key characteristic of payment card systems is their legal organization, and their mode of governance. The organization that manages the card payment scheme can be either a non-profit organization, managed by a group of banks, or it may be a for-profit organization and even be listed at the Stock exchange. For instance, MasterCard has been listed at the Stock exchange since May 2006. However, most domestic payment card schemes, for example the CB system in France, are non-profit organizations. In these systems, the members can have various roles and statuses, and different rights and obligations. If the payment system manages the relationship with the acceptors directly, it is said to be a "three-party" system. Otherwise it is known as a "four-party" system. Generally, however, the payment card system does not sign up merchants itself, except in Germany and in Austria. In these two countries, the domestic payment card schemes are "three-party" schemes, which manage the relationship with the acceptors directly. The processing of card transactions is done by network operators known as "Netzbetreiber". The German model is rather special compared with the rest of Europe, because the processing network is determined by the merchant. The card transaction in Germany is much closed to what is called "Lastschrift" (Direct Debit).

Figure 3 - General organization of payment card systems (ECB)



The payment systems also set up different rules for co-operation between banks, for risk management, and for transaction processing. For instance, the chip and PIN was not used in every European country before its introduction as a standard[15]. In some countries, such as the UK, this resulted in higher fraud rates than in the systems which had set up more demanding

[15] EMV standard.

security rules (for example the CB system). Not all systems operate on line, nor do they all request an authorization for each transaction ("on line" versus "off line" or "semi-offline" systems). In most payment systems, commissions called "interchange fees" are paid by the acquirer to the issuer for each transaction to ensure bank cooperation. Default interchange fees are defined multilaterally by the payment system, or bilaterally for each pair of acquiring / issuing banks. Sometimes, as in the CB system in France, the interchange fee is made up of a bilateral component and a multilateral component. The role of the interchange fees depends on the organization of the payment system in which they are applied[16]. In some systems, they are used to optimize the transaction volume by helping to reach a balance between the issuing and the acquisition costs. In other systems, as in the CB system in France, interchange fees are paid by the acquirers to the issuers for the interbank services necessary to ensure co-operation. In the Visa decision (July 2002), the European Commission has admitted that interchange fees are needed to support payment card systems, provided they are established with transparency, and calculated based on objective real costs.

Table 2 - Domestic payment card schemes, various forms of organization

	Payment card schemes and brands
Germany	**Interbanking rules:**ZKA which comprises 4 associations of banks (DSGV Savings Banks, BVR Cooperative Banks, BDB Commercial Banks, and VÖB State Banks) **Brand:** Electronik Cash "EC-Cash" **No interchange fee**. **Main issuing and acquiring processors:** First Data Deutschland, issuing and acquiring processor (formerly GZS bought by First Data Corporation in August 2005) EKS (Euro Kartensysteme): Brand under which MasterCard cards are sold in Germany. ConCardis, B+S Card Services, Citibank: main acquirers for Visa and MasterCard transactions. TeleCash, Easycash: non-bank acquirers. The «Netzbetreiber ». TeleCash is now owned by First Data.
Austria	**Interbanking rules:** 2 schemes **Europay Austria:** This company is owned by all the Austrian banks (7,6 million cards), issues cards for many banks, and acquires most debit card payment transactions. Also in charge of the ATM network. **Visa Austria:** Issuer and acquirer for transactions paid by credit cards « Visa Classic » and by debit card Electron. The transaction processing is subcontracted to the processor APSS, a company which was owned by the Austrian banks, and then was bought by First Data in August 2005. This company has become First Data Austria.

16 For a presentation of the theoretical literature on interchange fees, see VERDIER (2007).

Belgium	**Interbanking rules:** 2 payment card schemes and one brand. **Banksys:** Payment card scheme for debit cards. Acquirer for transactions Bancontact/MisterCash. Processor for all card transactions, connection with the clearing and settlement chamber. Manufacturer of payment terminals. **BankCard Company:** National payment card scheme for debit card payments. Acquirer for the Visa and MasterCard transactions. Issuer for the Corporate and Business cards. **Brand:** BCC Banksys and BCC have been bought by **Atos Origin**. Banksys has become Atos Belgium Luxembourg.
Spain	**Interbanking rules and Clearing:** 3 payment card schemes which provide clearing and settlement services under three different brands. **ServiRed (1985):** 33 million cards, 100 commercial and savings banks. Brand of the Visa Electron card. Processor of ServiRed: Sermepa **Sistema 4B (1974):** 16 million cards, 30 members, mainly commercial banks. Starting from the ATM network Telebanco 4B, in 1982, it extended its activity to the management of the acceptance points Telepago 4B. Euro 6000 (2001): 13 million cards, 35 members, mainly savings banks. Processor of Euro 6000: CECA.
France	**Interbanking rules:** Groupement des Cartes Bancaires, CB. Non-for-profit organization which defines the interbanking rules for card payments. Owns the "e-rsb" authorization network. **Interbank Clearing Network: in principle SIT/CORE**. **Brand:** CB (managed by Carte Bleue).
Italy	**Interbanking associations:** 2 payment card schemes and 2 different brands. **Associazione Bancaria Italiana (ABI):** Non- profit payment card association which owns the national debit card brand PagoBancomat and the ATM network brand Bancomat. This association provides issuing and acquiring licenses to its subsidiary CO.GE.BAN, which itself offers licenses to banks. Owns the switching and authorization network RNI. **Brand:** PagoBancomat. **CartaSi:** Company which owns 200 shareholders, leader for the issuing of credit cards and deferred debit cards. Issuing processor for all credit cards. Acquirer for some transactions for small banks. Issuing and acquisition processor: SSB (Societa per i Servizi Bancari).This company is in charge of the processing activities for CartaSi, and for the acquisition of the merchants who accept American Express and JCB cards. SSB merged with the company SIA.
Netherlands	**Interbanking association:** Currence, Company created in 2005. Shareholders: banks. Defines the common rules and the interchange fee. **Issuing and acquiring processor:** Interpay which owns a subsidiary for credit and deferred debit PaySquare (subsidiary for the acquisition of transactions made by small banks).
Portugal	**Interbanking association, clearing, issuing and acquisition processor:** SIBS (Sociedade Interbancaria de Serviços). Non- profit organization of which shareholders are the issuing banks. SIBS owns the ATM network, the debit card acceptance point "Multibanco", and the electronic purse. It also proceeds to the clearing and settlement of payment card transactions, checks and direct debits. Unicre is the equivalent of SIBS for the transactions made by Visa or MasterCard.

United Kingdom	**4 interbanking associations and one brand (Solo)** **S2 Card Services Ltd**. (S2CS) Debit card scheme which replaced Switch, which is in charge of the brands Maestro UK and Solo (30 million cards). The company became Maestro UK. **Visa UK and MMF** (MasterCard UK Members Forum) Discussion forums for the main issuers, to which the membership is not compulsory. **LINK:** Non- profit organization which manages the ATM network. **APACS** (Association For Payment Clearing Services): represents the main banks on the questions pertaining to competition, responsible for 3 clearing chambers, and settlement issues. The APACS is organized by subgroups of common interest. One of these subgroups, the Card Payments Group defines a common policy on strategic issues (fraud prevention, etc.).

Source: Groupement des Cartes Bancaires CB and other payment card systems

- **The role of Visa and MasterCard**

The "international" payment card schemes, Visa and MasterCard, are mainly used in Europe for all cross-border transactions (except for the transactions routed by three-party systems such as American Express and Diners). These systems have developed their own authorization network, and also process the settlement of the transactions themselves, and define the level of interchange fees paid in their respective systems.

Visa Europe is a not-profit organization, which counts over 4,500 members. It operates under a license which is a property of the company Visa Inc[17]. Visa Europe develops more and more specific products to meet the needs of the consumers from this geographical zone. In June 2006, Visa Europe launched its own debit card scheme, which it claimed to be compliant with the SEPA cards framework, the V-Pay system. Visa markets mainly three brands: Visa, Visa Electron (Debit card) and Plus (withdrawal card). The Visa cards are widely held in France, in the UK, and in Spain: 63% of its cards in Europe are held by consumers from these three countries.

MasterCard international also does business in all European countries. It was listed on the Stock exchange in May 2006. The most widespread products are the Maestro debit card, and the Cirrus withdrawal card. Around 63% of MasterCard cards are held by cardholders who live in the UK, France, Spain, and Turkey. The highest numbers of Maestro cards are in Germany, in the UK, in Italy and in the Netherlands. The market share of MasterCard in terms of the number of cards that carry the MasterCard or Maestro brand is higher than Visa cards in all European countries, except in France, Portugal, and Spain.

[17] Visa Europe holds less than 25% of Visa Inc., and is committed to sell 50% of its shares when it is listed on the Stock exchange.

5. The creation of a Single Euro Payments Area

▪ Presentation of the SEPA project

It is quite a difficult exercise to define the SEPA project, because, as we will see, the main players do not define the project in the same way. Originally, the European Central Bank and the European Commission gave the initial impetus to the creation of a single Euro payments area. The project was not however launched by the European Authorities, but by banks and other players which built a working group in 2002, the European Payments Council (EPC) to reflect on the definition of payment instruments and about strategic orientation concerning the standardization of the payment systems. This initiative has progressed, at times with some uncertainty, in parallel with the regulatory frameworks defined by the European Commission and the ECB. In order to provide a harmonized legal environment, the European Commission has established a Payment Services Directive (PSD), which was voted by the European Parliament in April 2007.

All players will agree that the aim of the SEPA is to enable each European consumer to pay in Euros, and with the same payment instruments, under the same conditions all over Europe[18]. To achieve this result, the intention of the project is to create pan-European payment schemes for three scriptural payment instruments: the SEPA credit transfer, the SEPA direct debit, and the card.

The European Authorities follow several roads to achieve the objective of a single European market, some of which may contradict each other. On the one hand, they wish to reinforce the monetary "coherence" of the Euro zone countries by harmonizing the conditions under which the different payment instruments are used. On the other hand, European regulatory authorities intend to provide banks with incentives to choose their prices transparently, and to gain in efficiency. The cost reductions for banks should trigger a decrease in the prices paid by consumers for electronic payment instruments. Another study conducted by the European Payments Council (EPC) in March 2003 shows that the cost of cash in Europe amounts to 50 billion Euros per year, of which 65% is paid by the banks. The real cost of cash is not paid by its

---

18 SEPA initially covers transactions in euros, but will eventually involve all European Union Member States, plus Iceland, Norway, Liechtenstein and Switzerland.

users, which forces banks to use cross-subsidies between the payment instruments that are responsible for inefficiencies[19].

The view of the European Commission is that the best way to unify the market is to promote competition. But, in the opinion of the author, this position must be clarified in the difficult context of a two-sided payment card industry, which exhibits network externalities, and large economies of scale. The first logical step, to achieve the SEPA, is to consider the links between the payment systems. In order to be able to deal with payment orders coming from all over Europe, the various payment infrastructures will have to become interoperable. Interoperability stems from the adoption of common standards, links between the networks, and participation criteria which do not rely on geographical implantation.

- **The SEPA cards framework**

In September 2005, the work conducted by the EPC resulted in the publication of a common interoperability framework for payment card systems, the SEPA Cards Framework (SCF). This project defines the main principles and technical conditions to enable cardholders to use their cards in each payment card system. The interoperability between payment card schemes depends on the definition of common technical standards[20].

According to the SCF, membership of payment card systems must be based on principles of transparency and non-discrimination. Banks should be free to become members of any card scheme that is SEPA compliant with a single license that will cover the Euro countries. Furthermore, in the view of the European Commission, tariffs for payment card services should be harmonized so as to become independent of the geographical zone where they are used. The current systems will have to start unbundling their offer of services, so that banks will have a choice between several channels for routing and processing their transactions. The vertical integration of payment schemes will have to be replaced by other structures, so as to increase competition and economies of scale. The domestic payment card schemes have already started to adjust to these new requirements for instance, by separating the marketing divisions from the schemes, or by recruiting staff from non-bank organizations. For instance, in the Netherlands,

[19] For an excellent survey of the debates about cost-based pricing of payment instruments, see Van HOVE (2004).

[20] For instance, the cards will have to be equipped with the EMV technology, a standard defined for chip cards by EMVCo, an entity created by Europay, Visa and MasterCard.

Interpay split to form Currence, to take charge of the governance and supervision of the payment instruments in the Netherlands, while Interpay[21] itself remained in charge of the card processing.

The EPC identified three options with regard to the evolution of payment systems to meet the SEPA requirements. In the first option, domestic payment card schemes are replaced by the international systems Visa and MasterCard, which would, presumably, have become SEPA compliant. In the second option, some national payment card schemes would extend their activities to other European countries, or establish partnerships with other systems. In the third option, several types of payment systems would coexist by cobranding and interoperability agreements.

- **The economic consequences of the SCF**

There are various economic paradoxes associated with the creation of the SEPA Cards Framework. The first one is related to the costs of a project that is created for a small amount of transactions. To date, cross border card payments account for 3% of the transaction volume in Europe. There is still uncertainty upon the fact that the SEPA will make the demand for cross-border payments rise. So the European Authorities run the risk of creating an upheaval of the current organization of payment card schemes, which work quite well, for 3% of the transactions. Only the reactions of the market players will say if it was worth it. The second paradox stems from the fact that economy is used by the European authorities to justify political purposes. And also, as mentioned before, the positions of the European Commission and the European Central Bank are not perfectly aligned.

The ECB favours the development of one or more European payment card schemes. Several reasons account for this viewpoint. The absence of a "European" payment card scheme could be detrimental to the interests of the European Union. The countries that have significant economic power have all created their own payment card scheme, for example Visa and MasterCard in the US, JCB in Japan or even CUP in China. The strategic control of payment systems is a major political issue. Payment systems collect and manage a large amount of data on consumer behaviour which could be used by other countries for purposes other than those for which they are intended. What is more, the monitoring of payment systems is an important aspect of the management of systemic risks born by the financial institutions. In the absence of one or more

[21] In 2006, Interpay became EQUENS.

European payment system, European banks are in danger of losing influence in the management of risk in card payments.

Meanwhile, the initial aim of the European Commission is to increase competition between payment systems, and to generate a reduction of costs of electronic payment instruments. At the end of the project, if the prices of card payments are only determined as a result of competition between Visa and MasterCard, the European authorities risk having an outcome that goes against their initial objective. In actual fact, the domestic payment systems have worked very well until now, with relatively low interchange fees and low costs in comparison to the Visa and MasterCard offers.

The regulatory authorities face three options to tackle these strategic issues. Either they can let the market react to the Payment Services Directive and the SEPA projects. Or they can provide banks with incentives to create a pan-European card scheme, for instance by allowing higher interchange fees to increase the number of card issuers. Finally, they could decide to force banks to create such a pan-European card scheme. If the outcome of SEPA is market-driven, the competition between payment systems could end up in the domination of Visa and MasterCard. Such an international duopoly is ideally positioned to take advantage of SEPA. Both companies have created a (supposedly) SCF-compliant debit card scheme, V-Pay for Visa and Maestro for MasterCard. They also have an extensive installed base of consumers, a solid reputation, and a sound network infrastructure. For instance, in the United Kingdom, since July 2002, the domestic debit card brand "Switch" migrated to Maestro. However, the pressure exerted by the users might well influence banks' decisions. An illustration of this is when the Belgian banks had decided to migrate to Maestro for debit cards by the end of 2007. This decision has been suspended because of high merchant resistance. European banks are also aware of the necessity to have their own card payment infrastructure so as not to be captive of Visa and MasterCard pricing strategies. Consequently, some European schemes have already started to join forces to create a pan European payment card scheme. Six payment systems (PagoBancomat, Multibanco, Link, Euro6000, Electronic Cash, Eufiserv) have launched the brand Euro Alliance of Payment Systems.

If the SEPA objectives are reached, then competition between banks in the issuing and acquisition businesses should increase. Since payments account for a third of banks' retail revenues[22], then banks will have to design strategies so as to maintain the same level of profits in this context. In the view of the author, it is important to keep in mind that banks' profits are also

[22] Source: AGEFI Hebdo, March 2007.

reinvested to promote financial innovations, or quality improvements. So a zero profit situation is not desirable from the point of view of social welfare maximisation. Why will competition increase? On the acquisition side, technical standardization should encourage the development of cross-border activities, since acquiring banks will be able to sign up merchants abroad more easily. On the issuing side, the new legal framework defined by the PSD should trigger the entry of non-bank organizations into the payments industry. For instance, mobile network operators could start issuing cards using the Payment Institution status of the directive.

To improve or maintain their competitiveness, banks have two options. The first idea is to establish partnerships or integrate horizontally. The search for critical mass should enable them to offer price reductions, new services, and to capitalize on the investments needed to set up common technical standards. For instance, BNP Paribas and Natixis Banque Populaire started to build a common platform to deal with retail payments, which is managed by a common subsidiary "Partecis". There is also a second strategic option. Banks could start outsourcing their payments activities to third-party processors. The processors have recorded a dramatic increase in their turnover, which results in cross-border vertical and horizontal mergers. For instance, the company Atos Worldline bought the activities of Banksys and BCC (vertical merger). The processor First Data Corporation also bought several companies to extend its activity geographically.

The amount and the structure of the revenues obtained by banks for retail payments should change. Banks will have to make a trade-off between the search for economies of scale on card payments and the development of new services, such as payments using mobile phones. The amount of investment needed to become SEPA-compliant should vary between 60 and 80 million Euros over a period lasting between 3 and 5 years[23]. According to a report conducted by the European Central Bank, under the assumption of an ideal scenario for the SEPA[24], banks' revenues should decrease by 7.6% and the costs should diminish by 1.3%. If the European Commission demands more transparency on payment transaction prices for consumers and merchants, banks will stop practising cross-subsidies between payment instruments. This should result in a fall in the use of the most-costly payment instruments. According to the ECB report, SEPA will generate economies only if the volume of electronic transactions increases, at the expense of cash and checks.

---

[23] Source: AGEFI Hebdo.

[24] Source: ECB Occasional Paper no. 71, August 2007.

6. Conclusion

The organization of payment card systems in Europe should evolve dramatically with the implementation of SEPA. The strategies applied by the players will depend essentially on the decisions of the regulatory bodies and the interaction between the systems, the banks, the non-bank organizations, the merchants and the users.

It is difficult to forecast the competitive equilibrium that results from platform competition in two-sided markets, because the reaction of one side depends on its anticipation of the behaviour of the other side. Cardholders will be able to use the least costly payment instrument for each transaction, because of increased transparency. They may also choose to adopt new payment instruments if significant innovations appear on the market. On the other hand, merchants have some bargaining power against banks, since they can choose to develop their own payment services, using some of the infrastructure developed by payment service providers. For instance, large retailers could try to create payment platforms which could be used by all their European subsidiaries. The outcome of competition will depend on the interaction between the infrastructure owners and potential new entrants to schemes or users of the infrastructure to enable them to offer new services. This trade-off between competition on upstream and downstream markets is a classical issue in network economics.

References

EUROPEAN CENTRAL BANK:

- (2007): "The Economic Impact of the Single Euro Payments Area", ECB Occasional Paper no. 71, August.

- (2007): *Report on Financial Integration in Europe*, March.

ROCHET J.-C. & TIROLE J.:

- (2002): "Cooperation among Competitors: The Economics of Payment Card Associations", *RAND Journal of Economics*, vol.2, no. 2, June, pp. 97-124.

- (2003): "Platform Competition in Two-Sided Markets", *the European Economic Association*, vol. 1, no. 4, winter, pp. 990-1209.

VAN HOVE L. (2004): "Cost-Based Pricing of Payment Instruments: the State of the Debate", *De Economist*, 152, no. 1.

VERDIER M.:

- (2006): "Retail Payment Systems: what can we learn from Two-Sided Markets?", *COMMUNICATIONS & STRATEGIES*, no. 61, 1st quarter, pp.37-59.

- (2007): "Interchange fees in Payment Card Systems: a Review of the Literature", Working Paper in Economics and Social Sciences, ENST, ESS-07-03.

- (2007): "*L'économie française des cartes de paiement*", Working Paper in Economics and Social Sciences, ENST, ESS-07-12.

III. CHAPITRE II : REVUE DE LA LITTERATURE SUR LES INTERCHANGES DANS LES SYSTEMES DE PAIEMENT PAR CARTE.

Dans ce chapitre, nous proposons une revue de la littérature sur les interchanges dans les systèmes de paiement par carte. Nous construisons un modèle général qui permet d'exposer les principaux résultats théoriques sur les interchanges. Les interchanges sont utilisés par les systèmes de paiement par carte pour allouer le coût total d'une transaction de paiement entre la banque du porteur (l'émetteur) et la banque du commerçant (l'acquéreur). Nous commençons par présenter l'explication de Baxter (1983) sur le mécanisme des interchanges, qui constitue le point de départ de la littérature. Sous l'hypothèse d'une concurrence pure et parfaite sur les marchés de détail bancaires, Baxter montre que les interchanges permettent de corriger les externalités d'usage que les consommateurs exercent sur les commerçants, lorsqu'ils renoncent à utiliser leur carte de paiement pour des transactions socialement efficaces. Ensuite, nous utilisons notre cadre général pour présenter les résultats de la littérature récente sur les interchanges, dans le cas où les commerçants ne sont pas autorisés à discriminer par les prix selon l'instrument de paiement utilisé par le consommateur. Nous comparons les interchanges choisis par une plate-forme de paiement qui maximise le profit joint des banques aux interchanges qui maximisent le surplus social. Puis, nous étudions l'influence des surcharges pratiquées par les commerçants sur le choix de l'interchange optimal. Enfin, nous présentons les résultats de la littérature sur la concurrence entre plates-formes de paiement.

Interchange Fees in Payment Card Systems: a Survey of the Literature

MARIANNE VERDIER*

Department of Economics and Social Sciences, Telecom ParisTech.

Abstract

In this paper, I build a general model to present the results of the literature about interchange fees in payment card systems. Interchange fees are used by payment systems to allocate the total cost of a payment card transaction between the cardholders' bank (the issuer) and the merchant's bank (the acquirer). Using this framework, I start by introducing Baxter (1983)'s justification of interchange fees, which constitutes the starting point of the literature. Under the basic assumption of perfect competition between banks, Baxter shows that the role of interchange fees in payment card systems is to correct usage externalities that consumers and merchants exert on each other. Then, I use my model to present the recent literature on the choice of the optimal interchange fee if merchants cannot price discriminate between the consumers who use different payment instruments. Using these results, and following the literature, I determine if profit maximising payment platforms choose excessive interchange fees, under specific assumptions about the nature of competition between banks and between merchants. Afterwards, I analyse how price discrimination affects the choice of optimal interchange fees. Finally, I present the literature that studies the impact of competition between payment platforms on interchange fees.

Key Words: Payment Card Systems, Two-sided markets, interchange fees, banks.

JEL Codes: L31, G21, L42.

* ENST, Paris, Department of Economics and Social Sciences, 46 rue Barrault, 75 013 Paris, France.
Mail: Marianne.verdier@gmail.com. Phone Number: (+33)6 11 75 40 03.

1 Introduction

In many countries, payment card networks have proved very popular over the past twenty years. For instance, in Europe, a total of 23 billion card payments are made annually with an overall value of 1350 billion Euros.[1] The success of payment cards is related to the presence of efficient payment card networks, which define rules and standards to ensure acceptance of cards, and security of transactions. There are two kinds of payment card networks: closed-loop systems or proprietary systems, like Amex or Diners, and open-loop systems, like MasterCard and Visa. Closed-loop payment systems choose directly the prices that are paid by the consumers and the merchants for each transaction. Open-loop payment card systems involve five categories of participants: the consumer, the merchant, the acquirer (the merchant's bank), the issuer (the cardholder's bank), and the payment system. The specificity of open-loop systems is that banks act as intermediaries between the payment platform and its end-users. Open-loop payment systems do not control the prices paid by end-users, but can choose a subsidy, called "interchange fee", which is paid by the acquirer to the issuer for each card payment. The interchange fee enables the payment platform to allocate the total cost of a payment card transaction between the issuers and the acquirers.

According to a study conducted by Morgan Stanley[2], annual revenues from interchange fees amount to $24 billion in the US credit card market for card-issuing banks. The economic importance of payment card systems has spurred a lot of research over the last five years about interchange fees, following the burgeoning literature about two-sided markets (see among others Rochet and Tirole (2002), Schmalensee (2002), Rochet and Tirole (2003), Wright (2004)). According to the two-sided market theory, payment card markets function imperfectly, because consumers and merchants exert usage externalities on each other. Under this assumption, the intervention of a payment system may be needed to influence the way consumers and merchants interact. As we will see, payment systems use interchange fees to modify the structure of the prices paid by the end-users, and increase the transaction volume. However, there are also two other approaches about interchange fees. Another theory claims that interchange fees can be assimilated to a form of illegal collective price fixing (see among

[1] Source: Interim report on Payment Cards, European Commission, April 2006.

[2] Morgan Stanley, Equity Research, Diversified Financials, 15 April 2004. For an excellent comparison of interchange fees in various countries, see Weiner and Wright (2005), Hayashi and Weiner (2005).

others Balto (2000), or Carlton and Frankel (1995)). According to this theory, the payment card industry does not exhibit any form of market failure. So, interchange fees should be suppressed, as an illegal method to soften the competition that takes place on banking retail markets. Finally, a third theory assumes that interchange fees should reflect the costs of the services provided by the issuer to the acquirer. Unlike the two-sided markets theory, this cost-based approach does not take into account the potential usage externalities that consumers and merchants may exert on one another.

In this paper, I propose a review of the theoretical literature that is based on the two-sided market theory, which assumes that payment card markets function imperfectly, because of the presence of usage externalities between consumers and merchants.[3] This literature has already been reviewed in the excellent surveys by Rochet (2003) and Schmanlensee (2003) (See also Chakravorti (2003) and Hunt (2003) for other overviews on the economics of payment cards). The contribution of my paper is to build a general framework, which enables me to derive all the results of the existing literature about interchange fees. Furthermore, my paper takes into account more recent papers, like Wright (2004), Rochet and Tirole (2006b, 2006c), Schwartz and Vincent (2006), or Guthrie and Wright (2007).

The rest of the paper is organized as follows. In Section 2, I start by building a general model of a payment card system. I lay the emphasis on the assumptions needed to model the behaviour of all the participants to a card transaction: the consumer, the merchant, the issuer, the acquirer, and the payment system itself. Then, in Section 3, I present the benchmark model conceived by Baxter (1983). Baxter's model explains why interchange fees may help correct the externalities observed in a payment system, and reach the socially optimal number of transactions. In Section 4, I use the general model built in Section 2 to analyse how a payment platform selects the optimal interchange fee if merchants cannot price discriminate between card-users and cash-users. I compare the volume maximising, the profit maximising and the welfare maximising interchange fees. I try to identify the variables that drive the differences between the interchange fee chosen by a profit maximising payment platform and by a social planner. I show that the nature of competition between banks and the market power of merchants are decisive elements to consider in the answer to this question. In Section 5, I study one of the rules that a payment system can impose on its members, which is the possibility to surcharge payments made by cards. I try to determine if this rule is desirable from the perspective of social welfare, and I assess its impact on interchange fees. Finally, in the last section, I present the literature that studies the impact of competition between payment platforms on interchange fees.

2 A general model of a payment card system

In this section, I introduce a general model of a payment card system that is consistent with the literature. An open-loop payment card system organises the interactions between four parties: on the consumer side, cardholders and issuing banks; on the merchant side, merchants and acquirers. In the literature on payment card systems, the issuers and the acquirers are assumed to be distinct firms.

Each time a transaction is processed, the payment system acts as intermediary between the issuers, the acquirers, the cardholders and the merchants. On the consumer side, a cardholder has to pay a fee to its issuing bank to use his payment card, while the merchants pay a fee to the acquirer each time a consumer pays by card. The issuing and the acquiring activities may involve distinct marginal costs, though the transaction is a single product, which is consumed jointly by the cardholder and the merchant.

The payment system selects an "interchange fee", which is paid by the acquirer to the issuer for each transaction. The interchange fee allocates the total cost of a card transaction between the issuer and the acquirer.

Consumers:

Consumers may purchase a good of value $v \geq 0$ from the merchants.

To pay for their expenses, they may always use cash, which is assumed to be hold at no cost. But they may also decide to hold a payment card at a cost F. In the general framework of this paper, I will assume that F is equal to zero, such that all consumers are

[3] The empirical existence of externalities in payment card markets has been successfully tested by Rysman (2006).

cardholders.[4] Each consumer attaches some benefit $b_B > 0$ to the value of using a payment card rather than paying cash ("B" standing for buyer).[5] When a consumer uses his card, he pays a fee, which I denote by f, to the issuer. If the issuer is not allowed to grant consumers with rebates, the card fee is assumed to be positive.

Once a consumer holds a card, he has to make several simultaneous decisions. For instance, he must choose which merchant to purchase from. All merchants sell the same good, but they may not offer the same payment services. The information that a merchant accepts cards may influence the consumer's choice of a store. In the general framework of this paper, I will assume that consumers are perfectly informed about card acceptance.

The consumer weights the benefits and the costs of using each payment instrument if the merchant accepts cards. I denote by p_{cash} the price of the good if the consumer pays cash, and by p_{card} the price of the good if he pays by card. If "surcharges" are authorised by the payment system,[6] the merchant can charge the consumer with a higher price if he pays by card. Otherwise, if the "No Surcharge Rule" holds (hereafter NSR), then $p_{card} \leq p_{cash}$. But this does not necessarily mean that the prices chosen for payments made cash or with cards are the same. However, if the "Non Discrimination Rule" holds (hereafter NDR), the merchant is forbidden to use price discrimination according to the choice of the payment instrument, so $p_{card} = p_{cash} = p$.

If the consumer buys the good and pays cash, his utility is:

$$v - p_{cash}, \quad (1)$$

whereas if he pays by card, his utility is:

$$v - p_{card} + b_B - f. \quad (2)$$

The consumer prefers to use his payment card if

$$b_B \geq b_B^m, \quad (3)$$

where b_B^m represents the marginal cardholder and $b_B^m = f + p_{card} - p_{cash}$.

[4] In most papers, the cardholding fee F is equal to zero. Notable exceptions are Wright (2003) and Guthrie and Wright (2003). In Wright (2003), the cardholding fee is positive and exogenous. In Guthrie and Wright (2003), consumers differ across their cardholding fee.

[5] In reality, the utility and the costs of cash holding and cash usage are not zero. The key assumption here is that these costs are lower than the utility of card usage and the cost of card holding. Therefore, the costs and the benefits of card holding and card usage can be interpreted as net of cash costs and benefits.

[6] See section 5 of Rochet and Tirole (2002), Gans and King (2003), or Wright (2003).

Notice that, if the NDR holds, the consumer uses his card if his benefit is higher than the transaction fee, that is, $b_B \geq f$.

Cardholders may attach different values to the benefits of card usage. In this case, the benefit b_B is distributed according to a probability density, h_B , over an interval $[\underline{b}_B ; \overline{b}_B]$. Its cumulative is denoted by H_B. I define the quasi-demand of consumers by the percentage of consumers wishing to use their payment card for given cardholder fee and retail prices and I denote it by $D_B(b_B^m) = 1 - H_B(b_B^m)$. This modelling choice implies that the maximum size of the payment card market is fixed. If cardholders are homogeneous as regards to their card usage benefit, then we have that $\underline{b}_B = \overline{b}_B = b_B$.

Merchants:

Merchants sell a good, which costs $d \geq 0$ to be produced, and I assume that $v > d$. A merchant has to make two decisions. He must choose which payment instruments to accept in his store, and he must also choose the price of the good. A merchant is legally obliged to accept cash, but he is free to accept or refuse payment cards.

If he decides to accept cards, he must pay a fixed fee *M* to the acquirer, in order to be affiliated to the payment card system. The parameter *M* also reflects the costs of the equipment that the merchant must buy to accept cards. If the system applies the "Honour All Cards Rule" (hereafter HACR), once merchants are affiliated to the platform, they are obliged to accept all the cards issued by its members. In this paper, I will assume that $M = 0$, and that the payment system applies the HACR.

Each time a consumer pays by card, the merchant obtains some benefit $b_S > 0$ ("S" standing for seller) of being paid by card rather than cash,[7] but he has to pay a fee to the acquirer, which is denoted by *m*.

---

[7] For instance, it is costly for the merchant to sort the coins, the bank notes, and carry them to his bank. There are also some costs associated to the risks of accepting fake bank notes and coins.

To determine if it is optimal to accept cards, the merchant must compare its profit in two situations. In the first scenario, the merchant does not accept cards, and the good can only be bought by cash. In the second scenario, the merchant accept cards, and his good can be bought by cash or by card.

If the payment is made by card, the merchant's profit is

$$p_{card} + b_S - m - d \text{ , (4)}$$

whereas if consumers pay cash, the merchant's profit is

$$p_{cash} - d \text{ . (5)}$$

In each scenario, the merchant chooses the retail prices for the good, p_{cash} and p_{card}, such that his profit is maximised.[8] If he obtains a higher profit when he sells the good both to cash-users and card-users, he chooses to accept cards.

Merchants may differ across their card acceptance benefit, which I denote by b_S. In that case,[9] b_S is assumed to be distributed according to a probability density, h_S, over an interval $\left[\underline{b}_S;\bar{b}_S\right]$. Its cumulative is denoted by H_S. As I did for consumers, I define the merchants' quasi demand, $D_S(b_S^m) = 1 - H_S(b_S^m)$, where b_S^m denotes the card acceptance benefit of the marginal merchant. The merchants' quasi demand represents the percentage of merchants who accept cards for given merchant commission and retail prices. If merchants are homogeneous as regards to their benefits of accepting cards, then, I assume that $\underline{b_S} = \overline{b_S} = b_S$.

The nature of competition between merchants influences the retail prices chosen by merchants at equilibrium (p_{cash} and p_{card}), and the level of b_S^m, the card acceptance benefit of the marginal merchant. If consumers are informed about card acceptance, we will see in Section 4.3 that strategic merchants are likely to choose a lower price for card payments to attract cardholders. In absence of strategic interactions between homogeneous merchants, cards are accepted everywhere if the margin obtained with card payments is higher than the margin obtained with cash payments. This condition is satisfied if and only if:

[8] If the NDR holds, the prices must verify $p_{card} = p_{cash} = p$. If the NSR holds, the prices must verify $p_{card} \leq p_{cash}$. If surcharges are allowed, it is assumed in the literature that the choice of two different retail prices for the same good is not costly for the merchant.

$$b_S \geq b_S^m \text{ (6)},$$

where $b_S^m = p_{cash} - p_{card} + m$. If the NDR holds, the prices must verify $p_{card} = p_{cash} = p$, and a merchant accepts cards if $b_S \geq m$. If the NSR holds, the prices must verify $p_{card} \leq p_{cash}$. If surcharges are allowed, it is assumed in the literature that the choice of two different retail prices for the same good is not costly for the merchant.

Banks:

The payment system organises the interactions between at least one issuer (I) and one acquirer (A). If there are several issuers or several acquirers, banks compete to offer payment card services to consumers and merchants. In the literature, it is assumed that issuers on the one hand, and acquirers on the other hand, are symmetric.

Banks choose the transaction fees, *f* and *m*, such that their profits, denoted by π_j for *j=I;A,* are maximised. The fees paid by consumers and merchants, respectively, depend on banks' marginal costs (c_j for *j=A;I*). The total marginal cost of a transaction is denoted by $c = c_I + c_A$. For each transaction, the acquirer pays to the issuer the interchange fee, *a*. If the interchange fee is positive, it reduces the issuer's marginal cost, which becomes $c_I - a$, and increases the acquirer's marginal cost, which becomes $a + c_A$. The transaction fees, *f* and *m*, are assumed to be increasing with banks' perceived marginal costs, $c_I - a$ and $a + c_A$ respectively.

Banks may also incur fixed costs, C_j, for *j=A;I*, and charge consumers and merchants with the fixed fees *F* and *M*, to affiliate them to the payment platform. In this paper, we will follow the literature, and neglect all the fixed costs and fees. Wright (2004) is the only paper to consider that banks incur fixed costs.

Banks' profits are expressed as follows:

$$\pi_I = (f(c_I - a) + a - c_I)V \text{ , (7)}$$

and

$$\pi_A = (m(a + c_A) - c_A - a)V \text{ , (8)}$$

[9] This assumption is made by Wright (2004), and Guthrie and Wright (2003, 2006).

where V represents the transaction volume.

The payment system:

The payment system selects the interchange fee, *a*, which maximises its objective function. It may also impose some rules on its members, such as the "No Surcharge Rule" (NSR), the "Non Discrimination Rule" (NDR), and the "Honour All Cards Rule" (HACR).

The objective of the payment system depends on the way its governance is organised. If the payment system is a not-for-profit joint venture, it is governed by a board of banks. In that case, it selects the interchange fee, a^P, which maximises a weighted sum of its members' profit, denoted by π. For instance, assume that the weights, λ for issuers, and 1-λ for acquirers, reflect the number of voting rights of each type of bank. Then, the payment system's objective is:

$$\pi = \lambda\pi_I + (1-\lambda)\pi_A . \ (9)$$

If the payment system is managed by a social planner, then, it chooses the interchange fee, a^W, which maximises total welfare. The literature also defines as a benchmark the interchange fee, a^V, which maximises the transaction volume.

I summarise the assumptions of each paper from the literature in a table placed in appendix A.

Now, I present the timing of the game, which determines the strategic interactions between the parties involved in a card payment transaction.

The timing of the game is as follows:

1. The payment platform selects the interchange fee, *a*.
2. Banks choose simultaneously and respectively the transaction fees, *f* and *m,* for consumers and merchants.
3. Consumers and merchants decide whether or not to join the payment platform.
4. Merchants choose simultaneously the retail prices, p_{cash} and p_{card}.
5. Consumers decide which merchant to purchase from, and whether or not to use a payment card.

3 A benchmark: Baxter's justification of interchange fees

In this section, I start by introducing Baxter (1983)'s model, which constitutes the starting point of the literature about interchange fees. Twenty years before the emergence of the two-sided markets theory, Baxter (1983) showed in a simple setting that payment card markets exhibit what is now called by the two-sided market literature "inter-group" externalities. The existence of externalities between two distinct groups of users is considered as the first characteristic of two-sided markets.[10] Because of these externalities, some transactions fail to be completed if issuers and acquirers interact freely, without the intervention of a payment system. The role of the payment system is to influence the prices paid by its members so as to internalise "inter-group" externalities. In his model, Baxter shows that interchange fees can be used by a payment card system to reach the socially optimal number of transactions.

In Baxter's framework, cardholders and merchants are homogeneous, banking retail markets are perfectly competitive and surcharges are not allowed. Under these assumptions, consumer and merchant transaction fees equal banks' marginal costs, that is $f = c_I$ and $m = c_A$. From (3), we know that a consumer will be willing to proceed to a card payment if and only if its card usage benefit b_B exceeds the transaction fee c_I, that is $b_B \geq c_I$. Using (6), the same reasoning can be done for merchant acceptance. If $b_S \geq c_A$, a merchant accepts to be paid by card. From the payment system's viewpoint, it is socially optimal to proceed to a transaction if the total benefits generated by a card payment exceed its cost, that is $b_S + b_B \geq c_A + c_I = c$. If $b_B < c_I$ and $b_S + b_B \geq c$, the consumer exerts a negative usage externality on the merchant, because he refuses to proceed to a card transaction that is socially optimal. This shows that payment card systems are characterised by "inter-group" usage externalities which can cause a market failure.

Let us keep Baxter's assumption of a negative usage externality exerted by a consumer on a merchant ($b_B < c_I$ and $b_S + b_B \geq c$, which implies that $b_S \geq c_A$). Baxter shows that the payment system can select an interchange fee such that all socially optimal transactions are

[10] According to Rochet and Tirole (2006a), two assumptions are needed to characterise a two-sided market. First, the market must exhibit "inter-group" externalities. Second, the ratio of the relative prices paid by each side of the market must impact the transaction volume.

completed. More precisely, if the acquirer pays to the issuer an interchange fee, *a,* such that $a = b_S - c_A$, then the issuer's marginal cost becomes $c_I + c_A - b_S = c - b_S$, while the acquirer's marginal cost becomes b_S. Because of perfect competition between banks, the variations of the marginal costs are completely passed through to cardholders and merchants. The cardholder pays a lower transaction fee, which becomes $c - b_S$, and the merchant pays a higher fee, equal to b_S, the card acceptance benefit. Therefore, the cardholder's usage condition becomes $b_S + b_B \geq c$, while the merchant is indifferent between accepting cards and cash. Consequently, all socially optimal transactions are completed.

Baxter provides the first justification of interchange fees. The interchange fees are used by the payment platform to correct the market failure caused by "inter-group" usage externalities.

Result 1 (Baxter 1983)

Assume that cardholders and merchants are homogeneous, that banks are perfectly competitive, and that the "No Surcharge Rule" holds.

If $b_B < c_I$ *and* $b_S + b_B \geq c$*, it is socially optimal for a payment system to choose an interchange fee* $a = b_S - c_A$*, which is paid by the acquirer to the issuer.*

This first example shows that the interchange fee can maximise the transaction volume by correcting the indirect usage externalities that cardholders and merchants exert on each other. The mechanism is the following one. If consumers exert a negative usage externality on merchants, it is socially desirable to subsidize the consumers' side, to the detriments of the merchants' side. The interchange fee decreases the issuers' costs, and increases the acquirers' costs. Because of perfect competition between banks, those costs modifications are completely passed through to consumers and merchants. Consumers pay a lower price for card transactions. Hence, their willingness to use payment cards is increased. It is possible for the payment platform to increase the interchange fee until all socially optimal transactions are processed.

Baxter's model highlights the role of the interchange fee in a payment system. But it is necessary to use a more general model to study the impact of other variables on the choice of the optimal interchange fee, such as the nature of competition between banks, or the strategic interactions between merchants. Under more general assumptions, the impact of the interchange fee on merchants and cardholders' demands will depend on two mechanisms. The interchange fee allocates the total cost of a card transaction between the issuer and the acquirer. But the final purpose of this cost allocation is to influence the decisions of the consumers and the merchants to use and accept cards, respectively. Hence, one has to determine first how banks pass through their costs to their customers, which will depend on the nature of competition between banks. If the costs are imperfectly passed through to consumers and merchants, the interchange fee may not help to achieve efficient use of payment cards. Second, one has to analyse how the merchants pass through the costs of card payments to the consumers. This depends on the nature of competition between merchants and the possibility to price discriminate between card-users and cash-users.

4 The optimal interchange fee under the Non Discrimination Rule

In this section, I study the choice of the optimal interchange fee if merchants cannot price discriminate between card-users and cash-users ("NDR"). Following Wright (2004), I start by comparing the various interchange fees chosen by the payment system according to its objective, if the users are heterogeneous. Then, I study the case of homogenous merchants and heterogeneous consumers. Finally, I apply these general results to prove the findings of the literature about the comparison of optimal interchange fees, under specific assumptions about the nature of competition between banks and between merchants.

4.1 General results if consumers and merchants are heterogeneous

In this subsection, I build on Wright (2004) to present the choice of the optimal interchange fee if consumers and merchants are heterogeneous. I assume that the marginal cardholder and the marginal merchant have been already determined, and I use the assumptions of Wright (2004) to ensure the existence of an optimal interchange fee. [11]

[11] See Wright (2004) for the details. Under these assumptions, the second order conditions are verified when the payment system maximises its objective.

I start by determining the interchange fee that maximises the transaction volume. Since merchants and consumers are heterogeneous over their card usage and card acceptance benefit, the transaction volume is given by

$$V = V(b_B^m; b_S^m) = \int_{b_S^m}^{\overline{b_S}} \int_{b_B^m}^{\overline{b_B}} h_B(b_B) h_S(b_S) db_B db_S = D_B(b_B^m) D_S(b_S^m). \quad (10)$$

Proposition 1 gives the volume maximising interchange fee.

Proposition 1 (Wright (2004)): the volume maximising interchange fee.

The volume maximising interchange fee is chosen such that

$$\left.\frac{\eta_S}{\eta_B}\right|_{a=a^V} = -1 \quad (11),$$

where η^B *and* η^S *denote the elasticity of the cardholders' quasi-demand, and the elasticity of the merchants' quasi demand to the interchange fee respectively.*

Proof. See Wright (2004).

Proposition 1 shows that the volume maximising interchange fee is chosen by the payment platform so as to balance demands between each side of the market. For instance, if consumers' demand is relatively more sensitive to price variations than merchants' demand, the payment platform should select a higher interchange fee, if its objective is to maximise the transaction volume.

The volume maximising interchange fee is chosen by the payment platform such that the extra card usage compensates exactly the loss in card acceptance. Indeed, at the volume maximising interchange fee, from the first order condition, we have that

$$D_B(b_B^m) \times \left.\frac{dD_S(b_S^m)}{da}\right|_{a=a^V} = -D_S(b_S^m) \times \left.\frac{dD_B(b_B^m)}{da}\right|_{a=a^V}.$$

The mechanism is the following. A higher interchange fee reduces the marginal cost of issuers, which is equal to $c_I - a$. The issuers may choose a lower transaction fee, *f*, for cardholders, which increases the percentage of consumers willing to use their cards by $dD_B(b_B^m)/da$. The final increase in card usage is equal to $(dD_B(b_B^m)/da)D_S(b_S^m)$, because the additional percentage of card users has to be multiplied by the proportion of merchants who accept cards, $D_S(b_S^m)$. At the same time, a higher interchange fee reduces the marginal cost of acquirers, which is equal to $c_A + a$. Acquirers may choose a higher merchant fee, *m*, which reduces the percentage of merchants that accept cards by $dD_S(b_S^m)/da$. Finally, card acceptance is reduced by $(dD_S(b_S^m)/da)D_B(b_B^m)$, because the percentage of merchants who refuse cards has to be multiplied by cardholders' demand, $D_B(b_B^m)$.

I now study the choice of the interchange fee that maximises banks joint profits. I denote by M_I and M_A the margins that an issuer and an acquirer make per transaction respectively, and by M the weighted margin of the payment system, where

$$M = \lambda M_I + (1-\lambda)M_A.$$

Proposition 2 (Wright (2004)): profit maximising interchange fee.

The profit maximising interchange fee, a^P, verifies the following equation:

$$\lambda\eta_B + (1-\lambda)\eta_S = -\varepsilon_{PS} \quad (14),$$

where ε_{PS} denotes the elasticity of M to the interchange fee .

Proof. See Wright (2004).

Corollary 1: comparison of the volume maximising and the profit maximising IF.

Assume that $\lambda = 1/2$. If the issuers pass through their costs at a higher rate than the acquirers at the volume maximising interchange fee ($\left.\frac{dM_I}{da}\right|_{a=a^V} > -\left.\frac{dM_A}{da}\right|_{a=a^V}$), then the volume maximising interchange fee is strictly lower than the profit maximising interchange fee . If the rates of pass through are identical, $a^V = a^P$. Otherwise, $a^V > a^P$.

Proof. See Wright (2004).

Corollary 2: constant margins on banking retail markets

If the weighted sum of banks' margins on retail banking markets is independent of the interchange fee, the volume maximising and the profit maximising interchange fees are equal.

Corollary 1 shows that the profit maximising and volume maximising interchange fees may be different, even if issuers and acquirers have the same weight in the objective of the payment association. This is because acquirers and issuers do not necessarily pass through interchange fees costs and benefits to merchants and consumers at the same rate. If, at the volume maximising interchange fee, the pass through rate is higher on the consumer side, the payment platform prefers to decrease its transaction volume by raising the interchange fee ($a^V < a^P$), because this generates higher revenues on the consumers' side.

If issuers are more powerful than acquirers in the payment system ($\lambda > 1/2$), the payment platform may also raise the interchange fee above the volume maximising level, to increase the margin of the issuers.

I now determine the level of interchange fee that maximises social welfare. If consumers and merchants are heterogeneous, the expression of social welfare is the following:

$$W(b_S^m; b_B^m) = \int_{b_S^m}^{\overline{b_S}} \int_{b_B^m}^{\overline{b_B}} (b_S + b_B - c) h_B(b_B) h_S(b_S) db_B db_S . \quad (14)$$

Proposition 3 gives the choice of the welfare maximising interchange fee.

Proposition 3 (Wright (2004)): welfare maximising interchange fee

At the welfare maximising interchange fee,

$$\frac{\eta_B}{\eta_S} = \frac{m - c + \beta_B(b_B^m)}{c - f - \beta_S(b_S^m)} \; (16),$$

where $\beta_B(b_B^m)$ *is the average surplus of cardholders who use their cards, and* $\beta_S(b_S^m)$ *is the average surplus of merchants who accept cards.*

Proof. See Wright (2004).

Corollary 3: comparison of the welfare maximising and the volume maximising IF.

If, at $a = a^V$, $b_B^m + \beta_S(b_S^m) > b_S^m + \beta_B(b_B^m)$, *then the welfare maximising interchange fee is higher than the volume maximising interchange fee, that is* $a^V < a^W$.

Proof. See Wright (2004).

Proposition 3 shows that the choice of the socially optimal interchange fee involves a trade-off between the consumers' surplus and the merchants' surplus. Indeed, at the welfare maximising interchange fee, from the first order condition, we have that

$$D_S(b_S^m) \times \frac{dD_B(b_B^m)}{da}\left(b_B^m + \beta_S(b_S^m) - c\right) = -D_B(b_B^m) \times \frac{dD_S(b_S^m)}{da}\left(b_S^m + \beta_B(b_B^m) - c\right).$$

If there is a small increase in the interchange fee, the number of card users increases by a factor $dD_B(b_B^m)/da$. This generates an additional surplus per transaction of $b_B^m + \beta_S(b_S^m) - c$, which has to be multiplied by the proportion of merchants who accept cards, $D_S(b_S^m)$. But also, the percentage of merchants who accept cards decreases by a factor $dD_S(b_S^m)/da$, which reduces the surplus per transaction multiplied by the proportion of cardholders. The welfare maximising interchange fee is chosen such that the consumers' surplus increase compensates exactly the loss in merchants' surplus.

In general, the welfare maximising and the profit maximising interchange fees are not equal. To compare a^W and a^P, it is necessary to make more specific assumptions about competition between banks, competition between merchants, and consumers' preferences, which is done in Section 4.3. In Section 4.2, I study the case of homogenous merchants and heterogeneous consumers.

4.2 General results with homogeneous merchants and heterogeneous consumers

If merchants are homogeneous while consumers differ across their card usage benefit, this creates an asymmetry between the two sides of the market which impacts the choice of the optimal interchange fee. Provided that merchants accept cards, the volume of transactions paid by card depends only on the consumer side. This situation creates a competitive bottleneck to the detriments of the acquirers, because the issuers have a monopoly of access to cardholders' demand. This competitive bottleneck is a source of potential bias for the interchange fee.

In this subsection, I assume that there is a maximum level for the interchange fee compatible with merchants' acceptance of payment cards. I denote it by $\overline{a}$. If merchants are non strategic, we know that $\overline{a}$ always exists. Indeed, under the NDR, a merchant accepts cards if $b_S \geq m$. Since we assumed that the merchant fee is increasing with the interchange fee, there exists a maximum level for the interchange fee compatible with merchants' acceptance of payment cards. If merchants are strategic, the interchange fee $\overline{a}$ exists if there is an equilibrium in which all merchants accept payment cards, and if merchants do not deviate from this equilibrium for all $a \leq \overline{a}$. In this subsection, I also assume that $\lambda = 1/2$.

Proposition 4: profit maximising interchange fee.

If the total price $f + m$ *is increasing with the interchange fee,* $a^P = a^V = \overline{a}$.

Proof. See Appendix B.

If the total price is increasing with the interchange fee, the profit of the payment platform increases with the interchange fee. Hence, the payment platform chooses the maximum interchange fee compatible with merchants' acceptance of payment cards (otherwise it makes zero profit).

Proposition 5: welfare maximising interchange fee.

If $b_S + f(\overline{a}) - c_I - c_A < 0$*, then* $a^W < \overline{a}$. *Otherwise,* $a^W = \overline{a}$.

Proof. See Appendix B.

A social planner maximises the total surplus under the constraint that merchants accept cards. If $b_S + f(\overline{a}) - c_I - c_A \geq 0$, at the profit maximising interchange fee, there is an under-provision of payment card services. However, it is impossible to increase the level of interchange fee to reach social optimality because of the constraint that merchants accept cards, and $a^W = \bar{a}$. Otherwise, the interchange fee is too high from the point of view of a social planner.

4.3 Specific assumptions about banks and merchants under the NDR

I now add more structure to my model. I present several settings developed in the literature, which allows me to compare a^W and a^P in specific contexts.

In all the subsection 4.2, it is assumed that $\lambda = 1/2$, and that the NDR and the HACR hold. First, I study the impact of the nature of competition between banks on optimal interchange fees. Second, I analyse the influence of strategic interactions between merchants.

4.3.1 What is the impact of bank competition on interchange fees?

In all this subsection, I present models, which use different assumptions about the nature of competition on banking retail markets. As shown in Corollary 1, the profit maximising interchange fee depends on how banks pass through their costs to their customers. This is determined by the nature of competition between banks.

4.3.1.1 Perfect competition between banks

- **Homogenous merchants and consumers**

Baxter assumes that there is one consumer, one merchant, and that banking retail markets are perfectly competitive. The consumer exerts a negative usage externality on the merchant.

Result 1 (Baxter (1983)): Perfect competition on both sides of the market.

The volume maximising interchange fee and the welfare maximising interchange fee are equal to the merchant's net benefit of card acceptance, that is $a^V = a^W = b_S - c_A$.

Proof. See Baxter (1983).

The optimal interchange fee increases with the merchant's benefit from card acceptance and decreases with the acquirer's marginal cost. The intuition of this result is the following: the

larger the difference between consumers and merchants as regards card usage benefits, the stronger the externality exerted by one group on the other. Therefore, a higher interchange fee can help correct this externality.
If issuers' costs are very large in comparison to acquirers' costs, it is more likely that the consumer will exert a negative externality on the merchant. Therefore, the higher the acquirer's costs are, the lower the optimal interchange fee must be.

- **Heterogeneous merchants and consumers**

If both sides of the markets are heterogeneous, and if banks are perfectly competitive, from Corollary 2, we know that the volume maximising and the profit maximising interchange fees are equal. This is because perfect competition leads to constant margins on banking retail markets, which are equal to zero.
From Corollary3, if $c_I - a^V + \beta_S(c_A + a^V) > c_A + a^V + \beta_B(c_I - a^V)$, then $a^V < a^W$. Note that if demands are identical, $a^V = a^P = a^W = \frac{c_I - c_A}{2}$.

- **Homogenous merchants and heterogeneous consumers**

We now study the case of homogenous merchants and heterogeneous cardholders, using Proposition 4.

Result 2: Perfect competition on both sides of the market.
Under the assumptions of Section 4.2, if there is perfect competition on both sides of the market, and if $\bar{a} > b_S - c_A$ *, then* $a^W < \bar{a} = a^P$ *. Otherwise,* $a^W = a^P = a^V = \bar{a}$.

Proof. See Proposition 4.

This results shows that if both markets are perfectly competitive, and if the maximum interchange fee compatible with merchants' acceptance of payment cards is lower or equal to Baxter's interchange fee, the welfare maximising interchange fee and the profit maximising interchange fees are equal.

4.3.1.2 Perfect competition on the acquisition side, and imperfect competition on the issuing side

We apply the results of Proposition 4 to the case of perfect competition between acquirers, which is used in several models of the literature (See for instance Rochet and Tirole (2002) and Wright (2003)). We assume that the issuers' profit increases with the interchange fee.

Result 3: Perfectly competitive acquirers and imperfect competition between issuers.
Under the assumptions of Section 4.2, if there is perfect competition on the acquisition side, and if the issuers' profit increases with the interchange fee, $a^P = a^V = \bar{a}$.

Proof. See Proposition 4.

4.3.1.3 A monopolist issuer and a monopolist acquirer

We now examine the case in which both sides of the market are monopolists.
This case is modelled by Schmalensee (2002), who also assumes that the demands are linear on each side of the market. Linear demands are obtained for instance with uniform distributions for the card usage benefit and the card acceptance benefit.

Result 4 (Schmalensee (2002)) "Monopolists with linear demands"
The volume maximising and the profit maximising interchange fees are equal.
If demands are identical on both sides of the market, the optimal interchange fee is set to equalise banks' marginal costs, that is $a^W = a^V = a^P = \frac{c_I - c_A}{2}$.

Proof. See Schmalensee (2002).

If demands are linear, and if there is a bilateral monopoly, it can be shown that banks pass through their cost variations to consumers at the same rate. Hence, the first part of Schmalensee (2002)'s result is explained by Corollary 1. If demands are linear and identical, under the NSR, the volume maximising interchange fee is set to equalize banks' marginal costs. Since both sides of the market are now symmetric, consumers and merchants pay the same transaction fee. Hence, at the volume maximising interchange fee, the average surpluses generated on each side of the market are the same. From Proposition 3, we know that in this case the volume maximising and the welfare maximising interchange fees are equal.

4.3.1.4 Imperfect competition on both sides of the market with linear demands

Schmalensee (2002) assumes imperfect competition on both sides of the market. In his model, $D_B(f)$ and $D_S(m)$ are linear and there are the same number of firms on each side of the market.

Result 5 (Schmalensee (2002)) "Imperfect competition on both sides"

The profit maximising interchange fee departs from the volume maximising interchange fee in the same direction as the welfare maximising interchange fee, that is,

$$(a^P - a^V)(a^W - a^V) \geq 0,$$

where

$$a^V = \frac{c_I - c_A}{2}.$$

Proof. See Schmalensee (2002).

We can note that this property does not seem to be easily generalised beyond the linear case.

4.3.1.5 Conclusion

The variety of the situations examined in the literature enables us to make a few conclusions about the impact of competition between banks on interchange fees. In all cases, we observe that the volume maximising interchange fee flows to the high cost side of the market, and to the side of the market which demand is more elastic to prices. If one side of the market is more profitable than the other, the payment system tends to choose a profit maximising interchange fee which helps shifting revenues from one side to the other. The nature of competition between banks on each side of the market determines the rate of pass through of cost variations to consumers and merchants. The results of the literature are very clear about the divergence between the profit maximising and the volume maximising interchange fee. These differences are determined by the asymmetries between the pass through rates.

However, the models do not tell precisely if the profit maximising interchange fee is higher or lower than the welfare maximising interchange fee. We only know that, if there is imperfect competition on one side of the market, maximisation of profits is unlikely to yield to a social optimum, and that the welfare maximising interchange fee takes into account the average surplus generated on each side of the market. If banks have market power, they may choose excessive transaction fees, because they do not internalise the consumers' and the merchants' benefits of proceeding to a card transaction.

Also, the nature of competition between merchants influences the allocation of the transaction costs and benefits between consumers and merchants. I study this issue in the next subsection.

4.3.2 How do strategic interactions between merchants influence interchange fees?

The nature of the strategic interactions between merchants influences how merchants pass through the costs of card payments to consumers. If the interchange fee increases, this raises the marginal cost of a merchant because it has to pay a higher merchant fee to the acquirer. If merchants pass through completely this cost variation to consumers, this may neutralize the role of interchange fees, which is to subsidize the cardholders' side.

I start by studying the two polar cases of perfectly competitive merchants and monopolistic merchants, as Wright (2003). Finally, following Rochet and Tirole (2002), and Wright (2004), I analyse a situation in which two merchants compete "à la Hotelling". In this case, we will see that the merchants internalise a part of the card-users' surplus in their decision to accept cards.

In Wright (2003)'s model, merchants are homogenous, the acquirers are perfectly competitive, while the issuers are imperfectly competitive.

Result 6 (Wright (2003)) "Bertrand competition between merchants"

If merchants compete "à la Bertrand", the level of the interchange fee does not impact card usage.

Proof. See Wright (2003).

Under perfect competition, merchants pass through any additional costs of benefits they receive from card acceptance back to cardholders. Therefore, consumers always face the full costs and benefits of holding and using cards, which makes the interchange fee irrelevant. The payment platform cannot allocate the total cost of a card transaction between the consumers and the merchants.

If the merchant fee is high, the Non Discrimination Rule causes a separation between merchants who accept cards and the others. Merchants who accept cards only attract card users. If the merchant fee is low, merchants want to discount card payments. This is possible under the NSR, but impossible under the NDR. In that case, all merchants accept cards and cash at equilibrium. Hence, there can be no subsidy from cash-paying customers to card-users, and the cost of a payment card transaction for the merchant is completely passed through to the consumers that pay by card. As a consequence, the level of the interchange fee becomes irrelevant. Cardholders always face the total cost of a payment card transaction.

These results are in sharp contrast with Baxter's model, in which the interchange fee is decisive to achieve a social optimum. Notice that there is too little card usage from a social perspective, because cardholders do not internalize the issuers' mark-up on card transactions.

However, Wright (2003) shows that the result of Baxter's model holds if merchants are monopolists. He assumes that the surplus of buying the good is sufficiently large. Under this assumption, monopolistic merchants always set a price that is equal to the consumers' surplus of buying the good, *v*, under the "No Surcharge Rule", because they make more profit when they sell both to card-users and cash-users.

Result 7 (Wright (2003)) "monopolistic merchants"

The profit maximising interchange fee and the welfare maximising interchange fee are equal to Baxter's interchange fee, that is $a^P = a^W = b_S - c_A$.

Proof. See Wright (2003). This result is also verified if consumers pay a strictly positive card fee.

I explain briefly the intuition of Wright (2003)'s result. Since the acquirers are perfectly competitive, the merchant fee is equal to the marginal cost of an acquirer, that is $a + c_A$. Since cash-users and card-users pay the same price under the NSR, merchants accept cards if their benefit b_S is higher than the merchant fee. The maximum interchange fee compatible with merchant acceptance of payment cards is equal to Baxter's interchange fee, that is $\bar{a} = b_S - c_A$. From Proposition 4 and 5, we know that in this case, $a^P = a^W = b_S - c_A$.

Following Rochet and Tirole (2002) and Wright (2004), I now study the case of "Hotelling" competition between merchants. In his decision to accept cards, a strategic "Hotelling" merchant takes into account the benefits of attracting to his store some of the consumers that wish to pay by card. The decision to accept cards may increase its market share provided that the consumers are informed about card acceptance. This lowers merchants' incentives to turn down cards.

Rochet and Tirole (2002) assume that all consumers know with a probability α if a merchant accepts cards. In their model, the acquirers are perfectly competitive, the issuers are imperfectly competitive, and the two merchants are homogeneous as regards to their card acceptance benefit. They assume that the issuers' profit is increasing with the level of interchange fee.

Result 8a (Rochet and Tirole (2002)) "Hotelling competition between two merchants"

The maximum interchange fee compatible with merchant acceptance verifies $\bar{a} = b_S - c_A + \alpha\beta_B(f(c_I - \bar{a}))$.

If $f(c_I - \bar{a}) < c - b_S$*, then* $a^W < a^P = \bar{a}$ *. Otherwise,* $a^W = a^P = \bar{a}$.

Proof. See Rochet and Tirole (2002).

Rochet and Tirole (2002) show that strategic merchants internalise a part of the consumers' surplus in their card acceptance decision, because they take into account the fact that card acceptance attracts customers to their stores.. Hence, the maximum interchange fee compatible with merchants' acceptance is equal to Baxter's interchange fee plus the average surplus of the card-users that are informed about card acceptance.

Since the acquirers are perfectly competitive, and since $\pi_I^{'}(a) \geq 0$, from Proposition 4, the profit maximising interchange fee is set at the maximum level compatible with merchant acceptance.

Competition between "Hotelling" merchants may lead to an over-provision of payment card services if the acquirers are perfectly competitive, as in Proposition 5. As noted by Rochet and Tirole (2002), the payment association can exploit each merchant's willingness to obtain a competitive edge over other merchants. However, the interchange fee is not necessarily too high from the perspective of a social planner. This remarkable result is due to the social benefits of strategic interactions between merchants. Strategic interactions force merchants to internalise the cardholders' benefits of using their cards, while offsetting the market power of issuers, which could lead to excessive transaction fees for cardholders.

Wright (2004) uses the same setting with heterogeneous merchants and imperfect competition on both sides of the market. Merchants from the same industry have the same benefit of accepting cards, but there is a continuum of industries, which differ across their card acceptance benefit. He also assumes that the issuers and the acquirers pass through costs variations to consumers and merchants at the same rate.

Result 8b (Wright (2004)) "Hotelling competition with heterogeneous merchants."
Merchants accept cards if $b_S \geq b_S^m = m - \alpha(\beta_B(f) - f)$.
If, at $a = a^P$*, we have* $\beta_S(b_S^m) \geq m + (1-\alpha)(\beta_B(f) - f)$*, then* $a^W > a^P = a^V$.

Proof. See Wright (2004).

Since banks are symmetric, from Corollary 1, the volume maximising and the profit maximising interchange fees are equal. Like Rochet and Tirole (2002), Wright (2004) shows that a privately optimal interchange fee may generate too many card transactions. However, unlike Rochet and Tirole, Wright shows that it is not necessary to decrease the profit maximising interchange fee in order to maximise social welfare. For instance, if consumers are fully informed about card acceptance $(\alpha = 1)$, this is only the case if the average transactional benefit generated over all merchants who accept cards at $a = a^P$ is lower that the fee they pay. This shows that merchants' homogeneity is another key assumption that drives the results obtained about optimal interchange fees.

In this subsection, I showed that the strategic interactions between merchants are decisive in the choice of the optimal interchange fee. Merchants' market power determines the way the transaction costs and benefits are allocated between cardholders and merchants. If merchants compete à la Bertrand, the payment system cannot reallocate the costs from the merchant side to the consumer side, and increase the demand for card usage, because merchants' costs and benefits are completely passed through to consumers. If merchants are monopolists, they do not extract all the cardholders' surplus, because they do not want to loose cash-only consumers. If merchants compete à la Hotelling, the profit maximising interchange fee can be either higher or equal to the welfare maximising interchange fee. In this case, the fact that merchants use card acceptance for strategic purposes may counterbalance the issuers' market power.

Antitrust authorities often argue that the existence of strategic interactions between merchants increases the level of interchange fee chosen by the payment platform. This is due to the fact that merchants internalise a part of the consumer card usage benefit in their card acceptance decision, which increases the maximum interchange fee compatible with merchant acceptance. Rochet and Tirole (2006b) try to address this issue in a more general framework, by creating a benchmark for excessive interchange fees, which they call "the tourist test". They assume that an interchange fee passes the tourist test if the merchant is ex post indifferent about the payment instrument used by the consumer, because card acceptance does not increase its retail cost. In their model, the internalization effect is modelled by a parameter $s(\alpha, f)$, which increases in α and decreases with *f*. Merchants accept cards if

$$m \leq b_S + s(\alpha, f).$$

An interchange fee is said to pass the tourist test, if a merchant accepts a card payment from a non-repeat customer who holds enough cash. Rochet and Tirole compare the maximum interchange fee that passes the tourist test, a^T, the interchange fee that maximises the total user surplus, a^{TUS}, and the welfare maximising interchange fee, a^W. This enables them to identify the assumptions under which the tourist test is biased.

In their model, consumers are heterogeneous, merchants are homogenous, and the acquirers are perfectly competitive.

Result 9 (Rochet and Tirole (2006b)) "The tourist test"

If $\frac{\partial M_I}{\partial a} \geq 0$*, then* $a^{TUS} \geq a^T$. *Otherwise,* $a^{TUS} \leq a^T$.

If $M_I > 0$*, then* $a^W > a^T$. *If* $M_I = 0$*, then* $a^W = a^T$.

Proof. See Rochet and Tirole (2006b).

Rochet and Tirole (2006b)'s result shows that the tourist test is biased. If the issuers' margin increases with the interchange fee, the tourist test may fail, although the interchange fee is too low to maximise the total user surplus. In almost all cases (except with perfectly competitive issuers), the welfare maximising interchange fee is higher than the maximum interchange fee that passes the tourist test. This means that the tourist test is not always reliable to assess if efficiency has been reached. The conclusion is different if there is free entry on the issuing market (See Rochet and Tirole (2006b)).

All the results introduced in this subsection rely on the assumption that merchants are unable to surcharge payments made by card. Therefore, in the following section, I study the impact of the role of surcharges on interchange fees.

5 The impact of surcharges on optimal interchange fees and social welfare

Does the No Surcharge Rule (NSR) lead to the socially optimal number of transactions? In this section, I try to determine if lifting the NSR leads to welfare efficiency, by studying different models of merchant competition. In my notations, I keep the numbering of the results chosen in Section 4.3, in order to draw a parallel between merchants' behaviour under the NSR, and merchants' strategies when the NSR is lifted.

Allowing surcharges may call into question the role of interchange fees in payment card systems. Indeed, if surcharges are allowed, under some assumptions that I precise at the end of this section, interchange fees may become neutral. In that case, the transaction volume is not affected by the level of interchange fees. But this does not necessarily mean that lifting the NSR is desirable from the perspective of welfare efficiency.

5.1 Analysis of surcharges under various models of merchant competition

In this subsection, I analyse the impact of surcharges under various models of competition on the merchants' side.

Result 1 (no NSR), (Carlton and Frankel (1995)) "No strategic interactions between merchants"

The assumptions are the same as Baxter's, except that surcharges are allowed.

When banks are perfectly competitive, and when surcharges are allowed, if there is one consumer and one merchant, interchange fees are neutral, and all socially optimal transactions are processed through the network.

Proof. See Carlton and Frankel (1995).

Since merchants' costs of accepting cards are passed through to consumers, the consumers always face the total costs and benefits of using cards. Hence, they always use the card when it is socially optimal to do so.

Result 6 (no NSR) (Wright (2003)) "Bertrand competition between merchants"

The assumptions are the same as for Result 6, except that the NSR is lifted.

Under Bertrand competition, both the payment system and the regulator are indifferent to the NSR. Banks' profits and social welfare do not change when the no-surcharge rule is lifted, regardless of the level of the interchange fee. The interchange fee is neutral.

Proof. See Wright (2003).

When competition between merchants is tough, merchants are not able to surcharge excessively, since they pass through to cardholders the costs and benefits of card acceptance. The fact that cardholders face all the costs and the benefits of the card network helps achieve an efficient outcome.

With perfect competition, there can be no subsidy from cash-paying customers to card-paying customers. Indeed, under perfect competition, merchants only accept cards if they can recover their costs. The cost of recovering any interchange fee is therefore ultimately borne by consumers who use cards. Therefore, the level of interchange fees is neutral, and there is no difference between the outcome with surcharging and that without. The interchange fee cannot be used to allocate the total cost of a card transaction between the consumers and the merchants.

Result 7a (no NSR) (Wright (2003)) "Monopolistic merchants"

Assumptions are the same as for Result 7a except that surcharges are allowed.

If surcharges are allowed, the interchange fee becomes neutral.

The imposition of the No Surcharge Rule is both preferred by the regulator and the payment card association.

Proof. See Wright (2003).

If monopolist merchants are allowed to surcharge card payments, they choose a higher price than the socially optimal one for card payments. This leads to fewer cardholders, which decreases issuers' profits. Both social welfare and bank's profits are reduced. The imposition of the NSR is unambiguously preferred by the payment system and a welfare-maximising regulator.

Result 7b (no NSR) (Wright (2003)) "Monopolistic merchants with cardholding fees"

If consumers pay a fixed membership fee F, a unique equilibrium exists under surcharging, in which no consumers hold cards.

If consumers pay a fixed membership fee F, the NSR is preferred by both the payment system and the regulator. Both will set the interchange fee at Baxter's level.

Proof. See Wright (2003).

With the introduction of a membership fee, surcharging prevents consumers from joining the card system, even though card payments can be efficient for many transactions. Monopolistic merchants set prices to extract the entire surplus from the marginal customer, leaving no surplus to cover their costs of joining the card network. The introduction of a fixed membership fee for consumers suggests that a higher interchange fee is needed to offset these extra costs on cardholders' side. However, interchange fees are already set at the maximum level compatible with merchant acceptance. Therefore, the optimal interchange fee does not increase in comparison to the level chosen when there are no membership fees. The NSR is preferred by the payment system and the regulator, because otherwise, no consumer will be ready to hold a card, which will lower social surplus and issuers' profits.

Result 8a (no NSR) (Rochet and Tirole (2002)) "Hotelling competition between two merchants"

The assumptions are the same as for Result 8a, except that the NSR does not hold.

If surcharges are allowed, interchange fees become neutral, and there is an underprovision of card services (compared to the social optimum).

If $f(c_I - a^P) \geq c - b_S$*, social welfare is higher under the NSR. Otherwise, it may be either higher or lower.*

Proof. See Rochet and Tirole (2002).

When merchants compete "à la Hotelling", if surcharges are allowed, they pass through to the cardholder the increase in their net cost $(m - b_S)$ of a card transaction. Therefore, the interchange fee does not impact the transaction volume and becomes neutral. If $f(c_I - \bar{a}) \geq c - b_S$, there is already an underprovision of payment card services (see Result 8a), thus, lifting the NSR worsens the situation. On the contrary, if $f(c_I - \bar{a}) < c - b_S$, there is an overprovision of payment card services under the NSR. Lifting the NSR provides a countervailing force to this overprovision of payment card services, which may increase or reduce social welfare.

<u>**Summary of the results:**</u>

Let us summarise the results obtained by the literature about the lifting of the "NSR", with a table provided by Rochet (2003).

Competition between sellers	Impact of NSR	Volumes	Social Surplus	Reference
Monopoly	Limits inefficient surcharges	+	+	Wright 2003
Hotelling	Decreases cardholders' fees	+	Ambiguous	Rochet and Tirole 2002
Bertrand	Neutral	=	=	Wright 2003

Table 1: Impact of surcharges

Therefore, the payment platform must choose the best method to achieve its objective. If surcharging is not costly, banning the "No Surcharge Rule" may increase or

decrease welfare, depending on issuers' market power and sellers' resistance. When welfare decreases, it is better to adopt a "No Surcharge Rule" and to set the interchange fee at an appropriate level, if the objective of the platform is to maximise welfare.
However, the models of the literature entail some limits to understand the impact of the NSR on cash users, because the total quantity of transactions is fixed. For instance, in Wright's model (2003), under the NSR, a monopolist merchant does not increase the price paid by cash users, because any higher price entails loosing all cash transactions. Therefore, the imposition of the NSR unambiguously raises the surplus of consumers if merchants are monopolists.

Schwarz and Vincent (2006) depart from the existing literature, by assuming that the demand for transactions is elastic to prices. If cash users' demand is smooth, under the NSR, some price increases to cash users may become profitable for merchants. This new assumption may change the conclusions about the impact of the NSR on social welfare.

In their model, the choice of the payment instrument is assumed to be exogenous. There is one group of consumers of mass one who use only cards while the other group of mass τ uses only cash. Transaction demands are assumed to be downward sloping and linear. There is perfect competition between acquirers, while the issuers may be either collusive or perfectly competitive. Also, merchants are local monopolists.

Result 10 (Schwartz and Vincent (2006)) "The impact of the NSR when the transaction volume is elastic to prices"

If the issuers are collusive, the lifting of the NSR may either increase or reduce the total surplus if rebates are forbidden. If rebates are feasible, the surplus of card users, the total surplus of consumers and the total surplus are higher under the NSR, while the surplus of cash users is lower.

If the issuers are competitive, and if $b_S = 0$*, the lifting of the NSR increases the total surplus. If the mass of cash users becomes very large, the per capita quantity of cash transactions approaches the single monopoly level and the per capita quantity of card transactions approaches the competitive level.*

Proof. See Schwarz and Vincent (2006).

Schwartz and Vincent (2006)'s result shows that the impact of the NSR on welfare is very different if the transaction volume is not normalised to one. If rebates are forbidden, the NSR can even be detrimental to cardholders, if the relative size of the cash market is small. When demands are elastic, the effect of the NSR is to induce merchants to raise their prices to cash users. It also provides incentives for the payment system to raise its merchant charge. If rebates are not feasible, the higher fee to the merchant can also cause the transaction price paid by cardholders to rise, which may result in lower welfare. If rebates are allowed, this can reverse the NSR bias towards under-usage of payment card services, and the imposition of the NSR can increase the total surplus.

If there is perfect competition between issuers, the constraint that merchants must continue to serve the cash market binds for a larger size of the cash market. Perfect competition between issuers increases the tendency to offer rebates to card users, which makes the option of increasing the price for cash users more valuable for merchants. If the cash market becomes large, the merchant's price is driven by cash users, so it approaches the single monopoly level.

The results of Section 5.1 show that, in the case of Hotelling and Bertrand competition between merchants, if the NSR is lifted, the interchange fee may become neutral. It is indeed possible to choose another interchange fee associated to a new set of prices which yields the same payoffs for all agents at equilibrium.

5.2 Conditions under which interchange fees are neutral

Gans and King (2003) use the concept of "payment separation" to provide general conditions under which interchange fees are neutral. Payment separation is said to occur if consumers who purchase a good at a card price from merchants accepting cards do use their payment card. Notice that if surcharges are allowed, payment separation is available. But payment separation is not necessarily linked to the possibility to surcharge. Payment separation may also arise as a result of market competition. For instance, if there is perfect competition among merchants, as in Wright (2003), a rule that limits merchants to a single cash and card price will result in a market division between cash-only merchants and card-only merchants. In a general setting, Gans and King (2003) show that interchange fees become neutral if there is payment separation between card and cash transactions.

Result 11 (Gans and King (2003)) "Neutrality of interchange fees"

The proportion of consumers who use their cards to buy the good from a merchant who accept cards is denoted by Z.
If $Z = 1$, or, equivalently, if there is price separation between card and cash transactions, interchange fees are neutral.

Proof. See Gans and King (2003).

Gans and King's result shows that the potential for neutrality of interchange fees lies in the nature of the interactions between customers and merchants. If surcharging is possible, or if there is perfect competition between merchants, payment instruments' costs and benefits are reflected in merchants' pricing strategies. In this case, interchange fees have no real economic effects. However, in practice, many merchants refuse to surcharge card payments, even if they are allowed to do so. Furthermore, this result does not say if a social planner should prefer to apply the NSR and use an interchange fee, or lift the NSR. This suggests that other aspects of the role of interchange fees must be examined. In the following section, I choose to focus on the question of competition between payment associations.

6 Interchange fees and platform competition

In this section, I analyse how platform competition affects the choice of the optimal interchange fee. Does competition between payment platforms lead to social efficiency? Do competing payment platforms choose the same interchange fee as a monopolistic payment platform?

To answer to these questions, I modify the model introduced in Section 2 to allow for platform competition. There are now two payment platforms, which I denote by $i = 1;2$. I suppose that, at the first stage, each payment card platform i selects its interchange fee denoted by a^i. At stage two, banks choose the price of each payment card. At stage three, consumers and merchants choose to belong either to a single payment card association or to both payment card associations ("*singlehoming*" versus "*multihoming*"). Then, stages 4 to 5 are the same as stages 4 to 5 of the game presented in section 2, except that, if consumers multihome, they may now choose between three payment instruments (the card of platform 1, the card of platform 2, and cash), whereas merchants have to decide whether or not to accept one card, both or none. I denote by a^{PC} the equilibrium interchange fee resulting from platform competition in a symmetric equilibrium.

The common conclusion of the papers of this literature is that the outcome of platform competition depends on three key assumptions:

i. The possibility for consumers and merchants to multihome
ii. The asymmetries between the consumers' side and the merchants' side for the distribution of the card usage and card acceptance benefits.
iii. The differentiation between payment platforms.

Chakravorti and Roson (2006)'s paper is the only paper in which it is not assumed that the total price charged by banks is constant. In all other papers, it is assumed that banks' margins on retail markets are constant, such that $M_I + M_A = M$.

6.1 General results on platform competition if both sides of the market can multihome

I start by introducing Rochet and Tirole (2003)'s seminal paper about platform competition, and I apply their results to the case of payment systems. In their model, consumers and merchants are affiliated to both payment platforms, but do not want necessarily to trade on both of them. Platforms are differentiated, but only from the consumers' perspective. A consumer obtains a transactional benefit b_B^i of trading with platform i for $i = 1;2$ and a merchant obtains the same transactional benefit on each platform.

To measure the proportion of consumers who stop trading when platform "i" ceases to be available, Rochet and Tirole (2003b) use the "singlehoming index" σ^i , for $i = 1;2$ and $i \neq j$, where

$$\sigma^i = \frac{d_B^1 + d_B^2 - D_B^j}{d_B^i}.$$

In the previous definition, D_B^i represents the proportion of consumers willing to trade on platform i if the seller wants to trade only with platform i, and d_B^i the proportion of consumers willing to trade on platform i when the seller wants to trade with both platforms.

If the proportion of consumers that multihome is high, the singlehoming index is low.

Result 12: Rochet and Tirole (2003b)

In a symmetric equilibrium of competition between payment platforms, the optimal price structure is given by $\frac{m}{f}=\frac{\eta^S}{\sigma\eta_o^B}$, *where* $\eta_o^B=-\frac{f}{d^B}\times\frac{\partial d_B^i}{\partial f}$ *denotes the "own-brand" elasticity of demand for consumers.*

The interchange fee resulting from platform competition is

$$a^{PC}=\frac{M_I+c_I}{1+(\sigma\eta_o^B/\eta^S)}-\frac{M_A+c_A}{1+(\eta^S/\sigma\eta_o^B)}.$$

Proof. See Rochet and Tirole (2003b).

When platforms compete, they take into account the externalities that each side of the market exerts on the other. For instance, assume that the singlehoming index σ is high on the consumers' side, which means that the percentage of consumers that trade on both platforms is low.

Because of the externalities between the consumers' side and the merchants' side, competing payment platform can use both sides of the market to attract consumers.

i. On the consumers' side, they compete by choosing a lower price for cardholders, which is reflected by the presence of the own-brand elasticity η_o^B in the equation that gives the price structure (*m/f*).
ii. But they can also attract consumers through the merchants' side, by undercutting the price proposed by their rivals to merchants. This strategy is known as "steering". When a payment platform undercuts the price of its rival, this induces some merchants to stop multihoming, and to become exclusive sellers on that platform. By attracting exclusive sellers, the payment platform attracts also exclusive buyers. This is reflected by the term η^S/σ, which is the equivalent of the own-brand elasticity for merchants.

Rochet and Tirole (2003b)'s result show that the price structure resulting from a symmetric equilibrium of platform competition is equal on the ratio of the own-brand elasticities. For instance, as long as the own-brand elasticity is relatively higher on the merchant side, each payment platform has an incentive to steer merchants, by lowering its price structure (*m/f*).

With constant margins on the issuing and the acquiring sides, the price structure is directly influenced by the choice of the interchange fee. The interchange fee that results from platform competition reflects the trade-off between the competition on the consumers' side and steering on the merchants' side.

Even if there is perfect competition between issuers and acquirers, platform competition does not yield to the socially optimal price structure. Rochet and Tirole (2003b) show that the interchange fee resulting from platform competition and the welfare maximising interchange fee coincide only in the special case of linear demands.

6.2 Competition between identical payment platforms

Guthrie and Wright (2003) analyse the competition between two identical payment platforms under various forms of merchant competition. The timing of the game is modified in their model: heterogeneous consumers are informed about their card usage benefit after the choice of a merchant. Their model also highlights the importance of the consumers' decision to singlehome or multihome.[12] They start by studying the case of monopolistic homogeneous merchants.

Result 14a (Guthrie and Wright (2003)) "Competition between two identical platforms with monopolistic homogeneous merchants"

If consumers hold at most one card, competing payment platforms choose the maximum interchange fee compatible with merchant acceptance. In this case, $a^{PC} = a^{P}$.

If some consumers multihome, competing payment platform choose the interchange fee that maximises the surplus which is expected by merchants when they accept cards. Furthermore, $a^{PC} < a^{P}$ *and* $a^{PC} < a^{W}$.

Proof. See Guthrie and Wright (2003).

If merchants are monopolists and homogeneous, a single card payment system sets the interchange fee to the point where merchants only just accept cards. As in Baxter (1983), or Rochet and Tirole (2002), since merchants are homogenous as regards their card benefit, the demand for card payments depends only on the fee that is chosen by the issuers. Hence, the

[12] In their model, the consumers' decision to multihome depends on the cardholding cost. Consumers differ across their cardholding cost.

acquirers face a competitive bottleneck, because the issuers have a monopoly of access to cardholders' demand.

If consumers singlehome, payment systems have an incentive to lower their card fees to attract exclusive cardholders to their network, which can be achieved by increasing interchange fees. However, as in Rochet and Tirole (2002), there is no scope for raising interchange fees, because they are already set at the maximum level compatible with merchant acceptance. So platform competition does not modify the optimal interchange fee under singlehoming.

The previous conclusion no longer holds if consumers multihome. Payment platforms compete by setting the interchange fee to maximise merchant's surplus, instead of extracting their surplus completely, because they know that merchants can turn down the card with the highest interchange fee. The equilibrium interchange fee is lower than the welfare maximising interchange fee, because payment systems do not take into account the consumers' interests. Then, they analyse the case of Hotelling competition between merchants.

Result 14b (Guthrie and Wright (2003)) "Competition between two identical platforms with homogeneous strategic merchants"

If consumers hold at most one card, competing payment platforms choose the same interchange fee as a monopolistic payment platform, that is $a^{P} = a^{PC}$. *The interchange fee that results from platform competition is higher than the welfare maximising interchange fee, that is* $a^{W} \leq a^{PC}$.

If some consumers multihome, competing payment platforms choose the interchange fee that maximises the joint surplus expected by consumers and merchants. In this case, $a^{PC} < a^{P}$ *and* $a^{PC} < a^{W}$.

Proof. See Guthrie and Wright (2003).

If merchants are strategic, they internalise part of the consumers' surplus in their decision to accept cards. A single card payment system selects the maximum interchange fee compatible with merchant acceptance, as in Rochet and Tirole (2002).

If consumers singlehome, the analysis is the same as in the case of monopolistic merchants. Since interchange fees are already at the maximum level compatible with merchant acceptance, platform competition does not affect the choice of the optimal interchange fee.

If consumers multihome, the reasoning is the same as for monopolist merchants, except that attracting merchants now involves attracting consumers as well. Therefore, payment systems compete by maximising the joint surplus of end users. Since payment systems now take into account the surplus of merchants, the interchange fee resulting from platform competition is lower than the profit maximising interchange fee chosen by a single payment platform. From the perspective of welfare maximisation, the optimal interchange fee should be set such that cardholders decide to use their cards when the joint profit is higher than the joint cost, while merchants still accept cards. However, platform competition leads to an equilibrium interchange fee which is lower than the socially optimal interchange fee, because it does not take into account banks' profits. Since banks' margins are constant, banks' profits depend only on the transaction volume, which increases with the interchange fee.

The previous results are called into question under the assumption of heterogeneous merchants. Indeed, competition can lead to higher or lower interchange fees, depending on a trade-off on consumers' side. Consumers may want to join card schemes which have low fees but few merchants accepting cards, or high fees and many merchants. If the average cardholding benefit decreases with consumer fees, Guthrie and Wright (2003) show that platform competition will lead to a higher interchange fee. This result holds if merchants are monopolists, and if total users' price is independent of the interchange fee.

Guthrie and Wright (2007) provide another version of the same model, in which consumers get neither costs nor benefits for holding the card. They decide at stage 2 on the number of cards to hold. Since the cardholding and card acceptance decisions lead to multiple equilibria, they assume that buyers and sellers coordinate on equilibria which maximise a weighted sum of their joint interest, $\phi_S(a) + (\alpha + \omega)\phi_B(a)$, where $\alpha \in [0;1]$ is the probability that consumers are informed about card acceptance, and ω denotes the weight of consumers' profits. Also, they assume that banks make zero profit.

They show that, in any equilibrium, all card transactions occur at a single card fee, corresponding to a single interchange fee. Either both payment associations set the same interchange fee and they share card transactions with at least one side involving all agents multihoming, or one payment association attracts all cards transactions exclusively at this interchange fee.

Result 15 (Guthrie and Wright (2007)) "Competition between two identical payment platforms facing strategic homogeneous merchants"

When buyers' interests are not weighted too highly ($\omega < \omega^*$)*, competing card schemes set lower interchange fees than a single card scheme, that is* $a^{PC} < a^P$.

When buyers' interests are given more weight ($\omega \geq \omega^*$)*, competing card schemes set the same interchange fee as that chosen by a single scheme, and* $a^{PC} = a^P$.

If buyers' interests are not weighted too highly ($\omega < 1 - \alpha$)*, competing card schemes set interchange fees too low,* $a^{PC} < a^W$. *If buyers' interests are given more weight* ($\omega > 1 - \alpha$)*, competing card schemes set interchange fees too high if* $\alpha > 0$ *or at the welfare maximising level if* $\alpha = 0$.

If $\omega = 1 - \alpha$*, competing card schemes set interchange fees at the welfare maximising level.*

Proof. See Guthrie and Wright (2007).

The intuition of the result is the same as in the previous model. If the interchange fee is determined by a single payment association, the sellers' surplus is completely extracted, because of merchants' homogeneity as in the previous result.

Platform competition can in some cases reduce the bias against merchants. If the buyers' interests are not weighted too highly, the payment platforms compete to attract merchants, because they know that merchants can turn down the card with the highest interchange fee. If buyers' interests are given more weight, the interchange fee that results from platform competition is the same as the interchange fee chosen by a profit maximising payment platform.

The expression of social welfare is the following:

$$W = D_B(f)((\alpha + \omega)(\beta_B(f) - f) + b_S - m).$$

A single payment association maximises $D_B(f)$ subject to merchants' participation constraint. Under platform competition, if α or ω are increased, the cardholders' benefits receive more weight in welfare maximisation, which means that the optimal interchange fee increases.

Guthrie and Wright (2007) obtain a similar result with heterogeneous merchants. There is a critical weight of buyers' interests under which competing card schemes set a lower interchange fee than a single payment association. However, if merchants are heterogeneous, competing payment associations can choose a higher interchange fee than a single card scheme, which is not the case under merchants' homogeneity, because the payment card association sets already the highest interchange fee compatible with merchant acceptance.

6.3 Competition between differentiated payment platforms if the total price is not constant

I now introduce Chakravorti and Roson (2006)'s results about competition between differentiated proprietary payment platforms. Their model does not fit in my general model, because the timing of the game is changed by their assumptions (See Appendix D). Chakravorti and Roson (2006) extend the previous research by relaxing the assumption of a constant total price. Under this assumption, they show that the equilibrium prices resulting from competition between asymmetric platforms are lower than the prices chosen by a monopolistic cartel, which maximises the joint profits of both payment associations.

Result 16 (Chakravorti and Roson (2006)) "Competition between asymmetric platforms"

Equilibrium prices are not higher in duopoly than in monopolistic cartel.
The welfare of consumers and merchants is increased under duopoly.
Neither competition nor cartel yields welfare-efficient price structures.

Proof. See Chakravorti and Roson (2006).

Chakravorti and Roson do not obtain general analytical results about competition between asymmetric payment platforms, because of the complexity of their model. However, their work extends Guthrie and Wright (2003)'s results to the case of competing payment networks which provide specific benefits to consumers and merchants.

6.4 Competition between payment platforms and the HACR

Rochet and Tirole (2006c) analyse the impact of platform competition and the Honour All Cards Rule (HACR) on optimal interchange fees. They build a model in which there are two types of transactions, debit and credit, which may be either unbundled or tied on the merchant side. Under the HACR, a merchant is forced to accept debit cards if he accepts credit cards. They examine if tying debit and credit card acceptance increases or decreases welfare, when there is competition between two identical payment platforms.

In their model, demands for debit and credit card transactions are independent, merchants are homogenous, and payment systems are identical.

Result 17 (Rochet and Tirole (2006c)) "Platform competition and the HACR".
If the HACR does not hold, network competition results in identical fees for debit cards, while the credit card fee is the minimum fee that is compatible with merchant acceptance.
The HACR raises the interchange fee for debit and lowers the interchange fee for credit,
Also, the HACR always improve social welfare.

Proof. See Rochet and Tirole (2006c).

The intuition of this result is the following. Rochet and Tirole (2002), and Guthrie and Wright (2003) showed that, if consumers multihome, the interchange fee may become lower under platform competition, because the merchants have an opportunity of bypassing one system, while accepting the card issued in the other system. If the interchange fee is initially too high, platform competition increases social welfare. If consumers are perfectly informed about card acceptance, under platform competition, merchants take into account the total user surplus in their card acceptance decision. Therefore, under the HACR, merchants choose to accept both cards if it increases the total user surplus. If the HACR does not hold, the cardholder fee on credit card transactions is the minimum fee compatible with merchant acceptance, while the debit card transaction fee is high. Under the HACR, the payment system gains flexibility in its attempt to allocate costs between each side of the market, because the merchant acceptance constraint binds over the set of cards, rather than over each card. By choosing a higher interchange fee on debit card and a lower interchange fee on credit cards, the payment system can increase the transaction volume, while keeping the same combination of transaction fees.

7 Conclusion

The existing theoretical literature on payment systems has explained how interchange fees can contribute to correct the usage externalities by balancing consumers demand and merchants' acceptance decision. The differences between the profit maximising interchange fee and the welfare maximising interchange fee depend on the nature of competition between banks, and on the nature of strategic interactions between merchants. Lifting the "No Surcharge Rule" does not necessarily improve social welfare if merchants have market power, while platform competition does not lead to welfare maximising interchange fees in all cases.

This literature on interchange fees is recent, and many aspects of the payment card industry have not been modelled yet. For instance, models should be able to take into account competition between open-loop and closed-loop payment platforms, the impact of interchange fees on investments, the possibility to withdraw cash with payment cards, and the risks involved in payment transactions. It is also important to call into question several assumptions of the literature, especially the fact that the market structure is exogenous, and the normalisation of the transaction volume. It should be also useful to develop richer models of platform competition with differentiation, and to test empirically the results of the theory.

8 References

Balto, D. (2000) "The Problem of Interchange Fees: Costs without Benefits?," *European Law Review*, : 215-224.

Baxter, W. (1983) "Bank Interchange of Transactional Paper: Legal and Economic Perspectives," *Journal of Law & Economics*, vol.26, n°3 (October) : 541-88.

Carlton, D.W. and A.S. Frankel (1995) "The Antitrust Economics of Payment Card Networks," *Antitrust Law Journal*, 63: 643-668.

Chakravorti, S. (2003) "Theory of Credit Card Networks: A survey of the literature," *Review of Network Economics*, vol.2, n°2 (June): 50-68.

Chakravorti, S. and R. Roson (2006) "Platform competition in Two-Sided Markets: The Case of Payment Networks" *Review of Network Economics*, vol.5, Issue 1 (March): 118-142.

Gans, J. and S. King (2003) "The Neutrality of Interchange Fees in Payment Systems," Topics in Economic Analysis & Policy, Berkeley Electronic Press, vol. 3, n°1: 1069-1069.

Guthrie, G. and J. Wright (2003) "Competing Payment Schemes," Working Paper n°0311, Department of Economics, National University of Singapore.

Guthrie, G. and Wright, J. (2007) "Competing Payment Schemes," *Journal of Industrial Economics*, vol. 55, No. 1, pp. 37-67, March.

Hayashi, F. and S.E. Weiner (2005) "Competition and Credit and Debit Card Interchange Fees: A Cross-Country Analysis," Working Paper 05-03, Payment System Research Department, Federal Reserve Bank of Kansas City.

Hayashi, F. (2006) "A puzzle of Card Payment Pricing: Why Are Merchants Still Accepting Card Payments?," *Review of Network Economics*, vol.5, Issue 1 (March): 144-174.

Hunt, R. (2003) "An introduction to the Economics of Payment Card Networks," *Review of Network Economics*, vol.2, n°2 (June): 80-96.

Rysman, M. (2006) "An empirical analysis of Payment Card Usage," *Journal of Industrial Economics*, Forthcoming.

Rochet, J-C. (2003) "The Theory of Interchange Fees: A Synthesis of Recent Contributions," *Review of Network Economics*, vol.2, n°2 (June): 97-124.

Rochet, J-C. and J. Tirole (2002) "Cooperation Among Competitors: The Economics of Payment Card Associations," *RAND Journal of Economics*, vol.33, n°4 (winter): 549-570.

Rochet, J-C. and J. Tirole (2003a) "An Economic Analysis of the Determination of Interchange Fees in Payment Card Systems," *Review of Network Economics*, vol.2, n°2 (June): 69-79.

Rochet, J-C. and J. Tirole (2003b) "Platform Competition in Two-Sided Markets," *The European Economic Association*, vol.1, n°4 (June): 990-1209.

Rochet, J-C. and J. Tirole (2006a) "Two-sided Markets: a Progress Report," RAND Journal of Economics, vol.37, n°3 (March): 645-667.

Rochet, J-C. and J. Tirole (2006b) "Must-Take Cards and the Tourist Test," Working Paper, IDEI.

Rochet, J-C. and J. Tirole (2006c) "Tying in Two-Sided Markets and the Honor All Cards Rule," Working Paper, IDEI.

Schmalensee, R. (2002) "Payment Systems and Interchange Fees," *Journal of Industrial Economics*, vol.50, n°2 (June): 103-122.

Schmalensee, R. (2003) "Interchange Fees: A Review of the Literature," *Payment Card Economics Review*, vol. 1: 25-44, Winter 2003.

Schwartz, M. and D.R. Vincent (2006) "The No Surcharge Rule and Card User Rebates: Vertical Control by a Payment Network," *Review of Network Economics*, vol. 5, Issue 1 (March): 72- 102.

Weiner, S.E., and J. Wright (2005) "Interchange Fees in Various Countries: Developments and Determinants," *Review of Network Economics*, vol.4, Issue 4 (December): 290-323.

Wright, J. (2002) "Optimal Payment Card Systems," *European Economic Review*, vol.47, n°4 (August): 587-612.

Wright, J. (2004) "Determinants of Optimal Interchange Fees in Payment Systems," *Journal of Industrial Economics*, vol.52, n°1 (March): 1-26.

9 Appendix

Appendix A. The assumptions of the literature

Let us summarise briefly the assumptions of the literature in the following table. The letter S stands for Section, the letter Ss for subsection, and the letter P for Proposition.

	Consumers	**Merchants**	**Issuers**	**Acquirers**	**Payment system rules**
Baxter (1983)	One consumer	One merchant	Perfect competition	Perfect competition	NSR. No hypothesis on governance.
Carlton and Frankel (1995)	One consumer	One merchant	Perfect competition	Perfect competition	Surcharges allowed.
Rochet and Tirole (2002)	Heterogeneous. Exogenous card holding. No fixed fees (except in S5 P4). Perfectly informed about acceptance (except in S5 P5).	Hotelling differentiated. Strategic behaviour. Homogenous (until S6).	Market power. Issuers' profits are increasing with the IF.	Perfect competition.	Open-loop association controlled by issuers. NSR (except in S5 P6). HACR. In S6 P7, closed-loop system.
Schmalansee (2002)	Homogeneous. Exogenous card holding. Per transaction fees only. General demands (S3). Linear partial demand, decreasing (S4).	Homogeneous. Non strategic. General demands (S3). Linear partial demand, decreasing (S4).	Monopoly (S3-2). Other market structures(S3-3, S4).	Monopoly (S3-2). Other market structures (S3-3, S4).	Open-loop association jointly owned by issuers and acquirers. Proprietary system in S4. NSR. HACR.

Rochet and Tirole (2003b)	Not informed about card acceptance. Exogenous card holding. Heterogeneous.	Heterogeneous Non strategic.	Margins constant.	Margins constant.	NSR. HACR.
Gans and King (2003)	Annual card holding fees and usage fees.	2 types of merchants: cash only merchants and credit card merchants. Different assumptions about merchant competition.	Different kinds of competition between issuing banks. Existence of integrated banks which are both issuers and acquirers.	Acquiring banks care only about total fees.	Surcharges allowed or not.
Guthrie and Wright (2003)	Endogenous card holding. No cost of holding a card. Card holding benefits heterogeneous. Card usage benefits do not vary by network. Single-homing versus multi-homing.	Monopolistic (Ss1) or strategic merchants (Ss2). Homogenous (S3) or heterogeneous in card benefits (S4).	Margins constant.	Margins constant. Degree of pass through to merchants is 100%.	2 competing identical platforms. Perfect competition between payment schemes.
Wright (2003)	Same as R&T 2002. Except: Not socially optimal for all consumers to join the payment system. Endogenous card holding in S4, Ss4-6.	Homogeneous. Two cases: Monopolist merchants (S4) and Bertrand competition (S5).	Market power. Issuers' profits are increasing with the IF.	Perfect competition.	Comparison of surcharging versus NSR. Open-loop association controlled by issuers.

Wright (2004)	Identical to R&T 2002. Membership fees in S4.	Different industries. Merchants from the same industry are homogenous. Merchants from different industries are heterogeneous. Hotelling competition.	Market power. Fixed costs for banks in S4.	Market power. Fixed costs for banks in S4.	NSR. HACR.
Chakravorti and Roson (2006)	Hold at most one card and pay a fixed card fee. Endogenous card holding. Heterogeneous in card benefits. Card benefits vary by network. The distributions of card benefits are independently drawn (S3).	Heterogeneous. Non strategic. Card benefits vary by network. Card acceptance does not depend on the number of consumers members of a network.	No intra-system competition.	No intra-system competition.	2 proprietary platforms. (No modelling of IF). Both symmetric and asymmetric forms of competition are considered. NSR.
Schwartz and Vincent (2006)	Card holding is exogenous: one group of consumers use only cards. No fixed fee. Rebates are allowed in S5.	Local monopolists.	Collusive issuers (S5). Perfect competition (S6).	Perfectly competitive.	Proprietary network/ or equivalently open-loop network with the previous assumptions on I and A. Surcharges allowed.
Rochet and Tirole (2006b)	Heterogeneous cardholders. No annual fees. Fixed demand for transactions.	Homogeneous merchants except in S5 and S7. Merchants internalise the increase in the quality of service	Constant margins in S3, variable margins in S5. Free entry on the issuing market in S5,	Perfect competition.	NSR.

		perceived by consumers if they accept cards.	either with identical issuers, or with differentiated issuers.		
Guthrie and Wright (2007)	Heterogeneous cardholders. No fees.	Homogeneous except in S4.	Perfect competition.	Perfect competition.	NSR.

Appendix B: Section 4.2. General results if merchants are homogenous and consumers heterogeneous.

If the total price increases with the interchange fee, the profit of the payment platform increases with the interchange fee. Indeed, under the NDR, if merchants accept cards, the profit of the payment platform is

$$\pi = D_B(f)(f + m - c_I - c_A).$$

Since $D_B(f)$ increases with *a* (under the assumptions of Section 2), if $f + m$ increases with *a*, the profit of the payment platform increases with the interchange fee.

Banks make zero profit if merchants refuse payment cards. Hence, it is optimal for the payment platform to choose the maximum interchange fee compatible with merchants' acceptance of payment cards.

The social welfare is expressed as follows

$$W = D_B(f)(\beta(f) + b_S - c_I - c_A).$$

Solving for the first order condition of welfare maximisation yields

$$\frac{dW}{da} = -\frac{df}{da} h_B(f)(f + b_S - c).$$

Since W is assumed to be concave, if $\left.\frac{dW}{da}\right|_{a=\bar{a}} \geq 0$, then $a^W = \bar{a}$. Otherwise, $a^W < \bar{a}$. We have that

$$\left.\frac{dW}{da}\right|_{a=\bar{a}} = -\left.\frac{df}{da}\right|_{a=\bar{a}} h_B(f(\bar{a}))(f(\bar{a})) + b_S - c).$$

Since $\left.\frac{df}{da}\right|_{a=\bar{a}} \leq 0$, and $h_B(f(\bar{a})) \geq 0$, if $f(\bar{a})) + b_S - c \geq 0$ then $a^W = \bar{a}$. This proves Proposition 5.

<u>Appendix C: Assumptions of Result 16 (Chakravorti and Roson (2006)).</u>

i. There are two proprietary payment platforms indexed by $i = 1;2$, which choose directly the fees paid by the consumers and the merchants.

ii. Consumers receive a benefit b_B^i of paying with the card of platform i, where b_B^i is distributed according to a probability density h_B^i over an interval $\left[0;\overline{b_B^i}\right]$. They pay the fixed cardholder fee F^i and pay no transaction fee. Each platform incurs an affiliation fixed cost A_B^i for each consumer. It is assumed that consumers singlehome.

iii. Merchants receive a benefit b_S^i of accepting the card of platform i, where b_S^i is distributed according to a probability density h_S^i over an interval $\left[0;\overline{b_S^i}\right]$. They do not pay any fixed fee, and pay a transaction fee m^i to platform i when its card is used.

iv. The timing of the game is as follows. Consumer and merchant benefits are randomly drawn. Then payment card associations choose the cardholder and merchant fees that maximise their profits. Merchants decide which card to accept, and consumers decide which payment instrument to purchase. Afterwards, transactions are realised.

IV. <u>CHAPITRE III :</u>
ROLE DES INTERCHANGES DANS LES STRATEGIES D'INVESTISSEMENT DES ACTEURS DES SYSTEMES DE PAIEMENT PAR CARTE.

Dans ce chapitre nous déterminons comment les systèmes de paiement choisissent les interchanges pour tenir compte des investissements des acteurs des systèmes de paiement par carte. Dans le premier article, qui s'intitule « *Interchange Fees and Incentives to Invest in Quality of a Payment Card System* », nous nous intéressons aux investissements que les banques peuvent réaliser pour améliorer la qualité de service fourni aux consommateurs et aux commerçants. Nous montrons en particulier que le système de paiement peut avoir intérêt à réduire l'interchange payé par la banque acquéreur pour favoriser les investissements en qualité. Dans le second article, « *Private Cards and the Bypass of Payment Systems by Merchants* », nous étudions l'influence de l'interchange sur le choix que font certains commerçants d'investir dans leur propre infrastructure de paiement, en devenant émetteurs de cartes privatives. Nous montrons que s'il souhaite dissuader l'entrée de commerçants sur le marché des transactions de paiement, le système de paiement peut dans certains cas choisir de diminuer l'interchange.

<u>Articles :</u>

IV.1. <u>Interchange Fees and Incentives to Invest in Quality of a Payment Card System.</u>

VI.2. <u>Private Cards and the By-Pass of Payment Systems by Merchants.</u>

Interchange fees and incentives to invest in the quality of a payment card system*

Marianne Verdier†

October 20, 2008

Abstract

In this paper, I analyse the optimal interchange fee in a payment card system where two monopoly banks (an Issuer and an Acquirer) can invest to deliver a better quality of service to their customers. If the level of quality is exogenous, I extend Baxter (1983)'s model, by showing that the optimal level of interchange fee, which is equal to the Acquirer's margin (the merchant's bank), depends on the level of quality delivered by the payment system. If the level of quality is endogenous, the level of the interchange fee which maximises banks' joint profits depends on the relative contributions of banks to quality investments, and the relative perceptions of quality improvements on each side of the market. I show that, in some cases, because of the strategic effects, the payment platform may choose an interchange fee which is strictly lower than the Acquirer's margin in order to stimulate the Acquirer's investments.

JEL Codes: G21, L31, L42.

Keywords: Payment card systems, interchange fees, two-sided markets, investments in quality.

*I would like to thank Marc Bourreau for helpful comments and discussions, and audiences at the CREST-LEI seminar, the PSE-TOM seminar, and at the 2007 EARIE Conference.

†Author's affiliation: ENST, Department of Economics and Social Sciences, 46 rue Barrault, 75634 Paris Cedex 13, France; E-mail: marianne.verdier@enst.fr.

1 Introduction

Payment cards have become very popular over the last twenty years. For instance, in Europe, a total of 23 billion card payments are made annually, with an overall value of 1,350 billion Euros.[1] In several countries, the usage of payment cards has surpassed the usage of cash for retail payments. For instance, in the United Kingdom, total spending on payment cards outstripped cash spending for the first time in 2004, and the average adult owns 3.6 payment cards.

The success of payment cards can be related to their quality and convenience. In many countries, payment card systems have strived to improve the level of quality of payment card services, both for consumers and merchants, such as the delay and quality of transaction processing, the quality of payment terminals and communication facilities, the quality of security measures, the information about acceptation points for consumers, and the information about fraudsters for merchants. The level of quality of payment cards services depends on the investments made by the banks or imposed by the payment system.

This paper tries to determine the optimal price structure of a payment system when banks can invest in quality. In open-loop payment systems, such as Visa and MasterCard, a key element which influences the price structure and the volume of transactions made by cards is the payment of an interchange fee by the merchant's bank (the Acquirer) to the cardholder's bank (the Issuer). My purpose is to study the effect of the interchange fee on banks' incentives to invest in the quality of payment card services.

To that end, I propose a framework to study quality investments in a payment system, and their effects on the optimal interchange fee. My aim is to determine if a payment system, which has the opportunity of improving its quality of service, should adjust its interchange fee. I show that it depends on the asymmetries between each side of the market, namely the relative contribution of each bank to investments in quality, and the relative effect of quality improvements on consumers and merchants.

Recent discussions between the European Commission and the banks have shown that the relationship between the level of the interchange fee and the quality of the payment system services is a relevant policy issue, especially in Europe. On the one hand, in the Interim Report on Payment Cards released in April 2006, the European Commission called into question the role of interchange fees, which could lead to excessive profits in the issuing industry. On the other hand, several banks argued in their responses to the Interim Report that the profitability

[1] Source: Interim Report on Payment Cards, European Commission (April 2006).

measured was exaggerated "by ignoring the cost of financing investments in a payment card business".[2] According to the banks, interchange fees are necessary to provide them with the right incentives to share investments, which improves the quality of the services provided by the payment system. Since additional investments will be needed to ensure interoperability between payment card schemes for the creation of the Single Euro Payments Area (SEPA),[3] a reflexion about the relationship between the level of the interchange fee and the investments in quality should provide interesting insights to the debate between the banks and the competition authorities.

In this paper, I model a payment card system as a two-sided platform, which organizes the interactions between a monopolistic Issuer and a monopolistic Acquirer by choosing an interchange fee, paid by the Acquirer to the Issuer. In my setting, the Issuer provides payment card services to heterogeneous cardholders, while the Acquirer provides payment card acceptance facilities and services to homogeneous merchants. If banks have the possibility to invest in quality, I assume that the quality of the payment card service is defined as a weighted sum of contributions from the Issuer and the Acquirer.

The observation of payment card systems shows that both banks contribute to a better quality of service for consumers and merchants. For instance, the improvement of the security requires investments from the Issuer and the Acquirer. The Issuer invests to improve the quality of the chip, to gather data about card numbers, cardholders, fraudulently used cards, while the Acquirer invests to install specific software on merchants electronic payment terminals, which enables them to obtain information from the authorisation network. To improve the response of the authorisation network, the Issuer and the Acquirer must install several network lines, increase the size of their database, improve the quality of their electronic equipment. The guarantee of payment for merchants requires a screening of cardholders which can only be completed by the Issuer. These latter examples show that quality investments do not have necessarily the same impact on consumers and merchants. Therefore, I model the impact of quality investments on each side of the market with two different parameters. I assume that, if

[2]This was the response of Barclays, which carries on by saying that "the continued development of EMV Chip+PIN and secure e-commerce technology which are both important ingredients in SEPA are dependent on the continuation of current, successful payment card business models". Citybank added that interchange fees provide "incentives for innovation and investments". La Caixa pointed out that investments to implement the EMV technology amounted to 40,295,500 Euros until 2010 and that 25,000,000 Euros had already been invested in updating ATM and terminals. Swedbank argued that interchange fee are needed to ensure "investments in build-up, maintenance and continuing development of payment card services". See: "http//ec.europa/comm/competition/antitrust/others/sector_inquiries/financial_services/rep_report_1.html".

[3]The aim of the Single Euro Payments Area si to build a zone in which consumers will be able to make and receive payments in Euro under the same conditions, obligations and rights, regardless of their location.

consumers benefit from a higher level of quality, the demand for payment card services increases on the consumer side. Since merchants are homogeneous, I assume that, if merchants benefit from a higher level of quality, their willingness to pay for payment card acceptance facilities increases.

Many banks cannot coordinate on the choice of an optimal level of quality of service, because they are sometimes specialised either on the issuing or the acquiring services. Some payment platforms correct this type of externality by imposing on banks a minimum level of investments in quality. However, the payment platform cannot always sign contracts with banks which will ensure that they will make the appropriate level of effort in order to reach the level of quality needed to optimize the profits of the system.

Therefore, my model focuses on the choice of the levels of quality once the interchange fee has been fixed by the payment platform. I begin the analysis with a benchmark case, in which the level of quality is exogenous. I show that, in this case, it is optimal for the payment system to choose an interchange fee which is equal to the Acquirer's margin per transaction, like in Baxter (1983)'s model. But, unlike Baxter's interchange fee, in my model, the optimal level of interchange fee takes into account the level of quality of service.

If the levels of quality are endogenous, I show that the profit maximising interchange fee may be strictly lower than the Acquirer's margin, if investments in quality impact relatively more the consumer side. This is because, in some cases, the Acquirer's investments in quality and the interchange fee become strategic substitutes. Therefore, sometimes, the payment platform will make more profit by decreasing the level of interchange fee to provide the Acquirer with incentives to invest in quality, which impact the cardholders' demand positively. If investments impact relatively more the merchant side, the optimal interchange fee is the maximum interchange fee that satisfies the budget constraint of the Acquirer.

Afterwards, I take the point of view of a social planner, who tries to determine the welfare maximising interchange fee. I show that, if investments in quality impact relatively more the merchant side, the welfare maximising and the profit maximising interchange fee are equal. On the contrary, if investments impact relatively more the consumer side, I derive the conditions under which there is an overprovision of payment card services when the interchange fee is chosen by a profit maximising payment platform.

Then, I analyse the case in which the payment platform can also choose the levels of quality. The payment platform solves the coordination problem faced by the banks when they make their investment decisions. I show that, in this case, the interchange fee is fixed at the maximum level compatible with the budget constraint of the Acquirer, which is not always the case if banks cannot cooperate on investments, because of the coordination problem. However, the level of the interchange fee with cooperation on investments may be higher or lower than the profit maximising interchange fee if banks cannot cooperate on the quality choices.

Finally, I discuss the main assumptions of my model: the market structure and the homogeneity of merchants. I also discuss the optimal structure of the interchange fee. When the Acquirer's budget constraint is binding, the payment platform can increase its profit by choosing a two-part tariff structure for the interchange fee, which is not the case in Baxter (1983)'s model. My model gives also the intuition that, if the market is more concentrated on the acquisition side, the optimal interchange fee may be decreased to obtain a higher level of quality. I also extend Schmalensee (2002)'s model by showing that, if merchants are heterogeneous, if banks are monopolists and if the level of quality is exogenous, the interchange fee should be chosen so as to equalize banks' marginal costs, net of the marginal benefits of investments in quality. Unfortunately, our results cannot be generalised easily if the levels of quality are endogenous.

The existing literature on payment systems does not take into account the possibility for banks to invest in the quality of the payment system. Many authors (see among others: Baxter 1983, Rochet and Tirole 2002, Schmalensee 2002, Wright 2004) have analysed the role of interchange fees, which is to balance demands from the two sides of the market, and to optimise the functionning of the payment system. They have also compared the socially optimal interchange fee with the fee chosen by the payment system to maximise its profits, in order to assess the welfare effects of this "cooperation between competitors".[4] These models involve various assumptions about consumers, merchants, and competition between banks.[5] However, none of them takes into account the additional utility generated by a better level of quality, as it is done in my paper.

The closest paper to mine is the paper by Rochet and Tirole (2007) in which the level of quality perceived by the cardholder is internalised by the merchant for strategic purposes. In their model, merchants accept cards if the merchant commission is lower than their card acceptance benefits plus a parameter that models the consumers' awareness of the quality of service. The perspective of my paper is different, because I model a specific perception of the quality of service on each side of the market, and link it to banks' investments, which is not done in Rochet and Tirole's paper. In my paper also, merchants are not strategic, so they do not internalise the level of quality perceived by consumers. This assumption enables me

[4] Rochet and Tirole (2002).

[5] In the literature, consumers are assumed to be either homogenous or heterogeneous. Strategic merchants can sometimes use cards to differentiate themselves from their competitors (Rochet and Tirole, 2002). Different kinds of competition between issuers on the one hand, and acquirers on the other hand are modelled. For a review of the literature, see Rochet (2003).

to understand better the influence of the strategic interactions between banks when the latter choose how much to invest in quality.

The rest of the paper is organised as follows. In section two, I start by presenting the model and the assumptions. In section three, I solve for the equilibrium of the game. In section four, I study an example with quadratic cost functions. In section five, I give extensions of the results obtained in section four with other market structures, and heterogeneous merchants. I also discuss the optimal structure of the interchange fee. Finally, I conclude.

2 The model

I model an open-loop payment system as a two-sided market. On the issuing side, a monopolistic Issuer provides payment card services to heterogeneous cardholders. On the acquiring side, a monopolistic Acquirer provides payment card terminals and payment acquisition services to homogeneous merchants. The payment platform organises the interactions between the Issuer and the Acquirer by setting an interchange fee which is paid by the Acquirer to the Issuer on a per-transaction basis.

The respective benefits of card usage for consumers and card acceptance for merchants depend on the quality of the services offered by the payment system. The overall quality of the payment system depends on banks' investments in quality.

Consumers: Each consumer owns a payment card and another payment instrument.[6] A consumer is characterised by his benefit, b_B, of using a payment card rather than the other payment instrument. The benefit b_B is assumed to be uniformely distributed over $[0, 1]$, which implies that consumers differ across their card usage benefits. One interpretation is that they may attach different values to the convenience of using a payment card rather than cash.

I assume that, if the payment system delivers a higher quality of service, the consumers' benefits of card usage increase. For instance, if investments are made to decrease the duration of a card transaction at the point of sales, consumers may find it more convenient to use their cards rather than cash. Denoting the quality of the payment system by θ, the card usage benefit of a consumer of type b_B becomes $b_B + \alpha_B\theta$, where α_B is a parameter that represents the constant marginal positive effect of quality on usage benefits. Under this assumption, consumers with different types benefit equally from a better quality of service.

[6] In the model, I consider cardholding decisions as exogenous, and focus on the choice of using a payment card rather than another payment instrument, like cash, for instance, at the point of sales.

Merchants: I suppose that merchants are homogeneous as regards to their card usage benefit, which is denoted by b_S (with $b_S \geq 0$). Merchants are not strategic. I also assume that the quality of the payment system increases their benefits of card usage. If the quality of the payment system is θ, merchants' benefit of card usage becomes $b_S + \alpha_S \theta$, where α_S is a parameter that represents the marginal positive effect of quality on merchants'utility.

Notice that the marginal effects of quality on the benefits of consumers and merchants differ if $\alpha_S \neq \alpha_B$.

Banks: The Issuer (I) and the Acquirer (A) are monopolists. For each transaction, the Issuer charges card-users with a fee, f, and the Acquirer charges merchants with the commission, m. The Acquirer pays to the Issuer a per-transaction interchange fee, denoted by a. The interchange fee can be either positive or negative. Banks' have constant marginal costs c_i per transaction, for $i = I, A$, and the total marginal cost of the system is defined as $c = c_A + c_I$. The per-transaction margins are denoted by M_i, for $i = I, A$. Profits are denoted by π_I and π_A.

Banks can invest to improve the quality of payment card services. The level of quality set by bank i is denoted by θ_i, for $i = I, A$. The cost of a quality level of θ_i is denoted by the function $C_i(\theta_i)$ where $i = I, A$. I assume that $C_i(\theta_i)$ is twice differentiable and that $C_i^{'}(\theta_I) > 0$ and $C_i^{''}(\theta_I) > 0$. The quality of payment card services is modelled as a combination of the quality produced by the Issuer, θ_I, and the quality produced by the Acquirer, θ_A:

$$\theta = \lambda_I \theta_I + \lambda_A \theta_A,$$

where λ_I and λ_A reflect the respective contribution of the Issuer and the Acquirer to the quality of the payment system ($\lambda_i \geq 0$ for $i = I, A$). I denote the total cost of the payment system by $C_S(\theta) = C_I(\theta_I) + C_A(\theta_A)$.

If all merchants accept cards, the Issuer and the Acquirer make profits

$$\pi_I = VM_I(a, f) - C_I(\theta_I),$$

and

$$\pi_A = VM_A(a, m) - C_A(\theta_A),$$

where V represents the transaction volume.

If no merchant accepts cards, banks make no profits, i.e., $\pi_i = 0$ for $i = I, A$.

Payment system: The payment system (S) chooses the interchange fee, a, which maximises the sum of banks' profits, $\pi_S = \pi_I + \pi_A$. I assume that surcharges are not allowed, which means that merchants are forbidden to charge consumers a higher retail price if the latter use their payment cards. The total margin of the payment system is denoted by $M_S = M_I + M_A$.

Finally, I define the social welfare, W, as the sum of consumers' surplus, S_C, merchants' surplus, S_M, and banks' profits, $\pi_I + \pi_A$.

I also make the following assumptions:

A1 $b_S \geq c_A$.

A2 At the equilibrium, some consumers use their cards but not all.

A3 $C_I''(\theta_I) > \frac{(\alpha_B \lambda_I)^2}{2}$ and $C_A''(\theta_A) > (\alpha_S \lambda_A)^2$ for all $\theta_I, \theta_A \geq 0$.

The first assumption means that merchants accept cards if the Acquirer prices the transaction at its marginal cost. The second assumption states that the market is not covered at the equilibrium, which enables me to analyse the relationship between the interchange fee and the expansion of the payment card market. The third assumption ensures that the second-order conditions are satisfied in the maximisation problems.

The timing of the game is as follows:

1. The payment platform chooses the interchange fee, a, which maximises the joint profits of the banks.
2. Banks decide simultaneously and non-cooperatively on the levels of quality, θ_I and θ_A.
3. Banks choose simultaneously and non-cooperatively their transaction fees, f and m.
4. Consumers decide whether or not to use their payment cards. Merchants decide whether or not to accept cards.

I focus on the choice of the levels of quality once the interchange fee has been fixed by the payment platform. In practice, the level of the interchange fee is not reajusted very frequently,[7] which justifies the choice of this timing for the game. I study how the choice of the interchange fee impacts the levels of investment that are decided by banks, non cooperatively, without any intervention of the payment platform.

I look for the subgame perfect equilibrium, and solve the game by backward induction.

[7] For example, Visa has not changed the level of its interchange fee in Europe between 2002 and 2007.

3 The equilibrium

3.1 Stage 4: card usage and card acceptance

For given θ and m, a merchant accepts cards if

$$b_S + \alpha_S \theta \geq m. \tag{1}$$

Since all merchants have the same benefit b_S, all merchants accept cards if (1) holds, and no merchant accepts cards otherwise.

A consumer of type b_B wants to use his card if

$$b_B + \alpha_B \theta \geq f. \tag{2}$$

If all merchants accept cards, the transaction volume is equal to the percentage of consumers willing to use their cards, such that[8]

$$V = V(\theta, f) = P(b_B + \alpha_B \theta \geq f).$$

Notice that, since b_B is uniformely distributed over $[0;1]$, if $f - \alpha_B \theta \in (0;1]$, the market is not covered, and

$$V(\theta, f) = 1 + \alpha_B \theta - f. \tag{3}$$

At the equilibrium of stage 4, there are two possible cases. Either (1) holds such that all merchants accept cards, and $V(\theta, f)$ consumers use their cards, or no merchant accepts cards and all consumers use cash.

3.2 Stage 3: transaction fees.

Each bank chooses the transaction fees that maximise its profit. There are two cases: either m is set such that all merchants accept cards, or m is too high, such that no merchant accept cards. Let me start by the first case. If all merchants accept cards, banks' profits are expressed as follows:

$$\pi_I = V(\theta, f) M_I(a, f) - C_I(\theta_I),$$

and

[8] The market size is normalised to 1 in the model.

$$\pi_A = V(\theta, f)M_A(a, m) - C_A(\theta_A),$$

where $V(a, \theta, f)$ is given by (3). All merchants accept cards if the fee m is not too high. Since the Acquirer's profit, increases with m, for given a, θ_I, and θ_A, the Acquirer sets the maximum fee such that (1) holds, that is,

$$m(\theta) = b_S + \alpha_S \theta. \tag{4}$$

Given that cards are accepted by merchants, the Issuer chooses the consumer fee, f, that maximises its profit. Solving the first-order condition

$$\frac{\partial \pi_I}{\partial f} = 1 + \alpha_B \theta - a + c_I - 2f = 0,$$

the optimal fee is:[9]

$$f^*(a, \theta) = \frac{1 + \alpha_B \theta - a + c_I}{2}. \tag{5}$$

For the Issuer, the choice of the optimal customer fee involves a trade-off between a smaller margin per transaction and a higher transaction volume. Replacing for $f^*(a, \theta)$ in (3) yields the transaction volume at the equilibrium of the subgame, that is,

$$V(\theta, f^*(a, \theta)) = \frac{1 + \alpha_B \theta + a - c_I}{2} = V(a, \theta).^{10} \tag{6}$$

Notice that the transaction volume is increasing with the quality of the payment sytem, θ, and the interchange fee, a. Banks' margin at the equilibrium of stage 3 are expressed as follows:

$$M_I(a, \theta) = \frac{1 + \alpha_B \theta + a - c_I}{2} = V(a, \theta), \tag{7}$$

and

$$M_A(a, \theta) = b_S + \alpha_S \theta - a - c_A. \tag{8}$$

If cards are not accepted by merchants, no consumer uses his card, and banks make no profits. This does not constitute an equilibrium, as the Acquirer could raise its profit by choosing a merchant fee that satisfies (1).

[9] The second-order condition is satisfied.

[10] In the following sections, to simplify the exposition, I will abuse of the notation V, and write $V(\theta, f^*(a, \theta)) = V(a, \theta)$.

Notice that banks exert price externalities on each other. For instance, if the Acquirer chooses m such that no merchant accepts cards, the Issuer makes no profits, and loses all its consumers. Likewise, if the Issuer chooses a higher consumer fee, the transaction volume becomes lower, which reduces the profit of the Acquirer.

3.3 Stage 2: levels of quality

At stage 2, banks decide simultaneously and non cooperatively on their levels of quality. I start by looking at the properties of the best response functions, and then, I determine the equilibrium of the subgame. Bank i chooses the level of quality θ_i that maximise its profit π_i, given θ_j and a, for $(i,j) \in \{A, I\}^2$ and $i \neq j$. Its best response function is denoted by $R_i(a, \theta_j)$.

Lemma 1 *Assume that θ_I and θ_A constitute an equilibrium. Then, we have*

$$C_I^{'}(\theta_I) = \alpha_B \lambda_I V(a, \theta), \tag{9}$$

and

$$C_A^{'}(\theta_A) = \alpha_S \lambda_A V(a, \theta) + \frac{\alpha_B \lambda_A}{2}(b_S + \alpha_S \theta - a - c_A). \tag{10}$$

Proof. See Appendix A. ■

Each bank chooses its best response such that the marginal costs of investments are equal to the marginal benefits of a higher level of quality θ. The marginal benefits of a higher quality can be divided into two parts (see the table below): the marginal benefits obtained through higher prices, and the marginal benefits obtained because of an increase of the transaction volume.

First, investments in quality increase banks' margins per transaction, if their clients benefit from a higher quality of service.[11] Since banks have market power, they can raise their prices following an increase in the quality of service. For instance, we already noted from (5) that the customer fee increases with θ. We also proved in (4) that the Acquirer extracts all the surplus of the merchants, by charging them with a price, m, that reflects exactly their benefits of card acceptance. We summarise the marginal benefits obtained through higher prices in the following table:

[11] From (7), we know that the Issuer's margin per transaction increases with θ if $\alpha_B \neq 0$, and from (8), that the Acquirer's margin per transaction increases with θ if $\alpha_S \neq 0$.

Table 1: Marginal benefits of investments in quality

	Issuer	Acquirer
Marginal benefits obtained through higher prices.	$\frac{\alpha_B \lambda_I}{2} V(a, \theta)$	$\alpha_S \lambda_A V(a, \theta)$
Marginal benefits obtained through higher volumes.	$\frac{\alpha_B \lambda_I}{2} V(a, \theta)$	$\frac{\alpha_B \lambda_A}{2}(b_S + \alpha_S \theta - a - c_A)$

Second, from (6), we know that the transaction volume increases when banks invest more in quality, because the Issuer does not extract all the surplus from customers. We already noticed that, since merchants are homogeneous, the transaction volume depends only on cardholders' demand. This is an important source of asymmetry in our model. The Issuer chooses its level of quality according to the benefits generated on his side of the market, namely the cardholder side, while the Acquirer takes into account both sides of the market, which is reflected by the presence of α_B and α_S in (10).

In the setting, banks exert externalities on each other, by choosing their contribution to the overall level of quality, θ, which can be viewed as a public good.

It is important to note that, in the model, externalities are asymmetric. The first reason is that consumers are heterogeneous, while merchants are homogeneous, so, orginally, both sides of the market are not symmetric.[12] The monopolist Acquirer is able to charge merchants with the exact amount of quality increase, $\alpha_S \theta$, while the Issuer leaves some surplus to cardholders, because it controls the level of the transaction volume.

The second reason is that banks' contributions to the level of quality of the payment system are different if $\lambda_I \neq \lambda_A$. For instance, if $\lambda_i = 0$ and $\lambda_j > 0$, bank i may enjoy as a free-rider the benefits of bank j's investments. Therefore, in this case, bank j exerts a positive externality on bank i.

The third reason is that quality levels may be perceived differently by consumers and merchants if $\alpha_B \neq \alpha_S$. For instance, if $\alpha_B = 0$, cardholders do not benefit from a better quality of service, and the Issuer does not invest in quality. However, if $\alpha_S > 0$, the Acquirer and the merchants would benefit from a higher level of quality, so the Issuer exerts a negative externality on the other side of the market.

Lemma 2 *The levels of qualities, θ_I and θ_A, are strategic complements.*

Proof. See Appendix B. ■

If the Acquirer chooses a higher level of quality, this increases the transaction volume, and the Issuer's marginal benefits of quality investments. From (9), we know that the Issuer's level

[12] In section 5.2, I shall extend the model by introducing heterogeneity among merchants.

of quality is chosen such that its marginal benefits are equal to its marginal cost of quality. In our model, bank's marginal costs of quality are increasing with the level of quality. So, if the Acquirer invests more, the Issuer responds by choosing a higher level of quality. The intuition is exactly the same for the Acquirer: when the Issuer chooses a higher level of quality, this raises the Acquirer's marginal benefits of investments, so the Acquirer also chooses a higher level of quality at the equilibrium.

Lemma 3 *The Issuer's quality, θ_I, and the interchange fee, a, are strategic complements. If $\alpha_B \leq \alpha_S$, the Acquirer's quality, θ_A, and the interchange fee, a, are strategic complements, otherwise, they are strategic substitutes.*

Proof. See Appendix C. ■

The intuition behind this result is the following. We already saw that the Acquirer's incentives to choose a high level of quality depend on two effects:

- the marginal benefits obtained when quality increases, $\alpha_S \lambda_A$, multiplied by the transaction volume (gains from the merchant side),
- and the marginal volume of transactions generated by a higher quality, $(\alpha_B \lambda_A)/2$, multiplied by the margin M_A (gains from the consumer side).

If the interchange fee increases slightly from a to $a + da$, all other things being equal, the transaction volume rises by $da/2$, while the margin M_A diminishes by $-da$. That is, the Acquirer makes marginally positive profits from the merchant side, while it loses marginally from the consumer side. If $\alpha_B \leq \alpha_S$, merchants benefit marginally more from a higher quality than consumers, which implies that the Acquirer's marginal profits from the merchant side compensate its marginal losses from the consumer side. So, if $\alpha_B \leq \alpha_S$, then θ_A and a are strategic complements, and otherwise, they are strategic substitutes.

The Issuer's incentives to choose a high quality depend only on its gain from the consumer side. We saw in the previous subsection that the higher the transaction volume and the Issuer's margin are, the higher is the level of quality θ_I. A slight increase in the interchange fee generates at the same time a higher transaction volume and a higher margin for the Issuer. Therefore, θ_I and a are unambiguously strategic complements.

Equilibrium of the investment subgame: The levels of quality at the equilibrium are denoted by $\theta_I^*(a)$, $\theta_A^*(a)$, and $\theta^*(a)$, where:

$$\theta_A^*(a) = R_A(a, \theta_I^*(a)), \tag{11}$$

and

$$\theta_I^*(a) = R_I(a, \theta_A^*(a)). \tag{12}$$

Lemma 4 *If $\alpha_B \leq \alpha_S$, banks' levels of quality increase with the interchange fee, that is $(\theta_A^*)'(a) \geq 0$ and $(\theta_I^*)'(a) \geq 0$.*
Otherwise, the sign of $(\theta_A^*)'(a)$ and $(\theta_I^*)'(a)$ can be either positive or negative.

Proof. See Appendix D. ■

The result is quite intuitive if $\alpha_B \leq \alpha_S$. In that case, we know that the qualities and the interchange fee are strategic complements. At the same time, qualities are always strategic complements. So, if the interchange fee increases slightly, the Issuer's incentives to invest in quality increase, while the Acquirer's chooses a higher level of quality because of the effect of strategic complementarity. The same reasoning can be applied to the Issuer's choice of θ_I.

If $\alpha_B > \alpha_S$, the level of quality chosen by the Acquirer, θ_A , and the interchange fee, a, are strategic substitutes, while θ_I and a are strategic complements. If the interchange fee increases slightly, the Acquirer tends to reduce its level of quality, because the marginal increase of the transaction volume and the marginal benefits obtained on the merchant side are not sufficient to compensate the reduction of its margin. However, the levels of quality are strategic complements, and the Issuer chooses a higher level of quality. This tends to increase the level of quality chosen by the Acquirer. Depending on how both effects compensate each other at the equilibrium, the levels of quality chosen by the Issuer and the Acquirer can either increase or decrease. In section 4, I will provide an example that illustrates this case.

3.4 Stage 1: choice of the optimal interchange fee

Should a payment system choose a higher interchange fee when banks can invest in quality? In this section, I try to compare the profit maximising interchange fee with a benchmark case, in which the level of quality is exogenous. In another benchmark, I determine the optimal levels of quality if they are chosen by the payment platform. Afterwards, I take the point of view of a social planner, who tries to determine at stage one if the interchange fee choosen by a profit maximising payment platform leads to an overprovision of payment card services.

3.4.1 A benchmark: optimal interchange fee if the level of quality is exogenous

In this section, I assume that banks do not have the possibility to determine the level of quality of the payment system, that is, the parameter θ is exogenous. The payment system chooses the optimal interchange fee a^E so as to maximise banks' joint profits,[13] $\pi_S^E(a) = \pi_I^E(a) + \pi_A^E(a)$.

The profit of bank i is $\pi_i^E(a) = V^E(a)M_i^E(a)$ for $i \in \{A, I\}$, where

$$V^E(a) = M_I^E(a) = \frac{1 + \alpha_B\theta + a - c_I}{2},$$

and

$$M_A^E(a) = b_S + \alpha_S\theta - c_A - a.$$

Proposition 1 *If the level of quality θ is exogenous, the optimal interchange fee $a^E(\theta)$ paid by a monopolist Acquirer to a monopolist Issuer is equal to the Acquirer's margin, that is,*

$$a^E(\theta) = b_S - c_A + \alpha_S\theta.$$

The Acquirer makes no profit, whereas the Issuer makes strictly positive profits.
The optimal interchange fee $a^E(\theta)$ maximises the social welfare W under the budget constraints.

Proof. The reader can refer to Appendix E. ■

Since the Acquirer always chooses his fee such that all merchants accept cards, the only way for the payment system to increase the transaction volume is to stimulate consumers' demand. In this setting, because of merchants' homogeneity, the interchange fee does not balance demands between each side of the market, as in the case in other models from the literature (Schmalensee 2002, Wright 2004). That is why the payment system chooses a positive interchange fee, paid by the Acquirer to the Issuer, which is equal to the per-transaction margin of the Acquirer. It is optimal for the payment system to transfer the Acquirer's margin to the Issuer, because the latter can stimulate cardholder's demand by lowering transaction fees.

Another way of understanding this result is to note that the Issuer has a monopoly of access to cardholders' demand. Because of this competitive bottleneck, it is optimal for the payment system to select the maximum interchange fee compatible with non negative profits for the Acquirer. Notice that this is also the case in Baxter's model (1983), even if there is perfect competition between banks. In my model, Baxter's interchange fee, $b_S - c_A$, is obtained if $\theta = 0$. My analysis extends Baxter's model by showing that the level of quality of the payment system influences the choice of the optimal interchange fee. Notice that, in this case, the Issuer takes all the marginal benefits of investments.

In the following section, I will take as a benchmark the interchange fee $a^E(\theta)$, which is equal to the Acquirer's margin. I will try to determine if the optimal interchange fee can become

[13] The letter "E" stands for exogenous.

lower than the Acquirer's margin if banks have the possibility to invest in quality.

3.4.2 Optimal interchange fee with banks' investments

In this section, I consider the possibility of quality investments. I start by studying the effect of the interchange fee on banks' profits. Then, I analyse the choice of the profit maximising interchange fee by the payment system, and compare it to the benchmark interchange fee obtained if the quality is exogeneous. Finally, I compare the profit maximising interchange fee, and the welfare maximising interchange fee.

Impact of the interchange fee on banks' profits: The payment system chooses the interchange fee, denoted by a^P, which maximises banks' joint profits:

$$\pi_S(a, \theta_I^*(a), \theta_A^*(a)) = \pi_I(a, \theta_I^*(a), \theta_A^*(a)) + \pi_A(a, \theta_I^*(a), \theta_A^*(a)), \tag{13}$$

under the constraint that the Acquirer's profit must remain positive ($\pi_A \geq 0$).

I assume that the second-order conditions of profit maximisation are verified. The first-order condition is

$$\frac{d\pi_S}{da} = \frac{\partial \pi_I}{\partial a} + \frac{\partial \pi_A}{\partial a} + \frac{\partial \pi_I}{\partial \theta_A}\frac{\partial \theta_A^*}{\partial a} + \frac{\partial \pi_A}{\partial \theta_I}\frac{\partial \theta_I^*}{\partial a} = 0.$$

The interchange fee has both a direct effect and a strategic effect on banks' profits. In appendix F, I determine the direct and the strategic effects which are summarised in the following table:[14]

Table 2: The strategic effects.

Bank	Direct effect	Strategic effect
Issuer	Positive	Sign of $(\theta_A^*)'(a)$
Acquirer	Positive or negative	Sign of $(\theta_I^*)'(a)$
Joint profits	Positive	Positive (resp., negative) if $(\theta_i^*)'(a) \geq 0$ (resp., ≤ 0).

The direct effect measures how banks' profits react to a small increase of the interchange fee, if the levels of quality are exogenous. The direct effect for the Issuer is always positive, because the interchange fee increases both its margin, M_I, and the transaction volume. For the Acquirer, the direct effect may be positive or negative, because the interchange fee has a positive impact on the transaction volume, while it has a negative impact on its margin, M_A.

The strategic effect measures how bank i's profit reacts to an increase in the interchange fee through its strategic interaction with bank j at stage 2, when the levels of quality are chosen.

[14] In the following table, I assume that $a \leq b_S + \alpha_S\theta - c_A$.

The sign of the strategic effect for bank i is the same as the sign of $(\theta_j^*)'(a)$, for $(i,j) \in \{A, I\}^2$ and $i \neq j$.

If $\alpha_B = 0$, there are no strategic effects, because the level of quality has no impact on consumers' demand.

If $\alpha_B \in (0; \alpha_S]$, the strategic effects are positive, because banks' investments in quality increase with the interchange fee. Since the effect of quality investments is relatively stronger on the merchant side, a higher interchange fee provides the Acquirer with incentives to choose a higher level of quality. This is because the Acquirer can recover the costs of investment by charging higher prices, while obtaining higher transaction volumes thanks to the effect of the interchange fee on consumers' demand. Since the levels of quality are strategic complements, the Issuer selects also a higher level of quality. By choosing a higher level of quality, the Issuer increases the transaction volume and the Acquirer's margin. The profit of the Acquirer increases with the investments of the Issuer. The same reasoning is true for the profit of the Issuer.

If $\alpha_B > \alpha_S$, the strategic effects may be either positive or negative. In this case, the effect of quality investment is relatively stronger on the consumer side. If the interchange fee increases slightly, the marginal increase of the transaction volume and the marginal benefits obtained on the merchant side are not sufficient to compensate the marginal reduction of the Acquirer's margin. As we noted before, both banks can either react by chosing a higher level of quality or a lower level of quality, depending on how the strategic effects compensate each other. If bank i reduces its level of quality, this has a negative impact on the profit of bank j, because of a lower transaction volume, and a lower margin.

Choice of the optimal interchange fee: I can now analyse the optimal interchange fee.

Proposition 2 *If $\alpha_B \leq \alpha_S$, the Acquirer makes no profit, $\pi_A = 0$. The profit maximising interchange fee is the highest a^P that satisfies*

$$\pi_A(a^P, \theta_I^*(a^P), \theta_A^*(a^P)) \geq 0. \tag{14}$$

If $\alpha_B > \alpha_S$, we have $\pi_A \geq 0$. If $\pi_A > 0$, the profit maximising interchange fee, a^P, is strictly lower than the Acquirer's margin, that is,

$$a^P < a^E(\theta^*(a^P)) \tag{15}$$

Proof. See Appendix G. ■

Notice that we do not solve the case in which $(\theta_i^*)'(a) \geq 0$ and $(\theta_j^*)'(a) \leq 0$, for $i \neq j$ and $(i,j) \in \{A, I\}^2$. In that case, it is not possible to determine if the constraint is binding, and to compare a^E and a^P. It depends on how the strategic effects compensate each other. In section 4, I will provide more structure to the model to investigate this case.

If $\alpha_B \leq \alpha_S$, we know that banks' investments in quality increase with the level of the interchange fee. Therefore, it is optimal to increase the profit maximising interchange fee above the benchmark interchange fee, which is selected if the level of quality is exogenous. However, the profit maximising interchange fee is already equal to the Acquirer's margin. So the constraint is binding at the equilibrium, and the Acquirer makes no profit.

If $\alpha_B > \alpha_S$, banks' investments in quality can decrease with the level of the interchange fee. So it can be optimal to choose an interchange fee which is lower than the Acquirer's margin, in order to provide both banks with incentives to invest in quality.

The results are quite intuitive. If the Acquirer invests a lot, and if cardholders enjoy more the benefits of a higher level of quality than merchants, the optimal interchange fee is lower, because the investments of the Acquirer and the interchange fee are strategic substitutes. On the contrary, if the Acquirer does not contribute a lot to investments, and if investments in quality are relatively more beneficial for merchants, the interchange fee should be increased, because of strategic complementarity.

Comparison of the profit maximising interchange fee and the social maximising interchange fee. Assume that, at the first stage of the game, a benevolent social planner chooses the interchange fee, a^W, which maximises the social welfare under the budget constraints. My aim is to determine the conditions under which there is an overprovision of payment card services if the payment platform maximises banks' joint profits. I assume that the social welfare is a concave function of the interchange fee a.

Proposition 3 *If $\alpha_B \leq \alpha_S$, the welfare maximising and the profit maximising interchange fee are equal, $a^P = a^W$. If $\alpha_B > \alpha_S$, the welfare maximising interchange fee is lower than the profit maximising interchange fee if and only if $1 + \alpha_B (\theta^*)'(a^P) \leq 0$.*

Proof. See Appendix H. ■

If the strategic effects are positive, the welfare maximising and the profit maximising interchange fee are equal. It would be optimal to increase the interchange fee so as to provide banks with incentives to invest in quality. However, the constraint of positivity on the Acquirer's profit is already binding. So the welfare maximising and the profit maximising interchange fees are equal.

If $1 + \alpha_B (\theta^*)'(a) \leq 0$, there may be an overprovision of payment card services, if the interchange fee is chosen by a profit maximising payment platform, as in Rochet and Tirole's model (2002), but not for the same reasons. This is because banks fail to internalise the strategic impact of their behaviour of their quality choices on the consumers' surplus. If $1 + \alpha_B (\theta^*)'(a) \leq 0$, the surplus of consumers, which depends only on the transaction volume, is a decreasing function of the interchange fee. Since the social welfare takes into account the surplus of consumers, the welfare maximising interchange fee is lower than the profit maximising interchange fee.

Coordination of investments in quality. The payment platform chooses an interchange fee so as to correct two types of externalities. The first type of externality is related to the demand side, and the behaviour of consumers and merchants when they decide whether or not to use and accept cards. The second type of externality is linked to the fact that banks fail to coordinate when they decide on the levels of quality. A natural solution to this coordination problem is to let the payment card platform choose the levels of quality at the first stage, in order to maximise banks' joint profits. In practice, some payment platforms impose on banks a minimum level of investments, and banks coordinate on the choice of common infrastructure standards and processing rules. However, banks remain also free to choose by themselves to improve the level which is fixed by the payment platform. Also, payment cards systems cannot sign contracts on all investment decisions. However, it is interesting to compare the levels of quality and interchange fee obtained in the previous section, to a situation in which the platform would control the levels of investments.

Proposition 4 *If the payment platform controls the levels of quality and the interchange fee, it chooses the maximum level of interchange fee compatible with the budget constraint of the Acquirer,* a^**. The levels of quality verify*

$$C_I'(\theta_I) = (\alpha_B + \alpha_S)\lambda_I V(a^*, \theta) + \frac{\alpha_B \lambda_I}{2}(b_S + \alpha_S \theta - a^* - c_A),$$

and

$$C_A'(\theta_A)/\lambda_A = C_I'(\theta_I)/\lambda_I.$$

The welfare maximising interchange fee a^W *is also the maximum interchange fee compatible with the budget constraint of the Acquirer. The welfare maximising levels of quality are higher, for a given level of the interchange fee, than the profit maximising levels of quality.*

Proof. See Appendix I. ■

The payment system chooses the levels of quality such that the marginal contribution of each bank is equal to the sum of the marginal benefits generated for both banks. Since the quality level of the payment system is a public good, for a given level of the interchange fee, θ_I and θ_A are higher if they are chosen simultaneously by the payment platform, because it internalises the externalities that banks exert on one another. The optimal interchange fee is the highest that ensures non negative profits for the Acquirer.

In general, it is difficult to compare the profit maximising interchange fee if there is cooperation on quality investments, a_C^P, and the interchange fee if banks choose the quality levels non cooperatively, a^P. By studying the special cases where $\alpha_B = 0$, and $\alpha_S = 0$, I show that a_C^P may be either higher or lower than a^P. I also compare the profit maximising interchange fees, a^P and a_C^P, and the welfare maximising interchange fees, a^W and a_C^W, and Baxter's interchange fee $a^B = b_S - c_A$.

Proposition 5 *Depending on the specification of the costs functions, and on the relative impact of quality on each side of the market, a_C^P may be higher or lower than a^P.*

Proof. See Appendix J. I also provide comparisons of a^P, a_C^P, and a^B in the special cases $\alpha_B = 0$ and $\alpha_S = 0$. ■

4 An example

In this section, I specify the quality cost function to understand better the impact of the strategic interactions between banks on the optimal interchange fee. I assume that $C_i(\theta_i) = (k/2)\theta_i^2$, with $k > 0$ for $i = I, A$. The other assumptions are the same as in the general presentation of the model.[15]

In order to precise the sign of the strategic effects if $\alpha_S < \alpha_B$, I analyse an example in which the level of quality does not affect merchants' willingness to pay for card services ($\alpha_S = 0$). In that case, both banks invest in quality at stage 2, and the equilibrium levels of quality are:

$$\theta_I^*(a) = \frac{\alpha_B \lambda_I}{2k - \alpha_B^2 \lambda_I^2} \left[(1 + a - c_I) + \frac{\alpha_B^2 \lambda_A^2}{2k}(b_S - c_A - a) \right],$$

and

$$\theta_A^*(a) = \frac{\lambda_A \alpha_B}{2k}(b_S - c_A - a),$$

[15] Assumption 3 yields with this specification of the cost functions $2k > (\alpha_B \lambda_I)^2$ and $k > (\alpha_S \lambda_A)^2$. We also assume that $k > \alpha_S \alpha_B \lambda_A^2$. See Appendix K for the proof of the results.

and the quality of the payment card system is

$$\theta^*(a) = \frac{\alpha_B}{2k - \alpha_B^2 \lambda_I^2} \left[\lambda_I^2 (1 + a - c_I) + \lambda_A^2 (b_S - c_A - a) \right].$$

For the Acquirer, the interchange fee and the investments are strategic substitutes ($\alpha_S = 0 \leq \alpha_B$), while for the Issuer, they are strategic complements. In this example, the strategic effect of the Issuer's quality choice is positive, while the strategic effect of the Acquirer's quality choice is negative.[16] Since $\alpha_S = 0$, the Acquirer does not benefit from quality investments through a higher margin on merchants' side.

At stage one, the payment system chooses the interchange fee a^P which maximises banks' joint profits. The Acquirer's constraint is not binding, and the optimal interchange fee is lower than the Acquirer's margin, and than Baxter's interchange fee (See Appendix K).

In this example, the strategic effect of the Acquirer's quality choice dominates the strategic effect of the Issuer's quality choice. The Acquirer contributes to the increase of the transaction volume by its quality investments, and its level of quality θ_A^* decreases with the interchange fee. Therefore, since this effect dominates the strategic effect of the Issuer's choice of quality, it is optimal for the payment system to choose a smaller interchange fee than in the benchmark case to provide the Acquirer with incentives to invest in quality. In this case, it is optimal to substitute the interchange fee for investments in quality on the Acquisition side.

It is interesting to note that, in this case, if $\lambda_A = 0$, θ^* is higher than the level of quality obtained with coordination, θ^C. This example shows that the payment platform obtains a higher quality in some cases when banks choose the level of quality non cooperatively.

5 Extensions and discussions

In this section, I start by discussing the impact of the structure of the interchange fee. Then, I consider two extensions of the model. First, I discuss the influence of the market structure on the results obtained in section three. Second, I discuss the extension of the analysis to the case of heterogeneous merchants.

5.1 The structure of the interchange fee: fixed fee versus two-part tariff?

My results show that, if the strategic effects are positive, the payment platform chooses the maximum interchange fee compatible with the budget constraint of the Acquirer. Since the

[16] We have $(\theta_I^*)'(a) = \frac{\alpha_B \lambda_I}{2k - \alpha_B^2 \lambda_I^2} \times \frac{2k - \alpha_B^2 \lambda_A^2}{2k} \geq 0$ and $(\theta_A^*)'(a) = \frac{-\alpha_B \lambda_A}{2k} < 0$.

constraint is binding, the payment platform could increase banks' joint profits by choosing a fixed transfer T paid by the Issuer to the Acquirer, provided that the Issuer's profit remains positive. In this case, the interchange fee becomes

$$a^P = b_S + \alpha_S(\theta^*)(a^P) - c_A + 2\left[S_I(a^P) + S_A(a^P)\right],$$

and

$$T = -\pi_A(a^P, (\theta_I^*)(a^P), (\theta_A^*)(a^P)).$$

This shows that, unlike Baxter's interchange fee, a two-part tariff may be an appropriate structure for the interchange fee if banks incur fixed costs of investments in quality, and if the Acquirer's budget constraint is binding.

5.2 The impact of the market structure

Like Schmalensee (2002), I assumed that the market is made of a bilateral monopoly, which is generally not the case in the payment card industry. Though several market structures can be observed all over Europe, the concentration is often higher in the issuing industry than in the acquisition business. It is beyond the scope of this paper to determine the determinants of market concentration in the payment card industry, because the market structure is exogenous to the model. However, a few conclusions can be made with my model for other market structures than bilateral monopoly. For instance, assume that the issuer is a monopolist, while the market for acquisition is perfectly competitive. If acquirers make zero profit, they do not invest in quality. So, the solution to the problem is obtained by setting $\lambda_A = 0$ in the model. In this case, $\theta_A^* = 0$ and $(\theta_I^*)'(a) \geq 0$. So the interchange fee remains at the maximum level compatible with merchant acceptance. More generally, the model gives the intuition that if the issuing business is more concentrated than the acquisition market, the interchange fee should remain at the maximum level compatible with merchant acceptance. However, if the acquisition side is more concentrated that the issuing side, the interchange fee might be decreased, because the interchange fee and the Acquirer's investments may become strategic substitutes.

5.3 The impact of merchant heterogeneity

In this subsection, I try to examine how the results of the model are modified if merchants are heterogeneous. I assume that the card acceptance benefit b_S is distributed according to a uniform distribution over $[0, 1]$. Let me denote the percentage of merchants that accept card payments by $D_S(m)$.[17] I assume that, at the equilibrium, some merchants accept cards, but not all; this allows me to study the difference between this situation and the corner solution obtained when merchants are homogeneous. For a given merchant fee m, merchants' demand is $D_S(m) = 1 + \alpha_S\theta - m$, and the transaction volume is expressed as follows:

$$V(\theta, f, m) = (1 + \alpha_S\theta - m)(1 + \alpha_B\theta - f).$$

The general expression of banks' profits is not modified. However, in Appendix J, I show that the levels of quality are not necessarily strategic complements. The strategic complementarity of θ_I and θ_A depends now on the interchange fee.

I start by determining the benchmark interchange fee, when the level of quality is exogenous, then I study the impact of investments in quality on the optimal interchange fee.

Proposition 6 *If the level of quality is exogenous, and if merchants are heterogeneous, the profit maximising interchange fee selected by the payment platform equalises banks' marginal costs net of the marginal benefits of investments, such that:*

$$c_I - a^E(\theta) - \alpha_B\theta = c_A + a^E(\theta) - \alpha_S\theta.$$

Proof. In Appendix L1, I prove that the optimal interchange fee is:

$$a^E(\theta) = \frac{(c_I - \alpha_B\theta) - (c_A - \alpha_S\theta)}{2}.$$

This interchange fee equalises banks' marginal costs net of the marginal benefits of investment, such that:

$$c_I - a^E(\theta) - \alpha_B\theta = c_A + a^E(\theta) - \alpha_S\theta.$$

■

If the levels of quality are exogenous, and if merchants are heterogeneous, the payment system chooses an interchange fee which balances demands between each side of the market, and which may leave some positive margin to the Acquirer. As in Schmalensee (2002), who assumes identical linear demands under bilateral monopoly, the optimal interchange fee is set to equalize banks' marginal costs. However, in the present setting, the marginal costs must be considered as net of the marginal benefits of investments, such that:

$$c_I - a^E(\theta) - \alpha_B\theta = c_A + a^E(\theta) - \alpha_S\theta.$$

[17] The size of the merchants' population is normalised to one.

Proposition 7 *If the levels of quality are endogenous, if merchants are heterogeneous, and if the constraint $\pi_A \geq 0$ is not binding, the optimal interchange fee satisfies:*

$$a^P = a^E((\theta^*)(a^P)) + \frac{4}{2 + (\alpha_S + \alpha_B)(\theta^*)(a) - c} \left(S_I(a^P) + S_A(a^P)\right),$$

where $S_j(a^P)$ denotes the strategic effect for $j = I, A$.

Proof. See Appendix L2. ■

This equation shows that, if the strategic effects are not equal to zero, the optimal interchange fee is no longer set such that banks' marginal costs are equalized, because the marginal costs must be adjusted by the strategic effects:

$$c_I - a^P - \alpha_B\theta - \frac{2\left(S_I(a^P) + S_A(a^P)\right)}{2 + (\alpha_S + \alpha_B)(\theta^*)(a^P) - c} = c_A + a^P - \alpha_S\theta - \frac{2\left(S_I(a^P) + S_A(a^P)\right)}{2 + (\alpha_S + \alpha_B)(\theta^*)(a^P) - c}.$$

The sign and the magnitude of the strategic effects depend on the shape of the best response functions, which could be determined by specifying the cost functions. Under the assumption that $C_i(\theta_i) = (k/2)\theta_i^2$ for $i = I, A$, it is not possible to find a simple solution.

6 Conclusion

My paper extends Baxter (1983)'s model by showing that the level of quality of the payment system influences the choice of the optimal interchange fee. Under bilateral monopoly, if the level of quality is exogenous, the optimal interchange fee is equal to the Acquirer's margin, which depends on the level of quality perceived on the merchant side. However, this is not necessarily the case if banks have the possibility to invest in quality. If investments in quality impact relatively more the consumer side, the optimal interchange fee can be strictly lower than the Acquirer's margin. This proves that a payment system can choose to lower its interchange fee to provide the Acquirer with incentives to invest in a higher level of quality. If merchants are heterogeneous, under bilateral monopoly, my model extends Schmalensee (2002)'s results by showing that the optimal interchange fee equalises bank's marginal costs net of the marginal benefits of investments.

The analysis conducted in my paper should contribute to provide other insights in the current debates about interchange fees. For instance, in Denmark, there were no interchange fees for debit cards. However, in 2003, when banks faced high investment costs to implement the new technical standard "EMV", they discussed the necessity of setting up an interchange fee.[18] This example shows that banks consider the interchange fee as a mechanism which may foster investments to improve the level of quality of a payment system. The results of my paper confirm this view, by showing that the level of quality of the payment system should guide the choice of the optimal interchange fee. This explains also why payment systems in Europe that provide different types of services to cardusers and merchants have chosen different levels of interchange fees. My paper provides another interesting point for the discussions pertaining to the standardisation of payment card services in Europe. It shows that the setting up of a common level of quality for card payments in Europe, which will require different levels of investments across the European countries, should be financed by different pricing policies.

Another interesting topic that is not modelled in my paper is the fact that merchants can also invest themselves to improve the quality of the service perceived by the consumer. This is left to future research.

References

[1] ARMSTRONG M. (2006): "Competition in Two-Sided Markets", The RAND Journal of Economics, vol.37 pp. 668-691.

[2] ARMSTRONG M. & WRIGHT J. (2007): "Two-Sided markets, Competitive Bottlenecks and Exclusive Contracts", Economic Theory, vol. 32, pp. 353-380.

[3] BAXTER W. (1983): "Bank Interchange of Transactional Paper: Legal and Economic Perspectives", Journal of Law & Economics, vol. 26, no. 3, October, pp. 541-588.

[4] CARLTON D.W. AND A.S. FRANKEL (1995): “The antitrust economics of payment card networks”, Antitrust Law Journal, 63:643-668.

[5] CAILLAUD B. & JULLIEN B. (2003): "Chicken and Egg: Competition among Intermediation Service Providers", The RAND Journal of Economics, vol. 34, no. 2, June, pp. 521-552.

[6] CHAKRAVORTI S. (2003): "Theory of Credit Card Networks: A survey of the literature", Review of Network Economics, vol. 2, no. 2, June, pp. 50-68.

[7] CHAKRAVORTI S. & ROSON, R. (2006): "Platform competition in Two-Sided Markets: The Case of Payment Networks", Review of Network Economics, vol. 5, no. 1, March, pp. 26-44.

[18] Source "Banking Automation Bulletin", March 2005.

[8] GANS J. & KING S. (2003): "The Neutrality of Interchange Fees in Payment Systems", Topics in Economic Analysis & Policy, Berkeley Electronic Press, vol. 3, no. 1, pp. 1069-1069.

[9] GUTHRIE G. & WRIGHT J. (2007): "Competing Payment Schemes", Journal of Industrial Economics, vol. 55, pp. 37-67.

[10] ROCHET J-C. (2003): "the Theory of Interchange Fees: A synthesis of recent contributions", Review of Network Economics, vol. 2, no. 2, June, pp. 97-124.

[11] ROCHET J-C. & TIROLE J. (2002): "Cooperation Among Competitors: The Economics of Payment Card Associations", The RAND Journal of Economics, vol. 33, no. 4, winter, pp. 549-570.

[12] ROCHET J-C. & TIROLE J. (2003a): "An Economic Analysis of the Determination of Interchange Fees in Payment Card Systems", Review of Network Economics, vol. 2, no. 2, June, pp. 69-79.

[13] ROCHET J-C. & TIROLE J. (2006a): "Externalities and Regulation in Card Payment Systems", Review of Network Economics, vol. 5, no. 1, March, pp. 1-14.

[14] ROCHET J-C. & TIROLE J. (2006b): "Two-sided markets: a progress report", RAND Journal of Economics, vol. 37, no. 3, March, pp. 645-667.

[15] ROCHET J-C. & TIROLE J. (2007): "Must-Take Cards and the Tourist Test", Mimeo.

[16] SCHMALENSEE R. (2002): "Payment systems and Interchange Fees", Journal of Industrial Economics, vol. 50, no. 2 (June), pp. 103-122.

[17] WRIGHT J. (2002): "Optimal Payment Card Systems," European Economic Review, vol. 47, no. 4, August, pp. 587-612.

[18] WRIGHT J. (2004): "Determinants of Optimal Interchange Fees in Payment Systems", Journal of Industrial Economics, vol. 52, no. 1, March, pp. 1-26.

7 Appendix

Appendix A: proof of Lemma 1. For given θ_A and a, the Issuer chooses the level of quality, θ_I, that maximises its profit,

$$\pi_I(a, \theta_I, \theta_A) = V(a, \theta)M_I(a, \theta) - C_I(\theta_I). \tag{A1}$$

The first-order condition can be written as:[19]

$$\frac{\partial \pi_I}{\partial \theta_I} = \frac{\partial V(a,\theta)}{\partial \theta_I} M_I + \frac{\partial M_I(a,\theta)}{\partial \theta_I} V(a,\theta) - C_I^{'}(\theta_I) = 0. \tag{A2}$$

Since $M_I = V(a,\theta) = (1 + \alpha_B\theta + a - c_I)/2$, then $\partial V(a,\theta)/\partial\theta_I = (\alpha_B\lambda_I)/2$.
Replacing for M_I in (A2), I obtain $\dfrac{\partial \pi_I}{\partial \theta_I} = \alpha_B\lambda_I V(a,\theta) - C_I^{'}(\theta_I) = 0$, which yields $C_I^{'}(\theta_I) = \alpha_B\lambda_I V(a,\theta)$.

The optimal level of quality is chosen by the Issuer such that the marginal cost of investments is equal to the marginal benefits.
For given θ_I and a, the Acquirer chooses the level of quality that maximises its profit,

$$\pi_A(a,\theta_I,\theta_A) = V(a,\theta)M_A(a,\theta) - C_A(\theta_A). \tag{A3}$$

The first-order condition can be written as[20]

$$\frac{\partial \pi_A}{\partial \theta_A} = \frac{\partial M_A(a,\theta)}{\partial \theta_A} V(a,\theta) + \frac{\partial V(a,\theta)}{\partial \theta_A} M_A(a,\theta) - C_A^{'}(\theta_A) = 0. \tag{A4}$$

Since $M_A(a,\theta) = b_S + \alpha_S\theta - a - c_A$, and $\partial M_A(a,\theta)/\partial\theta_A = \alpha_S\lambda_A$, the first order condition becomes

$$V(a,\theta)\alpha_S\lambda_A + \frac{\alpha_B\lambda_A}{2}(b_S + \alpha_S\theta - a - c_A) - C_A^{'}(\theta_A) = 0.$$

Given a, the Acquirer's best response to θ_I satisfies the following equation,

$$C_A^{'}(\theta_A) = \alpha_S\lambda_A V(a,\theta) + \frac{\alpha_B\lambda_A}{2}(b_S + \alpha_S\theta - a - c_A).$$

The optimal level of quality is chosen by the Acquirer such that the marginal cost of investments is equal to the marginal benefits.

Appendix B: proof of Lemma 2. I prove the strategic complementarity of the levels of quality. I differentiate the first-order condition obtained from (A4) with respect to θ_I :

$$\frac{d}{d\theta_I}\left(\frac{\partial \pi_A}{\partial \theta_A}(a,\theta_I,R_A(a,\theta_I))\right) = 0,$$

which yields:

$$\frac{\partial^2 \pi_A}{\partial \theta_I \partial \theta_A} + \frac{\partial^2 \pi_A}{\partial {\theta_A}^2} \times \frac{\partial R_A(a,\theta_I)}{\partial \theta_I} = 0.$$

[19] Assumption A3 implies that the second-order condition is satisfied.
[20] Assumption A3 implies that the second-order condition is satisfied.

I already know from the second-order condition that:

$$\frac{\partial^2 \pi_A(a,\theta)}{(\partial \theta_A)^2} < 0, \tag{B1}$$

therefore:

$$\frac{\partial R_A(a,\theta_I)}{\partial \theta_I} = -\left(\frac{\partial^2 \pi_A}{\partial {\theta_A}^2}\right)^{-1} \frac{\partial^2 \pi_A}{\partial \theta_I \partial \theta_A}. \tag{B2}$$

I take the partial derivative of (A4) with respect to θ_I:

$$\frac{\partial^2 \pi_A(a,\theta)}{\partial \theta_I \partial \theta_A} = \frac{\partial V(a,\theta)}{\partial \theta_I}\alpha_S \lambda_A + \frac{\alpha_B \lambda_A}{2} \times \frac{\partial M_A(a,\theta)}{\partial \theta_I}.$$

Since $V(a,\theta) = (1 + \alpha_B \theta + a - c_I)/2$, then $\partial V(a,\theta)/\partial \theta_I = (\alpha_B \lambda_I)/2$.

Since $M_A(a,\theta) = b_S + \alpha_S \theta - a - c_A$, then $\partial M_A(a,\theta)/\partial \theta_I = \alpha_S \lambda_I$.

I conclude that $\dfrac{\partial^2 \pi_A(a,\theta)}{\partial \theta_I \partial \theta_A} = \alpha_B \lambda_I \alpha_S \lambda_A \geq 0$.

From (B1) and (B2), I conclude that

$$\frac{\partial R_A(a,\theta_I)}{\partial \theta_I} \geq 0. \tag{B3}$$

The same reasoning can be done for the Issuer's best response:

$$\frac{\partial R_I(a,\theta_A)}{\partial \theta_A} = -\left(\frac{\partial^2 \pi_I}{\partial {\theta_I}^2}\right)^{-1} \frac{\partial^2 \pi_I}{\partial \theta_A \partial \theta_I} \tag{B4}$$

where:

$$\frac{\partial^2 \pi_I}{\partial {\theta_I}^2} < 0, \tag{B5}$$

I differentiate the first-order condition obtained from (A2) with respect to θ_A.

Since $V(a,\theta) = M_I(a,\theta) = (1 + \alpha_B \theta + a - c_I)/2$, then $\partial V(a,\theta)/\partial \theta_A = \partial M_I(a,\theta)/\partial \theta_A = (\alpha_B \lambda_A)/2$.

Therefore, I have $\dfrac{\partial^2 \pi_I}{\partial \theta_A \partial \theta_I} = \dfrac{\alpha_B^2 \lambda_I \lambda_A}{2} \geq 0$.

From (B4) and (B5), I conclude that $\dfrac{\partial R_I(a,\theta_A)}{\partial \theta_A} \geq 0$. Therefore, θ_I and θ_A are strategic complements.

Appendix C: proof of Lemma 3. I determine whether the levels of quality and the interchange fee are strategic complements or strategic substitutes.

I differentiate the first-order condition obtained from (10) with respect to a:

$$\frac{d}{da}\left(\frac{\partial \pi_A}{\partial \theta_A}(a,\theta_I,R_A(a,\theta_I))\right) = 0,$$

which yields

$$\frac{\partial^2 \pi_A(a,\theta)}{\partial a \partial \theta_A} + \frac{\partial^2 \pi_A(a,\theta)}{(\partial \theta_A)^2} \times \frac{\partial R_A(a,\theta_I)}{\partial a} = 0. \tag{C1}$$

I already know from the second-order condition that $\frac{\partial^2 \pi_A(a,\theta)}{(\partial \theta_A)^2} < 0$. Equation (C1) becomes:

$$\frac{\partial R_A(a,\theta_I)}{\partial a} = -\left(\frac{\partial^2 \pi_A(a,\theta)}{(\partial \theta_A)^2}\right)^{-1} \frac{\partial^2 \pi_A(a,\theta)}{\partial a \partial \theta_A}. \tag{C2}$$

Therefore, $\partial R_A(a,\theta_I)/\partial a$ has the same sign as $\partial^2 \pi_A(a,\theta)/\partial a \partial \theta_A$.

I take the partial derivative of (A4) with respect to a :

$$\frac{\partial^2 \pi_A(a,\theta)}{\partial a \partial \theta_A} = \frac{\partial M_A}{\partial \theta_A}\frac{\partial V(a,\theta)}{\partial a} + \frac{\partial M_A}{\partial a}\frac{\partial V(a,\theta)}{\partial \theta_A}.$$

Since $V(a,\theta) = (1 + \alpha_B\theta + a - c_I)/2$, then $\partial V(a,\theta)/\partial a = 1/2$ and $\partial V(a,\theta)/\partial \theta_A = (\alpha_B\lambda_A)/2$.
Since $M_A(a,\theta) = b_S + \alpha_S\theta - a - c_A$, then $\partial M_A(a,\theta)/\partial \theta_A = \alpha_S\lambda_A$ and $\partial M_A(a,\theta)/\partial a = -1$.
Therefore, I have $\partial^2 \pi_A(a,\theta)/\partial a \partial \theta_A = \lambda_A(\alpha_S - \alpha_B)/2$.

If $\alpha_B \leq \alpha_S$, then $\frac{\partial^2 \pi_A(a,\theta)}{\partial a \partial \theta_A} \geq 0$, which implies , from (C2), that $\frac{\partial R_A(a,\theta_I)}{\partial a} \geq 0$.
Therefore, if $\alpha_B \leq \alpha_S$, then θ_A and a are strategic complements.
If $\alpha_B > \alpha_S$, then θ_A and a are strategic substitutes.

Similarly, for the Issuer, the sign of $\partial R_I(a,\theta_A)/\partial a \geq 0$ is the same as the sign of $\partial^2 \pi_I(a,\theta)/\partial a \partial \theta_I$.
I take the partial derivative of (A2) with respect to a, that is $\frac{\partial^2 \pi_I(a,\theta)}{\partial a \partial \theta_I} = \frac{\alpha_B\lambda_I}{2} \geq 0$.

Therefore, I have $\frac{\partial R_I(a,\theta_A)}{\partial a} \geq 0$. I conclude that θ_I and a are strategic complements.

Appendix D: proof of Lemma 4. I determine how the optimal levels of quality vary with the interchange fee.
Let us differentiate (12) with respect to a:

$$(\theta_I^*)'(a) = \frac{\partial R_I}{\partial a} + \frac{\partial R_I}{\partial \theta_A} \times \frac{\partial R_A}{\partial a}.$$

If $\alpha_B \leq \alpha_S$, from Lemma 3, I have $\partial R_A(a,\theta_I)/\partial a \geq 0$ and $\partial R_I(a,\theta_A)/\partial a \geq 0$.
Since, from Lemma 2, $\partial R_I/\partial \theta_A \geq 0$, I conclude that $(\theta_I^*)'(a) \geq 0$.
If $\alpha_B > \alpha_S$, then, from Lemma 3, $\partial R_A(a,\theta_I)/\partial a \leq 0$ and $\partial R_I(a,\theta_A)/\partial a \geq 0$. Since, from Lemma 2, $\partial R_I/\partial \theta_A \geq 0$, the sign of $\theta_I'(a)$ can be either positive or negative.
The same reasoning can be applied for the Acquirer, differentiating (11) with respect to a:

$$(\theta_A^*)'(a) = \frac{\partial R_A}{\partial a} + \frac{\partial R_A}{\partial \theta_I} \times \frac{\partial R_I}{\partial a}.$$

If $\alpha_B \leq \alpha_S$, then, from Lemma 3, $R_A(a,\theta_I)/\partial a \geq 0$ and $\partial R_I(a,\theta_A)/\partial a \geq 0$. Since, from Lemma 2, $\partial R_A(a,\theta_I)/\partial\theta_I \geq 0$, I conclude that $(\theta_A^*)'(a) \geq 0$.

If $\alpha_B > \alpha_S$, then, from Lemma 3, $\partial R_A(a,\theta_I)/\partial a \leq 0$ and $\partial R_I(a,\theta_A)/\partial a \geq 0$. Since, from Lemma 2, $\partial R_A/\partial\theta_I \geq 0$, the sign of $\theta_A'(a)$ can be either positive or negative.

Appendix E: proof of Proposition 1. I determine the optimal interchange fee if the level of quality is exogenous. The differentiation of banks' profits with respect to a yields:

$$\frac{d\pi_I^E(a)}{da} = V_I^E(a) = \frac{1+\alpha_B\theta + a - c_I}{2}. \tag{E1}$$

and

$$\frac{d\pi_A^E(a)}{da} = \frac{1}{2}M_A^E(a) - V_I^E(a) = \frac{-1+b_S+(\alpha_S-\alpha_B)\theta - 2a + c_I - c_A}{2}. \tag{E2}$$

I write the first-order condition for the maximisation of banks' joint profits,[21] using (E2) and (E1), that is

$$\frac{d\pi_S^E(a)}{da} = \frac{b_S - c_A + \alpha_S\theta - a}{2} = 0.$$

The optimal interchange fee is

$$a^E = b_S - c_A + \alpha_S\theta.$$

The Issuer's profit is given by:

$$\pi_I^E = \left(V^E\right)^2 = \frac{1}{4}(1+b_S+(\alpha_B+\alpha_S)\theta - c)^2.$$

I know from (4) that the Acquirer chooses the merchant fee m such that $m(\theta) = b_S + \alpha_S\theta$. Therefore, merchants make no surplus. The social welfare, W, is expressed as follows:

$$W = \pi_S + S_C,$$

where the average consumer surplus S_C is[22]:

$$S_C = \int_{f-\alpha_B\theta}^{1} (b_B + \alpha_B\theta - f)\, db_B = \frac{(1+\alpha_B\theta - f)^2}{2}. \tag{E3}$$

[21] The second-order condition is verified.

[22] A consumer of type b_B chooses to use his card if and only if (2) holds, and he makes the surplus $b_B + \alpha_B\theta - f$. Recall that we assumed that b_B is uniformely distributed over $[0;1]$.

The social welfare is expressed as follows:

$$W^E(a) = \pi_S^E(a) + \frac{1}{2}(V^E(a))^2.$$

I compute the derivative of social welfare with respect to a:

$$\frac{dW^E(a)}{da} = \frac{d\pi_S^E(a)}{da} + \frac{dV^E(a)}{da}V^E(a) = \frac{2b_S + 1 + (2\alpha_S + \alpha_B)\theta - 2c_A - c_I - a}{2}, \tag{E4}$$

The objective function of the social planner is concave.
Since $V^E(a) = (1 + \alpha_B\theta + a - c_I)/2$, then $\frac{dV^E(a)}{da}V^E(a) \geq 0$.
Therefore, from (E4), I have $\frac{dW^E(a)}{da} \geq \frac{d\pi_S^E(a)}{da}$.
The following inequality holds $\left.\frac{dW^E(a)}{da}\right|_{a=a^E(\theta)} \geq \left.\frac{d\pi_S^E(a)}{da}\right|_{a=a^E(\theta)}$. Since $\left.\frac{d\pi_S^E(a)}{da}\right|_{a=a^E(\theta)} = 0$, $\left.\frac{dW^E(a)}{da}\right|_{a=a^E(\theta)} \geq 0$.
Let us denote by a^W the welfare maximising interchange fee. It verifies the first-order condition $\left.\frac{dW^E(a)}{da}\right|_{a=a^W} = 0$.
Therefore, I have $\left.\frac{dW^E(a)}{da}\right|_{a=a^E(\theta)} \geq \left.\frac{dW^E(a)}{da}\right|_{a=a^W}$. Since W is concave, I conclude that $a^E(\theta) \leq a^W$.
The welfare maximising interchange fee cannot be lower than the profit maximising interchange fee. However, the profit maximising interchange fee is already set at the maximum level compatible with a positive margin for the Acquirer. So, the constraint is binding at the equilibrium, and the welfare maximising interchange fee is equal to the profit maximising interchange fee.
Replacing for $a^E(\theta)$ in (E3), I get the expression of the social welfare at the welfare maximising interchange fee:

$$W^E = \frac{3}{8}(1 + b_S + (\alpha_B + \alpha_S)\theta - c)^2.$$

Appendix F: Strategic effects. I determine the sign of the strategic effects. I differentiate the Issuer's profit with respect to a, which yields:

$$\frac{d\pi_I}{da} = \frac{\partial\pi_I}{\partial a} + \frac{\partial\pi_I}{\partial\theta_I}(\theta_I^*)'(a) + \frac{\partial\pi_I}{\partial\theta_A}(\theta_A^*)'(a).$$

The application of the envelop theorem yields $\frac{\partial\pi_I}{\partial\theta_I}(a, \theta_I^*(a), \theta_A^*(a)) = 0$.
Therefore, $\frac{d\pi_I}{da} = \frac{\partial\pi_I}{\partial a} + \frac{\partial\pi_I}{\partial\theta_A}(\theta_A^*)'(a)$. From (A1), I know that $\frac{\partial\pi_I}{\partial a} = \frac{\partial M_I}{\partial a}V + \frac{\partial V}{\partial a}M_I$, and that $\frac{\partial\pi_I}{\partial\theta_A} = \frac{\partial M_I}{\partial\theta_A}V + \frac{\partial V}{\partial\theta_A}M_I$. From (7), I find that $\partial M_I/\partial a = 1/2$, and that $\partial M_I/\partial\theta_A = (\alpha_B\lambda_A)/2$.

From (6), I find that $\partial V/\partial a = 1/2$, and that $\partial V/\partial \theta_A = \dfrac{\alpha_B \lambda_A}{2}$. Since $M_I = V$, I have:

$$\frac{d\pi_I}{da} = V(a, \theta^*(a)) + \alpha_B \lambda_A (\theta_A^*)'(a) V^{II}(a, \theta^*(a)). \tag{F1}$$

As a result, the direct effect is positive for the Issuer, and the strategic effect has the same sign as $(\theta_A^*)'(a)$.

The same reasonning and the application of the envelop theorem to the Acquirer's profit yields $\dfrac{d\pi_A}{da} = \dfrac{\partial \pi_A}{\partial a} + \dfrac{\partial \pi_A}{\partial \theta_I}(\theta_I^*)'(a)$. From (A3), I know that $\dfrac{\partial \pi_A}{\partial a} = \dfrac{\partial M_A}{\partial a} V + \dfrac{\partial V}{\partial a} M_A$, and that $\dfrac{\partial \pi_A}{\partial \theta_I} = \dfrac{\partial M_A}{\partial \theta_I} V + \dfrac{\partial V}{\partial \theta_I} M_A$. From (8), I know that $\partial M_A/\partial a = -1$, and that $\partial M_A/\partial \theta_I = \alpha_S \lambda_I$. From (6), I know that $\partial V/\partial \theta_I = (\alpha_B \lambda_I)/2$, so

$$\frac{d\pi_A}{da} = \frac{1}{2} M_A - V(a, \theta^*(a)) + \left[\alpha_S \lambda_I V(a, \theta^*(a)) + \frac{\alpha_B \lambda_I}{2} M_A \right] (\theta_I^*)'(a). \tag{F2}$$

Consequently, the direct effect may be positive or negative for the Acquirer, and the strategic effect has the same sign as $(\theta_I^*)'(a)$.

Appendix G: proof of Proposition 2. Let us denote the strategic effects by $S_i(a)$ for bank i for $i = \{I; A\}$. I have $S_i(a) = \dfrac{\partial \pi_i}{\partial \theta_j}(\theta_j^*)'(a)$ for $(i; j) \in \{I; A\}^2$ and $i \neq j$.

The derivative of the payment system profit π_S with respect to the interchange fee a is:

$$\frac{d\pi_S}{da} = \frac{\partial}{\partial a}\left(V(a, \theta) M_S(a, \theta) \right) + S_I(a) + S_A(a). \tag{G1}$$

The result stems directly from (F2) and (F1) and Appendix F. With the parameters of the model, the equation (G1) becomes:

$$\frac{d\pi_S}{da} = \frac{1}{2} M_A(a, \theta) + \left[\frac{\alpha_B \lambda_I}{2} M_A(a, \theta^*(a)) + \alpha_S \lambda_I V(a, \theta^*(a)) \right] (\theta_I^*)'(a) + \alpha_B \lambda_A (\theta_A^*)'(a) V(a, \theta^*(a)).$$

If the constraint ($\pi_A \geq 0$) is binding, then the optimal interchange fee, a^P, satisfies the following equation:

$$M_A(a^P, \theta^*(a^P)) V(a^P, \theta^*(a^P)) = C_A(\theta_A^*(a^P)).$$

If the constraint $\pi_A \geq 0$ is not binding, then the optimal interchange fee, a^P, satisfies the first order condition of joint profit maximisation:

$$\frac{d\pi_S}{da} = \frac{1}{2} M_A(a, \theta^*(a)) + S_I(a) + S_A(a) = 0, \tag{G2}$$

which can be written

$$\begin{aligned} S_I(a^P) + S_A(a^P) &= \frac{1}{2}(a^P - b_S - \alpha_S\theta^*(a^P) + c_A), \\ S_I(a^P) + S_A(a^P) &= \frac{1}{2}(a^P - a^E(\theta^*(a^P)). \end{aligned}$$

If $\alpha_B \leq \alpha_S$, from Appendix F and Lemma 4, I know that the strategic effects are positive. If the constraint $\pi_A \geq 0$ were not binding, then from (G2), the profit maximising interchange fee would be higher than the Acquirer's margin, which is absurd. Therefore, if $\alpha_B \leq \alpha_S$, the constraint $\pi_A \geq 0$ is binding, and the optimal interchange fee verifies $\pi_A(a^P) = 0$, which proves the first part of the proposition.

Notice that a^P is the highest interchange fee that satisfies $\pi_A(a^P, \theta_I^*(a^P), \theta_A^*(a^P)) \geq 0$, because π_A is locally decreasing in the neighborhood of a^P:

$$\begin{aligned} \left.\frac{d\pi_A}{da}\right|_{a=a^P} &= \frac{1}{2}M_A(a^P) - V(a^P, \theta^*(a^P)) + S_A(a^P) \\ &= -S_I(a^P) - V(a^P, \theta^*(a^P)) \leq 0. \end{aligned}$$

If the strategic effects are negative, which, according to Lemma 4, may happen only if $\alpha_B > \alpha_S$, and if the constraint $\pi_A \geq 0$ is not binding, the profit maximising interchange fee satisfies the first order condition. Therefore, I have $S_I(a^P) + S_A(a^P) = (a^P - a^E(\theta^*(a^P))/2$, and $a^P - a^E(\theta^*(a^P) < 0$.

Appendix H: proof of Proposition 3. From (E3), the social welfare at the equilibrium of stage 2 is $W = \pi_S(a, \theta_I^*(a), \theta_A^*(a)) + (V(a, \theta^*(a)))^2/2$. I have

$$\left.\frac{dW}{da}\right|_{a=a^P} = \left.\frac{d\pi_S}{da}\right|_{a=a^P} + \left.\frac{dV(a,\theta^*(a))}{da}\right|_{a=a^P} \times V(a^P, \theta^*(a^P)). \tag{H1}$$

The profit maximising interchange fee satisfies the first-order condition, that is $\left.\frac{d\pi_S}{da}\right|_{a=a^P} = 0$. Therefore, from (H1), if $\left.\frac{dV(a,\theta^*(a))}{da}\right|_{a=a^P} \leq 0$, then $\left.\frac{dW}{da}\right|_{a=a^P} \leq \left.\frac{d\pi_S}{da}\right|_{a=a^P}$.
This implies that $\left.\frac{dW}{da}\right|_{a=a^P} \leq 0$. Since $\left.\frac{dW}{da}\right|_{a=a^W} = 0$, this proves that $\left.\frac{dW}{da}\right|_{a=a^P} \leq \left.\frac{dW}{da}\right|_{a=a^W}$.
Since W is concave, if $\left.\frac{dV(a,\theta^*(a))}{da}\right|_{a=a^P} \leq 0$, then $a^P \geq a^W$.

I precise the conditions that imply $\left.\frac{dV(a,\theta^*(a))}{da}\right|_{a=a^P} \leq 0$. The total differentiation of V

with respect to a yields

$$\begin{aligned}\frac{dV(a,\theta^*(a))}{da} &= \frac{\partial V(a,\theta^*(a))}{\partial a} + \frac{\partial V(a,\theta^*(a))}{\partial \theta_I}(\theta_I^*)'(a) + \frac{\partial V(a,\theta^*(a))}{\partial \theta_A}(\theta_A^*)'(a), \\ &= \frac{1}{2} + \frac{\alpha_B\lambda_I}{2}(\theta_I^*)'(a) + \frac{\alpha_B\lambda_A}{2}(\theta_A^*)'(a).\end{aligned}$$

If $\alpha_B \leq \alpha_S$, I know from Lemma 4 that $(\theta_I^*)'(a) \geq 0$ and $(\theta_A^*)'(a) \geq 0$. So, if the strategic effects are positive, the transaction volume is increasing with the interchange fee, and the welfare maximising interchange fee cannot be lower than the profit maximising interchange fee. From Proposition 2, we know that, if $\alpha_B \leq \alpha_S$, the profit maximising interchange fee is set at the maximum level compatible with non negative profits for the Acquirer. So the constraint is binding at the equilibrium, and the welfare maximising interchange fee is equal to the profit maximising interchange fee.

If $\alpha_B > \alpha_S$, then $\left.\frac{dV(a,\theta^*(a))}{da}\right|_{a=a^P} \leq 0$ if and only if $1 + \alpha_B(\theta^*)'(a^P) \leq 0$, which proves the result of the Proposition.

Appendix I: Proof of Proposition 4 In the following proof, I denote by a_C^P the profit maximising interchange fee if the level of quality is chosen by the payment platform, and a_C^W the welfare maximising interchange fee. The payment plaform chooses θ_I, θ_A, and a, in order to maximise banks' joint profits, that is

$$\pi_I + \pi_A = (b_S + \alpha_S\theta - c + \frac{1 + \alpha_B\theta - a + c_I}{2})V(a,\theta) - C_I(\theta_I) - C_A(\theta_A),$$

under the constraints $\pi_I \geq 0$ and $\pi_A \geq 0$. Solving for the first-order condition yields

$$C_I'(\theta_I) = (\alpha_B + \alpha_S)\lambda_I V(a,\theta) + \frac{\alpha_B\lambda_I}{2}(b_S + \alpha_S\theta - a - c_A), \tag{I1}$$

and

$$C_A'(\theta_A) = (\alpha_B + \alpha_S)\lambda_A V(a,\theta) + \frac{\alpha_B\lambda_A}{2}(b_S + \alpha_S\theta - a - c_A). \tag{I2}$$

Since $\frac{d(\pi_A + \pi_I)}{da} = \frac{1}{2}(b_S + \alpha_S\theta - a - c_A)$, the interchange fee is the highest compatible with non negative profit for the Acquirer (otherwise, the interchange fee would be equal to the margin of the Acquirer, and its profit would be negative because of the cost of the investment in quality).

I denote by θ_I^C and θ_A^C the levels of quality obtained if they are chosen by the payment platform. I find that $C_I'(\theta_I^C) \geq C_I'((\theta_I^*)(a))$, and that $C_I'(\theta_A^C) \geq C_I'((\theta_A^*)(a))$. Therefore, the levels of quality are higher if the payment platform internalises the coordination problem faced by the banks.

If the interchange fee is chosen to maximise the social welfare, $W = \pi_I + \pi_A + \frac{1}{2}V(a,\theta)^2$, solving for the first-order condition yields

$$C_I'(\theta_I) = (\frac{3}{2}\alpha_B + \alpha_S)\lambda_I V(a,\theta) + \frac{\alpha_B\lambda_I}{2}(b_S + \alpha_S\theta - a - c_A),$$

and

$$C_A'(\theta_A) = (\frac{3}{2}\alpha_B + \alpha_S)\lambda_A V(a,\theta) + \frac{\alpha_B\lambda_A}{2}(b_S + \alpha_S\theta - a - c_A).$$

Since $\frac{dW}{da} = \frac{1}{2}(b_S + \alpha_S\theta - c_A - a + \frac{1+\alpha_B\theta + a - c_I}{2})$, if the payment platform or the social planner chooses the interchange fee that solves the first-order condition, the budget constraint of the Acquirer is binding. Therefore, the welfare maximising interchange fee is the maximum interchange fee that satisfies the budget constraint of the Acquirer.

Appendix J: Proof of Proposition 5. To prove that a_C^P may be higher or lower than a^P, I study different cases. I show that:

- If $\alpha_B = 0$, $a^B \leq a^P = a^W$ and $a^B \leq a_C^P = a_C^W$.
- If $\alpha_B = 0$, and if $b_S - c_A - 1 + c_I + \alpha_S\lambda_A(C_A')^{-1}(\alpha_S\lambda_A(1-c_I)/2) \leq 0$, then $a^P \leq a_C^P$ and $\theta^*(a^P) \leq \theta^C(a_C^P)$.
- If $\alpha_S = 0$, $a^B \geq a^P$, and $a^B \geq a_C^P$.
- If $\alpha_S = 0$, and if $1 + \alpha_B\lambda_I(\theta_I^*)'(a_C^P)/2 \leq 0$, $a^P \geq a_C^P$.

Let us start by the case $\alpha_S = 0$. From (G2), I know that, if banks cannot coordinate on the choice of the level of quality, we have

$$\begin{aligned}\frac{d\pi_S}{da} &= \frac{1}{2}M_A(a,\theta) + \left[\frac{\alpha_B\lambda_I}{2}M_A(a,\theta^*(a))\right](\theta_I^*)'(a) + \alpha_B\lambda_A(\theta_A^*)'(a)V(a,\theta^*(a)) \\ &= \frac{1}{2}(b_S - a - c_A)(\frac{\alpha_B\lambda_I}{2}(\theta_I^*)'(a) + 1) + \frac{1}{2}\alpha_B\lambda_A(\theta_A^*)'(a)(1 + \alpha_B(\theta^*)(a)).\end{aligned}$$

Replacing for $a = a^B = b_S - c_A$, I obtain $\left.\frac{d\pi_S}{da}\right|_{a=a^B} = \frac{1}{2}\alpha_B\lambda_A(\theta_A^*)'(a^B)(1 + \alpha_B(\theta^*)(a^B))$.

If $\alpha_S = 0$, from (B2), I obtain the level of quality chosen by the Acquirer if banks cannot cooperate on the quality,

$$(\theta_A^*)(a) = (C_A')^{-1}(\frac{\alpha_B\lambda_A}{2}(b_S - c_A - a)).$$

So $(\theta_A^*)'(a) \leq 0$, and $\left.\frac{d\pi_S}{da}\right|_{a=a^B} \leq 0$. Since I assumed that the second-order conditions are verified, and since $a = a^P$ solves the first-order condition, I obtain the inequality $a^B \geq a^P$. Replacing for $a = a_C^P$ in (G1), I obtain

$$\left.\frac{d\pi_S}{da}\right|_{a=a_C^P} = \frac{1}{2}(b_S - a_C^P - c_A)(\frac{\alpha_B \lambda_I}{2}(\theta_I^*)'(a_C^P) + 1) + \frac{1}{2}\alpha_B \lambda_A (\theta_A^*)'(a_C^P)(1 + \alpha_B(\theta^*)(a_C^P)).$$

Since $(b_S - a_C^P - c_A) = C_A(\theta_A^C)/V$, I find that $b_S - a_C^P - c_A \geq 0$. So, $a^B \geq a_C^P$.

Since $\alpha_B \lambda_A (\theta_A^*)'(a_C^P)(1 + \alpha_B(\theta^*)(a_C^P)) \leq 0$, it is sufficient to have $\alpha_B \lambda_I (\theta_I^*)'(a_C^P)/2 + 1 \leq 0$, to have $\left.\frac{d\pi_S}{da}\right|_{a=a_C^P} \leq 0$. In this case, $a_C^P \geq a^P$. Otherwise a_C^P may be higher or lower than a^P. It is not simple to compare in this case $\theta_A^*(a^P)$ and $\theta_A^C(a_C^P)$.

I now study the case $\alpha_B = 0$. From (I1) and (I2), I obtain

$$C_I'(\theta_I^C) = \lambda_I C_A'(\theta_A^C)/\lambda_A,$$

and

$$\theta_A^C = (C_A')^{-1}(\alpha_S \lambda_A (\frac{1 + a - c_I}{2})).$$

Let $h(a) = \theta_A^C(a) = (C_A')^{-1}(\alpha_S \lambda_A (\frac{1 + a - c_I}{2}))$, and $\theta_I^C = g(\theta_A^C) = (C_I')^{-1}\left(\frac{\lambda_I}{\lambda_A} C_A'(\theta_A^C)\right)$.

The profit maximising interchange fee with coordination on the choices of the quality levels satisfies to the budget constraint of the Acquirer, that is

$$(b_S + \alpha_S \theta^C(a_C^P) - a_C^P - c_A)\left(\frac{1 + a_C^P - c_I}{2}\right) = C_A(\theta_A^C(a_C^P)),$$

with $\theta^C(a) = \lambda_I \times g(\theta_A^C(a)) + \lambda_A \theta_A^C(a) = \lambda_I \times g(h(a)) + \lambda_A h(a)$.

From (9) and (10), I know, that, if $\alpha_B = 0$, then $\theta_I^*(a) = 0$, and $\theta_A^*(a) = h(a)$. Also, according to Proposition 2, the profit maximising interchange fee is the highest that satisfies to the budget constraint of the Acquirer, that is $(b_S + \alpha_S \theta^*(a^P) - a^P - c_A)(1 + a^P - c_I)/2 = C_A(\theta_A(a^P))$, with $\theta^*(a) = \lambda_A \theta_A^*(a) = \lambda_A h(a)$.

Let us define $x(a) = (b_S + \alpha_S \lambda_A h(a) - a - c_A)(1 + a - c_I)/2 - C_A(h(a))$.

I have $x(a^P) = 0$, and $x(a_C^P) = -\alpha_S \lambda_I \times g(h(a_C^P))(1 + a_C^P - c_I)/2 \leq 0$.

Since $x(a)$ is twice differentiable over $[c_I - 1; 1]$, $x'(a) = \frac{1}{2}(b_S + \alpha_S \lambda_A h(a) - 2a - 1 + c_I - c_A)$, and $x''(a) = \left[(\alpha_S \lambda_A/2)^2 - C_A''(h(a))\right]/C_A''(h(a))$. From assumption 3, we have $x''(a) \leq 0$. So $x'(a)$ is decreasing over $[c_I - 1; 1]$. If $x'(0) \leq 0$, then x is decreasing over $[0; 1]$. Since $\left(a^P; a_C^P\right) \in [0; 1]^2$, and $x(a_C^P) \leq x(a^P)$, this implies that $a_C^P \leq a^P$.

I have $\theta_A^*(a) = h(a) = \theta_A^C(a)$. Since h is increasing with a, if $x'(0) \leq 0$, then $\theta_A^*(a^P) \leq \theta_A^C(a_C^P)$. Since $\theta_I^*(a) = 0$, this implies $\theta^*(a^P) \leq \theta^C(a_C^P)$.

Appendix K: an example. Replacing $C_i'(\theta_i)$ for $k\theta_i$ into (9) and (10) yields to the best response functions for the Acquirer and the Issuer,

$$\theta_A = \frac{\lambda_A}{2(k - \alpha_S\alpha_B\lambda_A^2)}\left(\alpha_B(b_S - c_A - a) + \alpha_S(1 + a - c_I) + 2\alpha_S\alpha_B\lambda_I\theta_I\right),$$

and

$$\theta_I = \frac{\alpha_B\lambda_I}{2k - \alpha_B^2\lambda_I^2}(1 + \alpha_B\lambda_A\theta_A + a - c_I).$$

The properties of the best response functions prooved in Lemma 1 and 2 are verified: qualities are strategic complements, θ_I and a are strategic complements, and θ_A and a are strategic complements if $\alpha_B \leq \alpha_S$.

I compute the Nash Equilibrium of stage 2 by taking the intercept of the best response functions. To simplify the expression of the results, I define $u = b_S - c_A - a$ and $v = 1 + a - c_I$. Equilibrium levels of quality are

$$\theta_I^*(a) = \frac{\lambda_I\alpha_B\left[\left(2k - \alpha_S\alpha_B\lambda_A^2\right)v + \alpha_B^2\lambda_A^2 u\right]}{2(2k - \alpha_B^2\lambda_I^2)(k - \alpha_S\alpha_B\lambda_A^2) - 2\alpha_S\alpha_B^3\lambda_I^2\lambda_A^2}, \tag{I1}$$

$$\theta_A^*(a) = \frac{\lambda_A\left[\left(2k - \alpha_B^2\lambda_I^2 + 2\alpha_B\alpha_S\lambda_I^2\right)\alpha_B u + (2k - \alpha_B^2\lambda_I^2)\alpha_S v\right]}{2(2k - \alpha_B^2\lambda_I^2)(k - \alpha_S\alpha_B\lambda_A^2) - 2\alpha_S\alpha_B^3\lambda_I^2\lambda_A^2}, \tag{I2}$$

and

$$\theta^*(a) = \frac{2\alpha_B u\lambda_A^2(k + \alpha_S\alpha_B\lambda_I^2) + (2k(\alpha_B\lambda_I^2 + 2\lambda_A^2\alpha_S) - 3\alpha_S\lambda_A^2\alpha_B^2\lambda_I^2)v}{2(2k - \alpha_B^2\lambda_I^2)(k - \alpha_S\alpha_B\lambda_A^2) - 2\alpha_S\alpha_B^3\lambda_I^2\lambda_A^2}. \tag{I3}$$

The transaction volume is equal to:

$$V(a) = \frac{u \times 2\alpha_B^2\lambda_A^2(k + \alpha_S\alpha_B\lambda_I^2) + v \times \left(4k^2 - \alpha_S\alpha_B^3\lambda_A^2\lambda_I^2\right)}{2(2k - \alpha_B^2\lambda_I^2)(k - \alpha_S\alpha_B\lambda_A^2) - 2\alpha_S\alpha_B^3\lambda_I^2\lambda_A^2}.$$

If $\alpha_S = 0$, the optimal interchange fee is

$$a^P = b_S - c_A - \frac{(2k)(\alpha_B^2\lambda_A^2) \times (1 + b_S - c)}{(2k - \alpha_B^2\lambda_A^2)(2k + \alpha_B^2\lambda_A^2) + \left(2k - \lambda_I^2\alpha_B^2\right)\alpha_B^2\lambda_A^2}.$$

Then I study the case of coordination on the choice of quality levels. With this specification of the cost function, the levels of quality chosen by the payment platform are independent from this interchange fee, and for $i = I; A$,

$$\theta_i^C = \frac{\alpha_B \lambda_i (1 + b_S - c)}{4k - \alpha_B^2(\lambda_A^2 + \lambda_I^2)}.$$

If $\lambda_A = 0$, $\theta^C = \frac{\alpha_B \lambda_I^2 (1 + b_S - c)}{4k - \alpha_B^2(\lambda_A^2 + \lambda_I^2)}$. Replacing for a_{NC}^P in $\theta^C(a)$, I obtain $\theta^* = \frac{\alpha_B \lambda_I^2 (1 + b_S - c)}{2k - \alpha_B^2(\lambda_A^2 + \lambda_I^2)}$. So $\theta^C < \theta^*$.

Appendix L1: proof of Proposition 6. The general expression of banks' profits is not modified. At stage 4 of the game, banks choose the transaction fees that maximise their profits. Solving for the first-order condition yields[23]:

$$\frac{\partial \pi_I}{\partial f} = (1 + \alpha_S \theta - m)(1 + \alpha_B \theta - a + c_I - 2f) = 0,$$

and

$$\frac{\partial \pi_I}{\partial f} = (1 + \alpha_B \theta - f)(1 + \alpha_S \theta + a + c_A - 2m) = 0.$$

The optimal transaction fees are

$$f^*(a, \theta) = \frac{1 + \alpha_B \theta - a + c_I}{2},$$

and

$$m^*(a, \theta) = \frac{1 + \alpha_S \theta + a + c_A}{2}.$$

The transaction volume at equilibrium of stage 4 is given by

$$\begin{aligned} V(a, \theta) &= \frac{1}{4}(1 + \alpha_B \theta + a - c_I)(1 + \alpha_S \theta - a - c_A) \\ &= M_A(a, \theta) M_I(a, \theta), \end{aligned}$$

and banks' profits are expressed as follows:

$$\pi_I = M_A(a, \theta)(M_I(a, \theta))^2 - C_I(\theta_I),$$

and

$$\pi_A = M_I(a, \theta)(M_A(a, \theta))^2 - C_A(\theta_A).$$

[23] The second-order condition is verified.

At stage 3 of the game, banks still choose their levels of quality such that the marginal benefits of investing in quality are equal to the marginal costs. However, the sign of the strategic effects is more difficult to determine, because the levels of quality are not necessarily strategic complements. The strategic complementarity of θ_I and θ_A depends now on the interchange fee.

I give a sketch of proof of this result for the Acquirer:

$$\frac{\partial^2 \pi_A}{\partial \theta_A \theta_I} = \frac{\partial V(a,\theta)}{\partial \theta_I} \times \frac{\partial \pi_A}{\partial \theta_A} + \frac{\partial V(a,\theta)}{\partial \theta_A}\frac{\partial M_A(a,\theta)}{\partial \theta_I} + \frac{\partial^2 M_A}{\partial \theta_I \theta_A} V(a,\theta) + \frac{\partial^2 V(a,\theta)}{\partial \theta_I \theta_A} M_A(a,\theta).$$

Since $\partial^2 V/\partial\theta_I\theta_A = (\alpha_B\alpha_S\lambda_I\lambda_A)/2$, and $\partial^2 M_A/\partial\theta_I\theta_A = 0$,

$$\frac{\partial^2 \pi_A}{\partial \theta_A \partial \theta_I} = \frac{\alpha_S\lambda_A\lambda_I}{4}(\alpha_S+\alpha_B+2\alpha_S\alpha_B\theta+(\alpha_S-\alpha_B)a-\alpha_S c_I-\alpha_B c_A+\alpha_B+\alpha_B\alpha_S\theta-\alpha_B(a+c_A)).$$

Since $\frac{\partial R_A}{\partial \theta_I} = -(\frac{\partial^2 \pi_A}{\partial^2 \theta_A})^{-1}\frac{\partial^2 \pi_A}{\partial \theta_A \theta_I}$, the previous expression shows that the sign of $\frac{\partial R_A}{\partial \theta_I}$ depends on the interchange fee.

If the levels of quality are exogenous, as in Schmalensee (2002), the payment system chooses an interchange fee which balances demands between each side of the market, and which may leave some positive margin to the Acquirer. The profit of the payment system is expressed as follows:

$$\begin{aligned} \pi_S^E &= \pi_I + \pi_A \\ &= V(a,\theta)(M_I(a,\theta) + M_A(a,\theta)). \end{aligned}$$

Solving for the first-order condition yields[24]:

$$\frac{d\pi_S^E}{da} = \frac{1}{8}(2 + (\alpha_S + \alpha_B)\theta - c)((\alpha_S - \alpha_B)\theta - 2a + c_I - c_A) = 0.$$

The optimal interchange fee is $a^E(\theta) = \left[(c_I - \alpha_B\theta) - (c_A - \alpha_S\theta)\right]/2$.

Appendix L2: proof of Proposition 7. If the levels of quality are endogenous to the model, the general expression of the derivative of banks' profits with respect to the interchange fee is still

$$\frac{d\pi_S}{da} = \frac{\partial}{\partial a}\left(V(a,\theta)M_S(a,\theta)\right) + S_I(a) + S_A(a),$$

[24] The second order condition is verified.

where $\dfrac{\partial}{\partial a}\left(V(a,\theta)M_S(a,\theta)\right) = \dfrac{d\pi_S^E}{da}$. If the constraint $\pi_A \geq 0$ is not binding, the optimal interchange fee satisfies to the following equation:

$$a^P = a^E((\theta^*)(a^P)) + \frac{4}{2+(\alpha_S+\alpha_B)(\theta^*)(a)-c}\left(S_I(a^P)+S_A(a^P)\right).$$

This equation shows that, if the strategic effects are not equal to zero, the optimal interchange fee is no longer set such that banks' marginal costs are equalized, because the marginal costs must be adjusted by the strategic effects:

$$c_I - a^P - \alpha_B\theta - \frac{2\left(S_I(a^P)+S_A(a^P)\right)}{2+(\alpha_S+\alpha_B)(\theta^*)(a^P)-c} = c_A + a^P - \alpha_S\theta - \frac{2\left(S_I(a^P)+S_A(a^P)\right)}{2+(\alpha_S+\alpha_B)(\theta^*)(a^P)-c}.$$

Private Cards and the Bypass of Payment Systems by Merchants

Marc Bourreau*and Marianne Verdier†

November 3, 2008

Abstract

This paper studies the incentives of a merchant to bypass a payment platform by issuing private cards. In our model, a payment platform organizes the interactions between a monopolistic issuer and a monopolistic acquirer by choosing a level of interchange fee. We study how the level of interchange fee impacts a merchant's decision to issue private cards. In a basic setting in which there are no strategic interactions between merchants, we show that there can be inefficient bypass. Then, we allow for strategic interactions between merchants by giving an Hotelling structure to the product market. We show that if a merchant decides to issue private cards, he sets a very agressive price for its payment service, to compete with the issuer, and to steal consumers from the other merchant. When it is possible to deter entry, we prove that the payment platform can prevent the merchant from issuing private cards by lowering the level of the interchange fee.

JEL Codes: G21, L31, L42.

Keywords: Payment card systems, interchange fee, two-sided markets, private cards.

*Institut TELECOM, TELECOM ParisTech, Department of Economics and Social Sciences, and CREST-LEI, Paris. Email: marc.bourreau@telecom-paristech.fr

†Institut TELECOM, TELECOM ParisTech, Department of Economics and Social Sciences, Paris. Email: marianne.verdier@telecom-paristech.fr

1 Introduction

In the United-States, in 2006, payment card transactions cost merchants nearly $57 billion.[1] The costs of card payments is a major source of conflict between banks and merchants. Merchants have to pay a fee (the "merchant fee") to their bank (the "Acquirer") each time a consumer pays by card, which they claim to be excessive.[2] In 2005, in the United-States, the usual amount of the merchant fee ranged from 1% to 2.7% of the transaction. Merchants argue that they cannot pass through to consumers the cost of a payment card transaction, since surcharges are forbidden by most payment card associations (like Visa). Also, they contend that it has become impossible to refuse a payment instrument which is now widely used by consumers.

This explains why merchants have thought about strategies to reduce the costs of payment card transactions. One of these strategies, which has been implemented by large retailers such as Wal-Mart or JC Penney and Macy's, has been to start issuing "private cards". Unlike payment cards issued by banks, which are members of payment card associations, private cards can only be used at the retailer's shop. The private card enables the merchant to save the cost of the merchant fee, if it is issued without the support of a financial institution. The detention and usage of private cards have become widespread over the last ten years. According to the International Card Manufacturer's Association (IMCA), 5.6 billion private cards have been sold or delivered worldwide in 2004. Private cards account for 42.9% of the cards issued.

The purpose of this paper is to analyse merchants' incentives to issue their private cards, and to characterise the possible reactions of the payment card association.

Payment card networks are often managed by a payment association, such as Visa, or MasterCard, which organises the interactions between the bank of the cardholder, the "Issuer", and the bank of the merchant, the "Acquirer". Such payment card associations entail several benefits for the bank members. For instance, an Issuer is ensured that his payment card will be accepted by all the merchants that are affiliated with the association, while an Acquirer knows that the Issuer will respect the rules for security and processing that are designed by the association. Hence, banks benefit from network effects of membership, and from a reduction in the asymmetry of information when they proceed to payment transactions. Payment card associations also enable banks to allocate optimally the total cost of a payment card transaction between each other, by choosing an "interchange" fee, that is paid by the Acquirer to the Issuer,

[1] Source: Nilson Report, Issue 877 (2007).

[2] See for instance www.nationalgrocers.org, "Of further concern is the grocery industry trend toward both higher interchange rates and higher volumes of electronic transactions, with a number of companies reporting more than 50 percent of their purchases being made with credit and debit cards". See also the Visa Wal-Mart case (2003).

each time a consumer pays by card. The effect of the interchange fee is to reduce the marginal cost of the Issuer and to increase the marginal cost of the Acquirer. This is a way for the payment association of subsidizing the consumers' side, by allowing the Issuers to choose a lower price for the payment card, to the detriment of the merchants' side. Hence, though interchange fees stimulate the demand for card payments, their effect on merchants' side may provide large retailers with incentives to bypass the payment card association.

This paper aims also at analysing the impact of private cards on the level of the interchange fee that is chosen by the payment association. We try to determine if the payment platform can use the interchange fee to deter merchants from entering the market for payment card transactions.

The possibility to bypass the payment association by issuing private cards has never been studied in the literature on payment card systems.[3] Among others, Rochet and Tirole (2002) and Wright (2004) show that the optimal level of interchange fee depends on the nature of competition between merchants. An interesting insight, provided by Rochet and Tirole (2002), is that merchants are ready to accept higher merchant fees to avoid losing market share if they refuse cards. But no paper takes into account the fact that merchants can compete with the payment association by providing their own payment services.

We model the payment card association as a two-sided platform which organises the interactions between a monopolistic Issuer and a monopolistic Acquirer. To analyse a merchant's incentives to issue private cards, we build two different settings. We start by a basic model in which merchants are local monopolists. This framework enables us to study the conditions under which a merchant issues private cards, if there are no strategic interactions with other merchants, and if the payment platform does not react to this decision. We show that there can be some inefficient bypass because of three different effects. By internalising the acquisition of payments, the merchant can retain its benefit of being paid by card, instead of transferring this surplus entirely to the monopolistic Acquirer. This effect is reinforced if the merchant is more efficient than the payment platform, since he sets a lower fee for card payments, which increases the volume of transactions that are paid by card. Furthermore, by issuing private cards, the merchant can extract some surplus from the card users on the issuing side.

Then we give a different structure to the product market to allow for strategic interactions between merchants. There are two merchants that are differentiated à la Hotelling, and positioned exogenously at the two extremes of a linear city of length one. One merchant provides a good of higher quality than the other. Merchants are homogenous as to their card acceptance

[3] For a review of the literature, see Rochet (2003).

benefit and accept payment cards if the merchant fee is not too high. The merchant which produces the good of higher quality can choose to issue its private card. The private card cannot be used by consumers to pay at the other merchant's shop. To issue the private card, the merchant has to pay a fixed cost. We assume that consumers differ across their card usage benefit, which is the same for a given consumer if he pays by card or if he uses the private card.

We start by showing that, in this setting, if the merchant decides to issue its private card, he chooses a transaction fee equal to zero, such that, if consumers come to his shop, they always prefer the private card to the bank-issued payment card. The intuition is that the merchant is active on the market for card transactions and on the product market, and that his incentives on each of these two markets are to set a very low price for the private card. On the market for payment transactions, we show that the merchant has an incentive to undercut the price that is set by the issuer for the payment card. Also, the merchant chooses a low price for the private card because he obtains a higher benefit per transaction if his consumers pay with the private card than if they pay cash. On the product market, the merchant has an incentive to set a low price for the private card, because he obtains a higher market share, by stealing consumers from his competitor.

We prove that, if one merchant issues private cards, the other merchant becomes less resistant to card acceptance than in the benchmark case, in which no merchant issues private cards. The threat of losing consumers on the product market raises the maximum merchant fee that he is willing to pay to accept payment cards. Since the monopolistic Acquirer chooses the maximum merchant fee compatible with merchants' acceptance of payment cards, the effect of the private card is to increase the merchant fee. On the other hand, the Issuer charges a lower card fee, to compete with the very aggressive price that is set by the merchant for the private card. Therefore, the competition with the private card changes the structure of prices.

Then, we derive the impact of the interchange fee on the merchant's incentives to enter the market for payment card transactions by issuing private cards. We show that there are two effects. A higher interchange fee reduces the card fee, which toughens the competition with the Issuer. This effect lowers the merchant's incentives to issue private cards. On the other hand, a higher interchange fee increases the merchant fee, and hence the costs of the rival merchant, which raises the benefits of issuing private cards. In our setting, the first effect is dominant if the card fee is sufficiently low, and the incentives to issue private cards decrease with the interchange fee. Otherwise, if the card fee is high, the second effect becomes dominant. If the card fee is low, the payment platform cannot deter entry, since it already sets the maximum interchange fee compatible with positive profits for the acquirer when the merchant does not issue private cards. Hence, at the equilibrium, there is either blockaded entry or entry accommodation. The payment platform can only deter entry if the card fee is sufficiently high by reducing the level of the interchange fee. Therefore, if entry is not blockaded, we show that the threat of the private card could lead the payment platform to reduce its interchange fee.

We also consider other forms of market structures on the banking retail markets. With perfect competition on the acquisition side and a monopoly on the issuing side, we show that the payment system may set a low interchange fee to deter entry. If both sides of the market are perfectly competitive, the payment platform minimises the probability of entry by choosing Baxter's interchange fee. In an extension of our model, we also study the reaction of the payment platform if the second merchant can follow its competitor and issue private cards.

The rest of this paper is organised as follows. In section two, we start by presenting a basic model of bypass by a local monopolist. In section three, we study the bypass of the payment association by a strategic merchant. In section four, we extend the model presented in section three by assuming other market structures on banking retail markets, and by studying the possible reaction of the other merchant. Finally, we conclude.

2 A model of bypass by a local monopolist

In this section, we introduce a basic model to understand the merchants' incentives to bypass the payment association. We determine the conditions under which a merchant issues private cards, if it has no strategic interaction with other merchants, and if the payment platform does not react to its bypass decision.

2.1 The model

We build a model in which merchants are local monopolists. In our setting, if one merchant chooses to bypass the payment association, this decision does not impact the other merchants' choice to accept cards, and the prices chosen by the banks.

Merchants: A continuum of local monopolists of mass one sells an identical good to the consumers at a price p. The marginal cost of selling the good is the same for all merchants and equal to c. Each merchant may decide to accept payment cards that are issued by the members of the payment association. We assume that, if a merchant is indifferent between accepting and refusing payment cards, he accepts them. We suppose that merchants are homogeneous as regards to their card acceptance benefit, which we denote by b_S, with $b_S \geq 0$.

We consider that one merchant, which we denote by M_0, can decide to issue a private card at a fixed cost F. If a consumer decides to use the private card when he goes to this shop, he has to pay a transaction fee, f^{PC}. The merchant incurs a cost $c_M \in [0,1]$ for each transaction paid by the private card. This cost corresponds to the costs of issuing and acquiring a transaction paid with the private card.

Consumers: A consumer has to choose whether or not to buy the good, and which payment instrument to use. In his wallet, each consumer always holds cash and a payment card issued by his bank.[4] He can always use cash at no cost[5] to pay for his expenses. If he decides to use a payment card, he has to pay a transaction fee, f, to the issuer of the card (a bank or the merchant M_0), provided that the card is accepted.

Each local monopoly faces a mass one of consumers. A consumer is characterised by his benefit, b_B, of using a card rather than cash. We assume that the benefit b_B is the same whether the card is issued by the bank or by the merchant, and that b_B is uniformly distributed over $[0, 1]$. One interpretation is that consumers may attach different values to the convenience of using a card rather than cash.

A consumer, whose card usage benefit is b_B, enjoys a net utility of

$$U = v - p + b_B - f,$$

if he uses his card and pays the transaction fee f, and a net utility of

$$U = v - p,$$

if he pays cash, where v represents a fixed utility obtained from consuming the good.

Banks: The Issuer (I) and the Acquirer (A) are monopolists. For each transaction, the Issuer charges card users with a fee, f^C, and the Acquirer charges merchants with a fee, $m \geq 0$. The Acquirer pays to the Issuer a per-transaction interchange fee, denoted by a^P, with $a^P \geq 0$. Banks' have constant marginal costs c_i per transaction, for $i = I, A$, and profits are denoted by Π_I and Π_A. If no merchant accepts cards, banks make no profits, i.e., $\Pi_i = 0$ for $i = I, A$.

Payment system: The payment system (S) chooses the interchange fee, a^P, which maximises the sum of banks' profits, $\Pi_S = \Pi_I + \Pi_A$. We assume that the Non-Discrimination Rule (NDR)

[4] In the model, we consider cardholding decisions as exogenous, and focus on the choice of the payment instrument at the point of sales.

[5] The costs and the benefits of using cash are normalised to zero.

holds, which means that merchants are forbidden to charge different prices according to the payment instrument used for the transaction.

Other assumptions: We assume that $v - c \geq 2$. This assumption ensures that each monopolistic merchant chooses a price such that the market is covered. We also assume that $0 \leq b_S \leq c_I + c_A \leq 1$. This assumption ensures that some consumers but not all use their payment cards.

Timing The timing of the game is as follows:

1. The payment platform chooses the interchange fee, a^P, which maximises the joint profits of the banks.
2. The monopolistic merchant M_0 decides whether or not to issue private cards.
3. Banks choose simultaneously and non-cooperatively their transaction fees, f^C and m, and the merchant M_0 decides simultaneously on the private card transaction fee, f^{PC}.
4. Each monopolistic merchant chooses its price and whether or not to accept payment cards.
5. Consumers decide whether or not to buy the good and which payment instrument to use (cash, payment card or private card).

With this timing, we assume that merchant M_0 decides whether or not to issue a private card, once the interchange fee has been set. Indeed, in practice, payment platforms do not adjust the level of the interchange fee very frequently. Besides, we choose to focus on the effect of the interchange fee on a merchant's incentives to bypass the payment system.

We look for the subgame perfect equilibrium, and solve the game by backward induction.

2.2 Stage 4 and 5: card acceptance decisions and prices

We study the prices that are chosen by a merchant whether he issues private cards or not.

If the merchant does not issue private cards: The following Lemma gives the price chosen by a local monopolist, and the card acceptance condition.

Lemma 1 *If $m \leq b_S$, each monopolistic merchant accepts payment cards, and extracts all the surplus of the cash users by choosing $p^* = v$.*
Each merchant makes profit $\pi_m^C = v - c + (b_S - m)(1 - f^C)$. Otherwise, if $m > b_S$, the merchants refuse payment cards.

Proof. See Appendix A-1. ■

If the merchant issues private cards: We now determine the price that is chosen by merchant M_0 if he issues private cards. We focus on the case in which $f^{PC} \leq f^C$. Otherwise, the private card would never used by the consumers. Since the merchant has to pay the fixed cost of issuing private cards, the strategy of issuing private cards would be clearly dominated.

Lemma 2 *If merchant M_0 issues private cards, he extracts all the surplus from cash users by choosing $p^* = v$, and he makes profit $\pi^{PC}_{M_0} = v - c + (b_S - c_M + f^{PC})(1 - f^{PC}) - F$.*

Proof. See Appendix A-2. ■

In both lemmas, as the consumers' surplus of buying the good is sufficiently high by assumption, a local monopoly maximises its profit by choosing a price such that the market is covered. In absence of strategic interactions with other merchants, a merchant accepts payment cards if its benefit per transaction is higher than the fee he pays to the Acquirer.

2.3 Stage 3: transaction fees

We now determine the transaction fees that are chosen by the Issuer, the Acquirer, and by the merchant M_0 if the latter has issued private cards. Since there is a continuum of local monopolists in our model, the decision of the merchant M_0 to issue private cards does not influence the prices that are chosen by the banks. Let D^C denotes the demand of card users. The Issuer and the Acquirer choose the transaction fees, f^C and m respectively, that maximise their profits,

$$\Pi_I = D^C(f^C + a^P - c_I),$$

and

$$\Pi_A = D^C(m - a^P - c_A),$$

subject to the card acceptance condition $m - b_S \leq 0$,[6] and the conditions $\Pi_I \geq 0$ and $\Pi_A \geq 0$. According to Lemma 1, a monopolistic merchant that accepts cards chooses a price such that the market is covered. Hence, if merchants accept cards, $D^C = 1 - f^C$.

Since Π_A increases with m, the Acquirer maximises its profit by choosing the maximal merchant fee compatible with merchants' acceptance of payment cards. Therefore, we have $m^* = b_S$. For this value of the merchant fee, each merchant is indifferent between accepting and refusing payment cards, and from Lemma 1, the profit of a merchant is $\pi^C_m = v - c$. The transaction fee that maximises the Issuer's profit is $(f^C)^* = \left(1 - a^P + c_I\right)/2$.

[6] If merchants do not accept payment cards, we have $\Pi_I = \Pi_A = 0$.

With the following Lemma, we give the optimal private card fee chosen by merchant M_0 if he issues private cards.

Lemma 3 *If merchant M_0 issues private cards, he sets $\left(f^{PC}\right)^* = \min\left\{(1-b_S+c_M)/2, (f^C)^*\right\}$. If $c_M - b_S \leq c_I - a^P$, he obtains a profit of $\pi_{M_0}^{PC} = v - c + \frac{1}{4}(1+b_S-c_M)^2 - F$; otherwise, he obtains a profit of $\pi_{M_0}^{PC} = v - c + (b_S - c_M + (f^C)^*)\left(1-(f^C)^*\right) - F$.*

Proof. See Appendix A-3. ■

Notice that $\left(f^{PC}\right)^* < (f^C)^*$ if and only if $c_M - b_S < c_I - a^P$. This condition means that the private card fee is strictly lower than the payment card fee if, for each transaction, the net cost of issuing private cards is strictly lower than the net cost born by the issuer.

2.4 Stage 2: the bypass condition

Merchant M_0 has an incentive to issue private cards if and only if $\pi_{M_0}^{PC} \geq \pi_m^C$. This bypass condition can be rewritten as

$$\frac{(1+b_S-c_M)^2}{4} \geq F,$$

if $c_M - b_S < c_I - a^P$, and

$$(b_S - c_M + \frac{1-a^P+c_I}{2})\left(\frac{1+a^P-c_I}{2}\right) \geq F,$$

otherwise.

2.5 Stage 1: the optimal interchange fee

The payment platform chooses the interchange fee a^P that maximises banks' joint profits,

$$\begin{aligned} \Pi_I + \Pi_A &= \left((f^C)^* + m^* - c_I - c_A\right)\left(1-(f^C)^*\right) \qquad (1) \\ &= \left(b_S - a^P - c_A + \frac{1+a^P-c_I}{2}\right)\left(\frac{1+a^P-c_I}{2}\right), \end{aligned}$$

subject to $\Pi_I \geq 0$ and $\Pi_A \geq 0$. Maximising (1) with respect to a^P gives an unconstrained optimum $a^P = b_S - c_A$.[7] Since for this value of the interchange fee, we have $\Pi_I \geq 0$ and $\Pi_A = 0$, then the optimal interchange fee is

$$\left(a^P\right)^* = b_S - c_A.$$

[7] Since $\Pi_I + \Pi_A$ is concave in a^P, the second order condition is verified.

The optimal interchange fee chosen by the payment platform is equal to Baxter's interchange fee. The following Proposition gives the conditions under which merchant M_0 chooses to bypass the payment association.

Proposition 1 *If $c_M \leq c_I + c_A$, merchant M_0 chooses to bypass the payment association if and only if $(1 + b_S - c_M)^2 /4 \geq F$. Otherwise, if $c_M > c_I + c_A$, he chooses to bypass if and only if $(1 + b_S - c_M - c_M + c_I + c_A)(1 + b_S - c_I - c_A)/4 \geq F$.*

Proof. This result is obtained by replacing for $\left(a^P\right)^*$ in the bypass condition given at stage 2. ■

As a corollary, consider the limit case $F = 0$. If merchant M_0 is at least as efficient as the payment system (that is, $c_M \leq c_I + c_A$), there is always bypass, since $|b_S - c_M| \leq 1$. If merchant M_0 is less efficient than the payment system (that is, $c_M > c_I + c_A$), then there can be bypass if $b_S - c_M$ is sufficiently high. In other words, there can be inefficient bypass.

The incentives to bypass are driven by three different effects. To begin with, by internalising the acquisition of payments, merchant M_0 can retain its benefit of being paid by card rather than cash, b_S, instead of transferring this surplus entirely to the monopolistic Acquirer through the merchant fee. This effect is reinforced if merchant M_0 is more efficient than the payment system, since the lower fee for card payments (as $\left(f^{PC}\right)^* < (f^C)^*$) increases the volume of card transactions. Finally, by issuing private cards, merchant M_0 can extract some surplus from the card users on the issuing side.

We checked the robustness of these bypass conditions by assuming different market structures on the banking retail markets. If there is perfect competition on the acquisition side, and a monopolistic issuer, the bypass conditions remain the same, as the card fee that is chosen by the issuer and the interchange fee that is set by the payment platform are identical. If there is perfect competition on the issuing side, and a monopolistic acquirer, the bypass condition is also the same, though the optimal interchange fee is different (See Appendix A-4).

3 A model of bypass by strategic merchants

In this section, we modify our basic model to account for the strategic interactions between merchants on the one hand, and between the bypassing merchant and the banks, on the other hand.

3.1 The model

We use the framework that we developed in the previous section, except that we now give an "Hotelling" structure to the product market. Our setting is modified as follows.[8]

Merchants Two merchants, denoted by 1 and 2, are located at the extremities of a linear city of length one. Merchant 1's shop is located at point 0 and merchant 2's shop at point 1. Each merchant $i \in \{1, 2\}$ sells the same good at price p_i, and the marginal costs are the same and equal to c. We assume that merchant 1 can issue private cards at a fixed cost F, whereas merchant 2 cannot issue private cards.[9] The merchants are homogeneous as regards to their card acceptance benefit, which is denoted by b_S. Merchant 1 obtains the same card acceptance benefit whether the transaction is paid by a bank's card or the private card.

Consumers Consumers are uniformly located along the linear city. They incur a linear transportation cost t when they travel to shop either at merchant 1's or merchant 2's shop. When it decides to shop at merchant i's, a consumer purchases zero or one unit of the good.

In his wallet, each consumer always holds cash and a payment card issued by his bank. The payment card issued by the bank can be used either to buy from merchant 1 or merchant 2, provided it is accepted at the point of sales. A consumer may also hold a private card, issued by merchant 1, which can only be used to purchase a good at merchant 1's shop.

Each consumer is characterised by his benefit, b_B, of using a card rather than cash. We assume that the benefit b_B is the same whether the card is issued by the bank or by merchant 1, and that b_B is uniformly distributed over $[0, 1]$.

A consumer located at x, whose card usage benefit is b_B, and who buys from merchant i located at x_i, enjoys a net utility of:

$$U = v + t\,|x - x_i| - p_i + b_B - f,$$

if he uses his card, and pays the transaction fee f, and a net utility of

$$U = v + t\,|x - x_i| - p_i,$$

if he pays cash, where v represents a fixed utility obtained from consuming the good. We assume

[8]In Section 5, we will discuss how the market structure on the acquisition side affects our results.
[9]For instance, we could assume that the fixed cost of introducing private cards for merchant 2 is prohibitively high. In the extension section, we will discuss the possible reaction of merchant 2.

that v is sufficiently high, such that the market is covered.[10]

Other assumptions We also make the following assumptions.

Assumption 1. $t \geq 11/3$.

This assumption ensures that Π_I is concave with respect to f^C.[11]

Assumption 2. $0 \leq c_M \leq b_S \leq c_I + c_A < 1$

The fact that $b_S \geq c_M$ implies that merchant 1 makes a net benefit for each transaction paid with the private card. We also assume that $c_M \leq c_I + c_A$, which means that merchant 1 is at least as efficient as the association of the Issuer and the Acquirer. Finally, since $b_S \leq c_I + c_A < 1$, it is socially optimal that some consumers but not all pay with their payment cards.

Timing: The timing of the game is the same as in the previous section. At stage 1, the payment platform chooses the interchange fee that maximises banks' joint profit, a^P. At stage 2, merchant 1 decides whether or not to issue a private card. At stage 3, merchant 1 decides on the level of the transaction fee for the private card, f^{PC}, while banks choose simultaneously and non-cooperatively their transaction fees, f^C and m. At stage 4, merchants choose their prices p_1 and p_2, and whether or not to accept cards. At stage 5, the consumers decide which payment instrument to use (cash, payment card or private card), and which merchant to buy from.

We look for the subgame perfect equilibrium, and solve the game by backward induction.

3.2 A benchmark: no private card

We start by analysing a benchmark, in which we assume that it is too costly for merchant 1 to issue private cards.[12] We determine the condition under which both merchants accept payment cards, and the optimal interchange fee chosen by the payment card system. This benchmark case is close to Rochet and Tirole (2002). But, in our setting, we assume that banks on each side of the payment platform are monopolies, whereas, in Rochet and Tirole, there is perfect competition in the acquisition market and imperfect competition in the issuing market.

We focus on the equilibrium in which both merchants accept cards.[13] Let $(a^P)^B$, $(f^C)^B$ and

[10] For instance, if no merchant issues private cards, and if both merchants accept cards, the market is covered if $v \geq c + 3t/2$.

[11] See Appendix E1.

[12] This benchmark also corresponds to the subgame in which merchant 1 does not issue a private card.

[13] There might also be "high resistance" equilibria as in Rochet and Tirole (2002), in which no merchant accepts cards.

$(m)^B$ denote the equilibrium interchange fee, transaction fee and merchant fee, respectively. We denote by $\pi_i^B\left((f^C)^B, m^B\right)$ the equilibrium profit of merchant i.

Proposition 2 *If merchant* 1 *cannot issue private cards, both merchants accept payment cards if* $m \leq b_S + \left(1 - f^C\right)/2$. *The optimal interchange fee is* $(a^P)^B = (4(b_S - c_A) + 1 - c_I)/3$, *and the optimal transaction fees are* $(f^C)^B = (1 + 2(c_I + c_A - b_S))/3$, *for the Issuer, and* $(m)^B = (4b_S + 1 - (c_I + c_A))/3$, *for the Acquirer.*

Proof. See Appendix B. ■

As in Rochet and Tirole (2002, 2006), we find that strategic merchants are ready to pay for a higher merchant fee, to attract consumers to their stores. They internalise a fraction of the cardholders' benefit of using their cards. If merchants were not strategic, the maximum merchant fee compatible with card acceptance would be b_S, and the optimal interchange fee would be $a^P = b_S - c_A$, as shown in Section 2.

3.3 The equilibrium with private cards

In this Section, we assume that merchant 1 can issue private cards[14] and we determine the equilibrium of the game, starting from the last stage.

3.3.1 Stage 5 and 4: card acceptance decisions and prices

If merchant 1 does not issue private cards, the analysis is similar to the benchmark case. From now on, we assume that merchant 1 issues private cards, and we determine the demands for merchants 1 and 2. We denote $\Delta f = f^C - f^{PC}$ and we assume that consumers who shop at merchant 1's and are indifferent between the payment card and the private card use the private card.

At stage 5, consumers take into account the price of the good in their decision to shop either at merchant 1's or merchant 2's, as well as the availability of each payment instrument. As each merchant can either accept or refuse cards, we have four possible cases, depending on the merchants' acceptance decisions. We denote by $\pi_i^{\delta_1,\delta_2}$ the profit of merchant i, where δ_i denotes the card acceptance decision of merchant i. We set $\delta_i = NC$ if merchant i refuses payment cards and $\delta_i = C$ if he accepts cards. At stage 4, merchant i chooses the price p_i that maximises his profit,

$$\pi_i^{\delta_1,\delta_2} = \left(D_i^{PC} + D_i^C + D_i^{Cash}\right)(p_i - c) + (f^{PC} + b_S - c_M)D_i^{PC} + (b_S - m)D_i^C,$$

[14] Or, equivalently, that the fixed cost of a private card system is not prohibitively high.

where D_i^{PC}, D_i^{C}, and D_i^{Cash} denote the demand of consumers who shop at merchant i's and pay with the private card, the payment card and cash, respectively. Notice that $D_2^{PC} = 0$ as, by assumption, merchant 2 does not issue private cards.

We determine below the equilibrium of stages 4 and 5 in each of the four possible cases, for $(\delta_1, \delta_2) \in \{NC, C\}^2$.

Both merchants accept payment cards. We start by analyzing consumers' decisions at stage 5. If $f^{PC} > f^{C}$, consumers who shop at merchant 1's always use their payment card instead of the private card, as their net utility from using the payment card, $b_B - f^C$, is strictly greater than their net utility of using the private card, $b_B - f^{PC}$. Therefore, the demands for merchant 1 and merchant 2 are identical to their demands in the benchmark case, if they both accept payment cards, and can be found in Appendix B.

If $f^{PC} \leq f^{C}$, consumers who shop at merchant 1's prefer the private card to the payment card. Consumers such that $b_B < f^{PC} \leq f^C$ always pay cash, as their net utility from a payment by card is negative. A standard Hotelling analysis shows that each merchant i obtains a share w_i of these consumers, where

$$w_i = \frac{1}{2} + \frac{1}{2t}(p_j - p_i),$$

for $(i;j) \in \{1;2\}^2$ and $i \neq j$. By integrating for $b_B \in \left[0, f^{PC}\right]$, we obtain that the demand from cash users is equal to $f^{PC} w_i$ for merchant i.

Consumers such that $b_B \in \left[f^{PC}, f^{C}\right)$ trade off between purchasing from merchant 1 and paying with the private card and purchasing from merchant 2 and paying cash, as their net utility from a payment by card $(b_B - f^C)$ is negative, whereas their net utility from a payment with the private card $(b_B - f^{PC})$ is positive. The marginal consumer is given by

$$v - p_1 - tx + b_B - f^{PC} = v - p_2 - t\left(1 - x\right),$$

that is,

$$x\left(b_B\right) = \frac{1}{2} + \frac{p_2 - p_1 + b_B - f^{PC}}{2t}.$$

Aggregating for $b_B \in \left[f^{PC}, f^{C}\right)$, the demand for merchant 1 from these consumers is

$$\int_{f^{PC}}^{f^C} x\left(b_B\right) db_B = \frac{p_2 - p_1}{2t}\Delta f + \frac{(\Delta f)^2}{4t} + \frac{\Delta f}{2},$$

whereas the demand for merchant 2 from these consumers is

$$\int_{f^{PC}}^{f^{C}} (1 - x(b_B))\, db_B = \frac{p_1 - p_2}{2t}\Delta f + \frac{\Delta f}{2} - \frac{(\Delta f)^2}{4t}.$$

Consumers such that $b_B \geq f^C$ trade off between purchasing from merchant 1 and paying with the private card and purchasing from merchant 2 and paying with the payment card, since their net utility of paying by card is positive. The marginal consumer is given by

$$v - p_1 - tx + b_B - f^{PC} = v - p_2 - t(1-x) + b_B - f^C,$$

that is,

$$x = \frac{1}{2} + \frac{p_2 - p_1 + \Delta f}{2t},$$

therefore, aggregating over $b_B \in [f^C, 1]$, the demand for merchant 1 from these consumers is

$$(1 - f^C)\left[\frac{p_2 - p_1 + \Delta f}{2t} + \frac{1}{2}\right],$$

whereas the demand for merchant 2 from these consumers is

$$(1 - f^C)\left[\frac{1}{2} - \frac{p_2 - p_1 + \Delta f}{2t}\right].$$

To sum up, we find that the demand of cash users is

$$D_1^{Cash} = f^{PC} w_1,$$

and

$$D_2^{Cash} = f^C w_2 - \frac{(\Delta f)^2}{4t},$$

for merchant 1 and merchant 2, respectively. Compared to the benchmark case, the demand of cash users for merchant 1 is determined by the price of the private card, which plays the same role as the payment card. If the price of the private card is lower than the price of the payment card, merchant 2 loses some of its cash users who prefer to shop at merchant 1's and pay with the private card. This corresponds to the second term in D_2^{Cash}.

The demand of card users is the demand of private card users for merchant 1,

$$D_1^{PC} = (1 - f^{PC}) w_1 + \frac{(1 - f^C)\Delta f}{2t} + \frac{(\Delta f)^2}{4t}, \quad (2)$$

and the demand of payment card users for merchant 2,

$$D_2^C = (1 - f^C)w_2 - \frac{(1 - f^C)\Delta f}{2t}. \tag{3}$$

If the private card is less expensive than the payment card, merchant 1 attracts some cash users and some card users from merchant 2. The number of cash users who switch from merchant 2 to merchant 1 is given by the third term in (2), that is, $(\Delta f)^2/(4t)$. The number of card users who switch from merchant 2 to merchant 1 is given by the second term in (2), that is, $(1 - f^C)\Delta f/(2t)$.

We now turn to stage 4 of our game. Merchant 1 makes profit

$$\pi_1^{C,C} = \left(D_1^{Cash} + D_1^{PC}\right)(p_1 - c) + (b_S + f^{PC} - c_M)D_1^{PC},$$

whereas merchant 2 makes profit

$$\pi_2^{C,C} = \left(D_2^{Cash} + D_2^C\right)(p_2 - c) + (b_S - m)D_2^C.$$

When merchants decide on their prices, they take into account both their net revenues from product sales (the first term in the profit functions) and the costs or benefits associated to card payments (the second term in the profit functions). Replacing for the expressions of demands in π_1 and π_2, and solving for the first order conditions,[15] we find that the equilibrium prices are

$$p_1 = c + t + \frac{1}{3}\left(\frac{(\Delta f)^2}{2} + (\Delta f)(1 - f^C) + (m - b_S)(1 - f^C) - 2\left(f^{PC} + b_S - c_M\right)(1 - f^{PC})\right),$$

and

$$p_2 = c + t + \frac{1}{3}\left(-\frac{(\Delta f)^2}{2} - (\Delta f)(1 - f^C) + 2(m - b_S)(1 - f^C) - \left(f^{PC} + b_S - c_M\right)(1 - f^{PC})\right).$$

A higher fee for the private card has two opposite effects on equilibrium prices. First, a higher f^{PC} decreases merchant 1's perceived marginal cost for the transactions paid by the private card, which tends to reduce merchants' prices. Second, a higher f^{PC} reduces the volume of transactions paid by the private card, hence, leads to a higher *average* perceived marginal cost for merchant 1. This is because the perceived marginal cost for transactions paid cash, c, is higher than the perceived marginal cost for transactions paid by the private card, $c - \left(b_S + f^{PC} - c_M\right)$, since $b_S > c_M$. For sufficiently low values of f^{PC}, the first effect dominates the second effect,

[15] The second order condition is verified.

and prices decrease with the private card fee. On the contrary, for sufficiently high values of f^{PC}, prices increase with the private card fee.

Replacing for the equilibrium values of p_1 and p_2 in $\pi_1^{C,C}$ and $\pi_2^{C,C}$, we obtain the equilibrium profits, which can be found in Appendix C.

Merchant 1 does not accept payment cards, while merchant 2 accepts them. If $f^{PC} \leq f^C$, whether merchant 1 accepts payment cards or not, his card consumers will always use the private card as it is cheaper. Therefore, whether he accepts cards or not, merchant 1 will face the same demand, and the equilibrium prices and profits are identical to the previous case. If $f^{PC} > f^C$, a similar analysis as in the previous section shows that the demand of cash users is

$$D_1^{Cash} = f^{PC} w_1 - \frac{(\Delta f)^2}{4t},$$

and

$$D_2^{Cash} = f^C w_2,$$

for merchant 1 and merchant 2, respectively. The second term in D_1^{Cash} represents the cash consumers of merchant 1 who decide to purchase from merchant 2 and pay by card. The demand of card users is the demand of private card users for merchant 1,

$$D_1^{PC} = (1 - f^{PC})w_1 + \frac{(1 - f^{PC})\Delta f}{2t},$$

and the demand of payment card users for merchant 2,

$$D_2^C = (1 - f^C)w_2 - \frac{(1 - f^{PC})\Delta f}{2t} + \frac{(\Delta f)^2}{4t}.$$

The second term in D_1^{PC} is negative (as $\Delta f < 0$) and represents the private card users who prefer to shop at merchant 2's and pay with the payment card. This term corresponds to the second term in D_2^C. The last term in D_2^C corresponds to the cash consumers of merchant 1 who decide to shop at merchant 2's and pay by card. The equilibrium prices are

$$p_1 = c+t+\frac{1}{3}\left(-\frac{(\Delta f)^2}{2} + (\Delta f)(1 - f^{PC}) + (m - b_S)(1 - f^C) - 2(f^{PC} + b_S - c_M)(1 - f^{PC})\right),$$

and

$$p_2 = c+t+\frac{1}{3}\left(\frac{(\Delta f)^2}{2} + -(\Delta f)(1 - f^{PC}) + 2(m - b_S)(1 - f^C) - (f^{PC} + b_S - c_M)(1 - f^{PC})\right).$$

The effect of f^{PC} on prices is similar to the previous case. Equilibrium profits, $\pi_i^{NC,C}$, can be found in Appendix C.

Merchant 1 accepts all payment cards, while merchant 2 refuses them. If $f^{PC} > f^C$, private cards are never used by consumers. This case is identical to the benchmark case, in which merchant 2 does not accept cards, while merchant 1 accepts them. If $f^{PC} \leq f^C$, payment cards are never used by consumers, as merchant 2 does not accept cards, and consumers prefer to use the private card when they shop at merchant 1's. Using the same analysis as in the previous cases, we find that the demands of cash users for merchant 1 and merchant 2 are

$$D_1^{Cash} = f^{PC} w_1,$$

and

$$D_2^{Cash} = w_2 - \frac{(1 - f^{PC})^2}{4t},$$

respectively. The demand of private card users for merchant 1 is

$$D_1^{PC} = (1 - f^{PC})w_1 + \frac{(1 - f^{PC})^2}{4t}.$$

The second term in D_1^{PC} represents the cash users of merchant 2 who decide to shop at merchant 1's and pay with the private card. The equilibrium prices are

$$p_1 = c + t + \frac{1}{3}\left(\frac{(1 - f^{PC})^2}{2} - 2(f^{PC} + b_S - c_M)(1 - f^{PC})\right),$$

and

$$p_2 = c + t + \frac{1}{3}\left(-\frac{(1 - f^{PC})^2}{2} - (f^{PC} + b_S - c_M)(1 - f^{PC})\right),$$

and the equilibrium profits, $\pi_i^{C,NC}$, can be found in Appendix C. The effect of f^{PC} on prices is similar to the previous cases.

Both merchants refuse payment cards. As consumers trade off between the private card and cash at merchant 1's and can only pay cash at merchant 2's, the demands are identical to the previous case in which merchant 2 refuses cards but not merchant 1, and $f^{PC} \leq f^C$. Equilibrium prices and equilibrium profits, $\pi_i^{NC,NC}$, are also identical.

Card acceptance conditions. At stage 4, simultaneously with setting prices, the merchants decide whether or not to accept cards. The situation in which both merchants accept cards constitutes a Nash equilibrium if and only if

$$\pi_1^{C,C}\left(m, f^C, f^{PC}\right) \geq \pi_1^{NC,C}\left(m, f^C, f^{PC}\right),$$

and

$$\pi_2^{C,C}\left(m, f^C, f^{PC}\right) \geq \pi_2^{C,NC}\left(m, f^C, f^{PC}\right).$$

The first condition means that merchant 1 has no incentive to deviate to the equilibrium in which merchant 2 is the only one who accepts cards. The second condition means that merchant 2 makes more profit if both merchants accept cards than in a situation where merchant 1 is the only one who accepts cards. The card acceptance decisions depend on the transaction fees, m, f^C and f^{PC}, which are set at stage 3 of the game.

3.3.2 Stage 3: choice of transaction fees

In this section, we assume that merchant 1 issues private cards, and we determine the transaction fees chosen by the banks and merchant 1.[16] We show that there exists an equilibrium in which both merchants accept payment cards, and that in this equilibrium, merchant 1 sets $f^{PC} = 0$.

We start by analyzing the decision of merchant 1. For given m and f^C, merchant 1 chooses the private card fee, f^{PC}, so as to maximise his profit,

$$\pi_1^{x_1,x_2} = \left(D_1^{PC} + D_1^C + D_1^{Cash}\right)(p_1 - c) + (f^{PC} + b_S - c_M)D_1^{PC} + (b_S - m)\, D_1^C. \qquad (4)$$

The following lemma shows that merchant 1's best response has a remarkable property.

Lemma 4 *If merchant* 1 *issues the private card, for any* m *and* f^C*, his best response is to choose a transaction fee equal to zero, that is,* $f^{PC} = 0$.

Proof. In Appendix D1, we show that if $f^{PC} < f^C$, merchant 1's profit decreases with the price of the private card, f^{PC}. Consequently, in this case, for any m, his best response is to set $f^{PC} = 0$. In Appendix D2, we show that merchant 1 always makes more profit if he undercuts f^C by choosing $f^{PC} < f^C$. Therefore, merchant 1's best response is to choose a transaction fee which is equal to zero. ■

Lemma 4 shows that merchant 1 sets a very aggressive price for his private card, which is below cost. In Section 2, we proved that, in absence of strategic interactions with the payment association and with other merchants, the bypassing monopolistic merchant chose a strictly

[16] If merchant 1 does not issue private cards, this is the benchmark case, that we have analyzed in Section 3.2.

positive card fee. Therefore, the intuition of Lemma is that the strategic interactions on the market for card transactions on the one hand, and the strategic interactions on the product market on the other hand, provide merchant 1 with strong incentives to set a low fee for the private card.

On the market for card transactions, merchant 1 competes in prices with bank I. Since the payment card and the private card are perfect substitutes, if f^C is sufficiently high, then the Bertrand logic applies, and merchant 1 has an incentive to undercut the price of the payment card. Indeed, from the analysis of stage 4 and 5, we know that if merchant 1 accepts payment cards and if he undercuts the Issuer by setting a slightly lower fee, that is, $f^{PC} = f^C - \epsilon$, with ϵ small, then the demand of card payments (either with a payment or a private card) remains unchanged. Consequently, merchant 1 has an incentive to undercut bank I if $f^C + b_S - c_M \geq b_S - m$ (see term (II) in (4)). Apart from this competitive effect on the market for card transactions, merchant 1 also has an incentive to lower his private card fee to encourage consumers to pay with the private card instead of cash, as he earns a higher benefit with the private card.

The private card fee has also an impact on competition in the product market. First, merchant 1 has an incentive to set a low fee to attract consumers of merchant 2, who prefer to shop at merchant 1's for lower transaction costs. Second, a lower f^{PC} softens competition on the product market because it increases the perceived marginal cost of merchant 1 for card transactions.

The effects of f^{PC} on the profits made on the product market and the market for payment transactions go in the same direction, and provide merchant 1 with strong incentives to set a very low private card fee.

We have proved that $f^{PC} = 0$ constitutes a dominant strategy for merchant 1. Therefore, from this point, we analyse the decisions of bank I and bank A for $f^{PC} = 0$. As $f^{PC} = 0$, for any f^C and m, the consumers of merchant 1 always prefer the private card to the payment card. Hence, the payment card may only be used by consumers of merchant 2. If merchant 2 refuses the payment card, banks do not make any profit. Therefore, bank I and A choose f^C and m, under the constraint that merchant 2 accepts cards. We show that this is the case for sufficiently low values of m.

Lemma 5 *There exists* $\widetilde{m}(f^C) \in \big(b_S + (1 - f^C)/2; b_S + 3(1 - f^C)/4\big)$, *such that merchant* 2 *accept payment cards for* $m \leq \widetilde{m}(f^C)$. *Merchant* 1 *is indifferent between accepting and refusing payment cards.*

Proof. See Appendix E. ■

As in the benchmark case, if the merchant fee is sufficiently low, there is an equilibrium in which both merchants accept payment cards. Since $f^{PC} = 0$, consumers always choose the private card to pay at merchant 1's. Hence, merchant 1 is indifferent between accepting and refusing payment cards. Merchant 2 accepts payment cards for sufficiently low values of m.

Corollary 1 *For a given payment card fee, f^C, the merchants are less resistant to card acceptance if merchant 1 issues private cards than if it does not.*

Proof. Indeed, in the benchmark case, the card acceptance condition was $m \leq b_S + (1 - f^C)/2$, while we have $\widetilde{m}(f^C) \geq b_S + (1 - f^C)/2$. ■

Merchant 2's incentive to deviate from the equilibrium in which both merchants accept cards is equal to the difference between his profit in case of deviation and his statu-quo profit.

In the benchmark case, as in Rochet and Tirole (2002), merchant 2's decision to refuse cards has two effects on his profit, a "perceived marginal cost effect", and a "market share effect". First, merchants' perceived marginal costs change if merchant 2 refuses cards, as he saves the merchant fee, m, net of the benefit of being paid by card, b_S. Therefore, his perceived marginal cost decreases if $m - b_S > 0$, and increases otherwise. Besides, when merchant 2 refuses cards, the proportion of card users at merchant 1's increases. Hence, merchant 1's average perceived marginal cost increases if $m - b_S > 0$, and decreases otherwise. Consequently, the higher m, the higher the benefits of deviation for merchant 2. Second, if he decides to refuse cards, merchant 2 may lose market share, as some of his card users may decide to switch to merchant 1. This market share effect makes deviation less profitable for merchant 2. Its magnitude is higher when the payment card fee is lower.

If merchant 1 issues a private card, merchant 2's incentives to refuse cards also depend on a perceived marginal cost effect and a market share effect. The market share effect is comparable to the one observed in the benchmark case, except that its magnitude is higher because merchant 1 sets a private card fee equal to zero. This reduces merchant 2's incentives to deviate, in comparison to the benchmark case. The perceived marginal cost effect has a different impact on merchant 1, since consumers always prefer the private card to the payment card when they shop at merchant 1's. For merchant 1, the perceived marginal cost of private card payments is negative (equal to $c_M - b_S$). Hence, when merchant 2 deviates and refuses cards, the proportion of private card users at merchant 1's increases, which reduces the average perceived marginal cost of merchant 1 (even if $m > b_S$). Therefore, merchant 2's incentives to deviate are lower compared to the benchmark case.

This explains why merchant 2 is less resistant to card acceptance. A direct consequence is that, for a given f^C, the Acquirer can set a higher merchant fee if merchant 1 issues private cards.

We now determine the transaction fees, f^C and m, that maximise the profits of the Issuer and the Acquirer, respectively, for $m \leq \widetilde{m}(f^C)$, that is,

$$\Pi_I = \left(f^C + a^P - c_I\right) D_2^C,$$

and

$$\Pi_A = (m - a^P - c_A) D_2^C,$$

where, from Appendix F,

$$D_2^C = \frac{1}{2t}(1 - f^C)\left[t + \frac{1}{3}\left(-(b_S + 1 + f^C)f^C + c_M - m(1 - f^C)\right)\right]. \tag{5}$$

The Issuer and the Acquirer trade off between a higher margin and a higher volume of card transactions. Notice, from equation (5), that the volume of card transactions is decreasing with the merchant fee, m. This is because the merchant fee is passed to consumers through merchant 2's perceived marginal cost.

The following proposition shows that there exists a unique equilibrium in which both merchants accept cards, and that the Acquirer chooses the maximum merchant fee compatible with merchant acceptance.

Proposition 3 *There exists a unique equilibrium, such that merchant* 1 *sets* $f^{PC} = 0$*, the Acquirer chooses the maximum merchant fee compatible with merchant* 2*'s card acceptance, and the issuer chooses a strictly positive card fee.*

Proof. See Appendix F. ■

The optimal merchant fee must be compatible with merchant 2's non deviation condition, as the Acquirer makes zero profit if merchant 2 deviates from the equilibrium in which the merchants accept cards. In Appendix F, we show that the merchant fee that maximises the Acquirer's profit does not satisfy the non deviation condition. Hence, since Π_A is concave in m,[17] the optimal merchant fee is equal to $\widetilde{m}(f^C)$.

Proposition 4 *The merchant fee is higher in the presence of a private card, while the transaction fee chosen by the Issuer for the payment card is lower, that is, we have* $m^* > m^B$ *and* $(f^C)^* < (f^C)^B$.

[17] This is proved in Appendix F.1.

Proof. See Appendix G. ■

When merchant 1 issues private cards and sets a very aggressive private card fee, the Issuer reacts by setting a lower payment card fee than in the benchmark case. Notice, however, that the Issuer's reaction cannot be explained only by the competition with the private card on the market for payment transactions, since f^{PC} is set to zero and $(f^C)^* > 0$.

The Issuer's reaction is also related to the product market. By setting $f^{PC} = 0$, merchant 1 obtains what could be interpreted as a quality advantage over merchant 2, which reduces the demand of merchant 2, including the demand from card users. The Issuer has an incentive to reduce merchant 2's quality disadvantage by lowering the payment card fee; in other words, the Issuer internalises the effect of the payment card fee on competition in the product market. As the payment card fee is reduced, the Acquirer can increase his merchant fee, since $\widetilde{m}(f^C)$ is decreasing in f^C.

Hence, the effect of the private card is to reinforce the market power of the Acquirer, as it makes merchants less resistant to card acceptance. On the contrary, the private card reduces the market power of the Issuer, because the latter has to lower the payment card fee to stimulate the demand of card users at merchant 2's. A consequence is that the price structure of the payment platform changes because of the competition with the private card. Unfortunately, it proves difficult to determine analytically the effect of the introduction of private cards on the total price that is charged by the payment platform, $f^C + m$. Therefore, we have to revert to numerical simulations.

We define $a^{\max}$ as the highest value of the interchange fee, a^P, such that the Acquirer's margin, $\widetilde{m}\left(\left(f^C\right)^*\left(a^P\right)\right) - a^P - c_A$, is positive.[18] We ran our simulations for the following values of the parameters: $t \in \{4, 4.1, ..., 10.0\}$, $c_A \in \{0.2, 0.3, 0.4\}$, $c_I \in \{c_A, c_A + 0.05, c_A + 0.1\}$, $c_M \in \{c_I + c_A - 0.2, c_I + c_A - 0.15, ..., c_I + c_A - 0.05\}$, $b_S \in \{c_M + 0.01, c_M + 0.02, ..., c_I + c_A - 0.01\}$, and $a^P \in \left\{0, 0.01, ..., \min\left\{a^{\max}, (a^P)^B\right\}\right\}$. The simulations show that for all t, c_I, c_A, c_M, and b_S, there exists a threshold value of a^P, which we denote by $\widetilde{a}^P$, such that the total price charged by the platform, $f^C + m$, is higher with the private card than in the benchmark case if $a \leq \widetilde{a}^P$, and the reverse is true otherwise.[19] This results shows that the introduction of private cards can lead to an *increase* of the total price charged by the platform, due to the reinforcement of the market power of the Acquirer.

[18] From Lemma 6, we know that when the interchange fee increases, the Acquirer charges a higher merchant fee. However, from Lemma 5, the equilibrium merchant fee is bounded from above. Since $\widetilde{m}\left(\left(f^C\right)^*\left(a^P\right)\right) - a^P - c_A \geq 0$, the interchange fee is also bounded from above.

[19] For each value of the parameter vector (t, c_I, c_A, c_M, b_S), we computed $\widetilde{a}^P$. Then, we tested whether $\left(m^* + (f^C)^*\right)\left(a^P\right) \geq \left(m + f^C\right)^B\left(a^P\right)$ if and only if $a^P \leq \widetilde{a}^P$, by testing this statement for each value of $a^P \in \left\{0, 0.01, ..., \min\left\{a^{\max}, (a^P)^B\right\}\right\}$.

3.3.3 Stage 2: decision to issue a private card

Merchant 1 decides to issue private cards if and only if

$$\pi_1^{C,C}\left((f^{PC})^*, (f^C)^*, m^*\right) - F \geq \pi_1^B\left((f^C)^B, m^B\right). \quad (6)$$

Notice that this corresponds to a vertical integration decision, except that it takes place in a two-sided market, that is, merchant 1 has to decide whether or not to create his own payment platform.

3.3.4 Stage 1: choice of the interchange fee

In this section, we start by conducting some comparative statics with respect to the interchange fee, if merchant 1 issues private cards. Then, we determine the optimal level of the interchange fee, that we compare with the one obtained in the benchmark case.

Comparative statics We assume that merchant 1 issues private cards, that is, condition (6) is satisfied. We analyse the effect of the interchange fee on the optimal transaction fees chosen by the Issuer and the Acquirer.

Lemma 6 *The transaction fee chosen by the Issuer for the payment card is decreasing with a^P, while the merchant fee chosen by the Acquirer is increasing with a^P, that is, we have $d(f^C)^*/da^P < 0$ and $d(m)^*/da^P > 0$.*

Proof. See Appendix H. ■

The interchange fee, a^P, has a direct and a strategic effect on the transaction fees, f^C and m. First, a higher a^P implies a lower perceived marginal cost for bank I and a higher perceived marginal cost for bank A. Therefore, bank I has incentives to decrease f^C, while bank A is willing to increase m. Second, m and f^C are strategic substitutes.[20] Therefore, a higher a^P implies a lower f^C, which in turn implies a higher m. Similarly, a higher a^P implies a higher m, hence a lower f^C. As the direct effect and the strategic effect have the same sign, we find that the payment card fee decreases with a^P, whereas the merchant fee increases with a^P.

We now study the impact of the interchange fee on entry. The entry condition, given by (6), can be rewritten as $EC(a^P) \geq 0$, where

$$EC(a^P) = \Psi^2 - 2tF - t^2,$$

[20] This result is shown in Appendix F-4.

and $\Psi = t + \frac{1}{3}(-c_M + \left((f^C)^* + m^*\right)(1-(f^C)^*) + \frac{((f^C)^*)^2}{2} + b_S(f^C)^*)$. Taking the derivative of EC with respect to a^P, we obtain

$$(EC)'(a^P) = \frac{2}{3}\Psi \times \left[\underbrace{(b_S + 1 - (f^C)^* - m^*)\frac{d(f^C)^*(a^P)}{da^P}}_{\text{(I)}} + \underbrace{(1-(f^C)^*)\frac{dm^*(a^P)}{da^P}}_{\text{(II)}}\right].$$

Assumption 1 implies that $\Psi \geq 0$. Since $b_S + 1 - (f^C)^* - m^* > 0$ from Lemma 5, and $d(f^C)^*/da^P < 0$ from Lemma 6, then term (I) is negative. Term (II) is positive as $dm^*/da^P > 0$, from Lemma 6. This shows that the interchange fee impacts merchant 1's incentives to issue private cards in two opposite ways. If the interchange fee increases, the perceived marginal cost of merchant 2 rises through the payment of the merchant fee. Therefore, merchant 1 benefits from a reduction of the demand of merchant 2, since the latter is forced to increase its price. Merchant 1's incentives to issue its private card become higher, because it gives him the opportunity of increasing its market share, while saving the cost of the merchant fee, which has increased. At the same time, if the interchange fee increases, this triggers a reduction of the payment card transaction fee, which yields a higher demand for merchant 2 if merchant 1 offers a private, hence lowers the incentives of merchant 1 to issue its private card.

The following Proposition shows that, in our setting, the first effect dominates the second effect, that is, $EC(a^P)$ is decreasing with a^P, if $(f^C)^*$ is sufficiently low.

Proposition 5 *Merchant 1's incentives to issue private cards decrease with the interchange fee, a^P, if $(f^C)^*\left(a^P\right) \leq 1/2$, whereas they increase with a^P if $(f^C)^*\left(a^P\right) \in (0.516; 1]$. If $(f^C)^*\left(a^P\right) \in (0.5; 0; 516)$, the incentives to issue private cards are increasing with a^P if t is sufficiently high.*

Proof. See Appendix J. ■

Optimal interchange fee Now, we determine the interchange fee that maximises banks' joint profits, that we denote by $\left(a^P\right)^*$. Whether merchant 1 issues private cards or not depends on the sign of $EC(a^P)$. Therefore, the banks' joint profits can be written as

$$(\Pi_I + \Pi_A)(a^P) = \begin{cases} (\Pi_I + \Pi_A)^B(a^P) & \text{if} \quad EC(a^P) < 0 \\ (\Pi_I + \Pi_A)^{PC}(a^P) & \text{if} \quad EC(a^P) \geq 0, \end{cases}.$$

where $(\Pi_I + \Pi_A)^{PC}(a^P) = ((f^C)^* + m^* - c_I - c_A)D_2^C(a^P)$. In the following Proposition, we characterise the possible equilibrium outcomes.

Proposition 6 *The equilibrium can be characterised by either:*

(i) entry accommodation: the payment system chooses the interchange fee that maximises its profit conditional on the fact that merchant 1 *issues private cards,* $\left(a^P\right)^* = \left(a^P\right)^{PC}$ *.*

(ii) blockaded entry: the payment system sets $\left(a^P\right)^* = \left(a^P\right)^B$ *and there is no entry.*

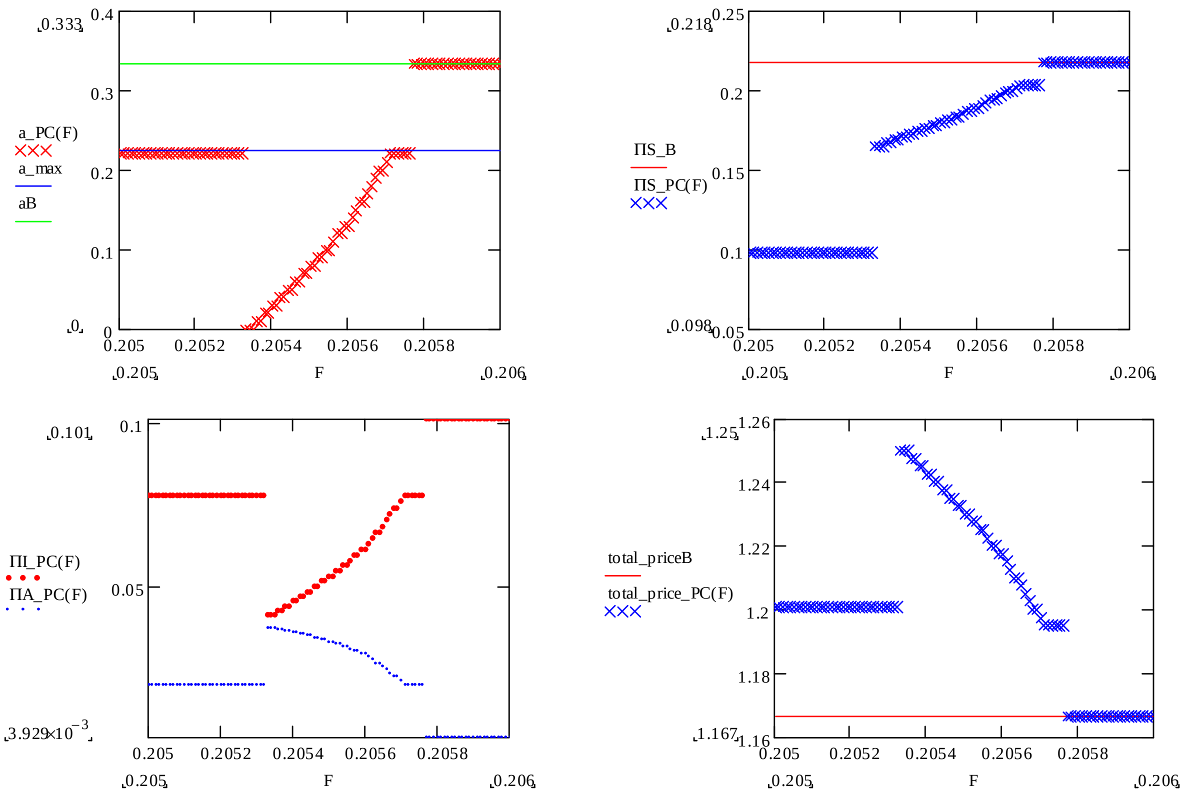
(iii) entry deterrence: the payment system sets $\left(a^P\right)^* = \widehat{a} < \left(a^P\right)^B$ *and deters entry; this can only occur if there exists* $a^P \in [0, \min\{a^{\max}, \left(a^P\right)^B\}]$ *such that* $(f^C)^* \left(a^P\right) > 1/2$*.*

Proof. If $EC(\left(a^P\right)^B) < 0$, blockaded entry is a possible equilibrium outcome. Otherwise, there is either entry accommodation or entry deterrence. Entry deterrence can only occur if there exists $a^P \in [0, \min\{a^{\max}, \left(a^P\right)^B\}]$ such that $(f^C)^* \left(a^P\right) > 1/2$. Indeed, if EC is decreasing with a^P for all values of a^P, the payment system must increase the interchange fee to deter entry. Since in the benchmark case the interchange fee is set at the maximum level compatible with positive profit for the Acquirer, a^P cannot be set above $\left(a^P\right)^B$. But we have $EC(\left(a^P\right)^B) \geq 0$, hence, entry cannot be deterred. Finally, from Proposition 5 we know that EC is increasing with a^P only for $(f^C)^* \left(a^P\right) > 1/2$. ■

Proposition 6 shows that the threat of the competition with the private card may lead the payment system to *decrease* its interchange fee, in comparison to the benchmark case. Hence, in no situation, the payment system will be tempted to increase its interchange to prevent the merchant from issuing private cards. If merchant 1's incentives to issue private cards decrease with the interchange fee, the payment system cannot deter merchant 1 from entering the market, because of the constraint that the Acquirer's profit remains positive. The only way for the payment platform to deter entry would be to set a higher interchange fee, which could only occur if the Issuer could compensate the Acquirer so that he made positive profit.

Suppose that entry is not blockaded, that is, $EC(\left(a^P\right)^B) \geq 0$. Since $(f^C)^* \left(a^P\right)$ is increasing with the cost of the Issuer, c_I, entry deterrence is more likely to occur for high values of c_I. In other words, the payment system will tend to deter entry only when the Issuer is inefficient by setting a low interchange fee. Finally, the payment system prefers to accommodate rather than to deter entry if $(\Pi_I + \Pi_A)(\left(a^P\right)^{PC}) \geq (\Pi_I + \Pi_A)(\widehat{a})$.

A numerical example As an illustration, we use the following parameter values: $t = 5$, $c = 0$, $c_I = 0.4$, $c_A = 0.3$, $c_M = 0.3$, and $b_S = 0.4$. The following figures show the optimal interchange fee, the equilibrium banks' profits as well as the total price set by the payment platform as a function of the entry cost, F.



The equilibrium as a function of the entry cost, F

The figure in the upper left shows the optimal interchange fee, which takes into account the optimal reaction of the platform. For low values of F, the payment system cannot deter entry. Therefore, it has to accommodate entry, and in this example it sets an interchange equal to $a^{\max}$, which is lower to $\left(a^{P}\right)^{B}$. For intermediate values of F, entry deterrence is a possibility and we find that it is preferred to entry accommodation. Therefore, the payment system lowers the interchange fee (down to zero, in this example). Then, the entry deterring interchange fee increases as F increases, since the entry threat becomes milder. When F is sufficiently high, there is no entry threat and the payment system sets the reference interchange fee; entry is blockaded.

The figure in the upper right shows, as expected, that the profit of the payment platform increases as the entry threat becomes milder (F increases). The figure in the lower left shows that the distribution of profits between the Issuer and the Acquirer depends on the outcome of the entry game. In particular, when the platform starts to deter entry, the Issuer's profit is reduced, whereas the Acquirer's profit is increased. This is due to the fact that the platform decreases the interchange fee to deter entry, which harms the Issuer while it benefits the Acquirer. Finally, the figure in the lower right shows that the total price varies non-monotically with the entry cost. When the equilibrium moves from the entry accommodation region to the entry deterrence region, the total price jumps up. Then, it decreases as F increases.

4 Extensions and discussions

In this section, we start by discussing the impact of the market structure on banking retail markets on merchant 1's incentives to issue private cards. Then, we give the condition under which merchant 2 does not react to merchant 1's entry.

4.1 The impact of the banking market structure on the incentives to issue private cards.

The market structure on the Issuing and Acquiring sides could impact the incentives of merchant 1 to issue private cards. So far, we assumed that the payment platform organised the interactions between a monopolistic Issuer and a monopolistic Acquirer. In what follows, we begin by assuming perfect competition on the acquisition side, and then we discuss the case in which there is perfect competition on both sides of the market.

Perfect competition leads the acquirers to choose a merchant fee that is equal to the marginal cost of the acquisition activity, that is, $m^* = a + c_A$.[21] We denote by $\overline{a}$ the maximum interchange fee such that both merchants accept payment cards.

Now, we study the condition under which merchant 1 enters the market for payment card transactions at stage 2. With perfect competition on the acquisition side, simulations suggest than a higher interchange fee *increases* merchant 1's incentives to issue private cards. In Section 3.3, we proved that a higher interchange fee has two opposite effects on merchant 1's incentives to issue private cards. If the acquirers are perfectly competitive, the second effect is dominant and a higher interchange fee raises merchant 1's incentives to enter the market for payment card transactions.

Let $\underline{a}$ be the minimum level of interchange fee such that merchant 1 issues private cards. If the payment platform wants to deter entry, it has to set $\left(a^P\right)^* = \underline{a}$. If entry is accommodated, since the Acquirers make zero profit, banks' joint profits are equal to the profit of the Issuer, and increase with the level of interchange fee. Hence, if the payment platform accommodates entry, it chooses the maximum interchange fee compatible with merchant acceptance, that is $\left(a^P\right)^* = \overline{a}$. The results of Proposition is modified as follows. If $a^B \leq \underline{a}$, entry is blockaded. If $a^B > \underline{a}$ and if $(\Pi_I)^B(\underline{a}) < (\Pi_I)^{PC}(\overline{a})$, the payment platform accommodates entry, whereas if $(\Pi_I)^B(\underline{a}) \geq (\Pi_I)^{PC}(\overline{a})$, the payment platform deters merchant 1 from issuing private cards.

[21] The decisions of the consumers and the merchants at stage 4 and 5 remain unchanged. At stage 3, the best responses of the Issuer and of merchant 1 are the same as in section 3.3.2.

If there is perfect competition on both sides of the market, banks make zero profit. Hence, the interchange fee has no impact on banks' joint profits. It can be shown that the payment platform minimises the probability of entry when it chooses an interchange fee that is equal to Baxter's interchange fee, that is $\left(a^P\right)^* = b_S - c_A$.[22]

To sum up, this analysis shows that the market structure influences the level of the interchange fee that deters entry.

4.2 Analysis of the reaction of the second merchant

In our setting, we assumed that only merchant 1 can issue private cards. Consider now the following modification to our setting. Once the platform has chosen the interchange fee, merchant 1 decides whether or not to issue private cards. Then, merchant 2 observes merchant 1's decision; if merchant 1 has issued a private card, merchant 2 can decide to follow and issue his own private cards. We denote by f_i^{PC} the private card fee of merchant i, and we focus on the subgame in which merchant 1 has issued private cards, to determine the conditions under which merchant 2 does not react to this decision.

If both merchants issue private cards, we show in Appendix L that they choose a private card fee that is equal to zero. There are now five possible equilibrium outcomes:

- blockaded entry: the payment platform set $\left(a^P\right)^* = \left(a^P\right)^B$ and both merchants do not issue private cards.
- entry accommodation of both merchants: both merchants issue private cards and the payment platform makes zero profit.
- entry accommodation of merchant 1: the payment platform accomodates the entry of merchant 1 by setting $\left(a^P\right)^* = \left(a^P\right)^{PC}$, and for this value of the interchange fee, the entry of merchant 2 is blockaded.
- entry deterrence of merchant 1: the payment platform sets $\left(a^P\right)^* = \widehat{a}$, which prevents merchant 1 from entering the market.
- entry deterrence of merchant 2: the payment platform chooses a level of interchange fee that prevents merchant 2 from entering the market. For this value of the interchange fee, the entry of merchant 1 can be either accomodated or blockaded.

In Appendix L, we give the condition under which the fixed costs of issuing private cards for merchant 2 are sufficiently high, such that he never reacts to merchant 1's decision to issue

[22] See Appendix K.

private card. Our analysis also shows that, if this condition is not verified, the payment platform may decide to deter merchant 2 from issuing private cards, otherwise, banks would have to exit from the market since payment cards are never used when both merchants issue private cards. An interesting insight is that the interchange fee that deters merchant 2 from entry may also deter merchant 1 from issuing private cards. Hence, the probability of entry accomodation of merchant 1 may become lower, because of the threat of merchant 2's reaction.

5 Conclusion

Our paper shows that, with monopolies both on the issuing and on the acquisition side, a payment platform may increase its level of interchange fee to deter a merchant from entering the market for payment card transactions. The effect of the competition with the private card is to reduce the card fee and to increase the cost of card acceptance for the merchant that does not issue private cards.

Further research is needed to understand better other forms of entry accommodation that can be designed by the payment platform. For instance, in many countries (e.g. France, Spain), several merchants have started issuing cards with the support of financial institutions that are members of payment card associations. The payment platform could also think of other types of contracts that would enable merchants to "opt-in" the payment system, such as cobranding agreements. Or a large retailer, as the merchant Target in the United-States, could decide to become an issuing member of the payment association. Research is also needed to understand the other opt-out strategies of the merchants. For instance, several merchants could decide, as for the Aurore Card in France, to build private payment associations that compete with payment card associations.

References

[1] BAXTER W. (1983): "Bank Interchange of Transactional Paper: Legal and Economic Perspectives", Journal of Law & Economics, vol. 26, no. 3, October, pp. 541-588.

[2] CHAKRAVORTI S. (2003): "Theory of Credit Card Networks: A survey of the literature", Review of Network Economics, vol. 2, no. 2, June, pp. 50-68.

[3] ROCHET J-C. (2003): "the Theory of Interchange Fees: A synthesis of recent contributions", Review of Network Economics, vol. 2, no. 2, June, pp. 97-124.

[4] ROCHET J-C. & TIROLE J. (2002): "Cooperation Among Competitors: The Economics of Payment Card Associations", The RAND Journal of Economics, vol. 33, no. 4, winter, pp. 549-570.

[5] ROCHET J-C. & TIROLE J. (2003a): "An Economic Analysis of the Determination of Interchange Fees in Payment Card Systems", Review of Network Economics, vol. 2, no. 2, June, pp. 69-79.

[6] ROCHET J-C. & TIROLE J. (2006a): "Externalities and Regulation in Card Payment Systems", Review of Network Economics, vol. 5, no. 1, March, pp. 1-14.

[7] ROCHET J-C. & TIROLE J. (2006b): "Two-sided markets: a progress report", RAND Journal of Economics, vol. 37, no. 3, March, pp. 645-667.

[8] ROCHET J-C. & TIROLE J. (2007): "Must-Take Cards and the Tourist Test", Mimeo.

[9] SCHMALENSEE R. (2002): "Payment systems and Interchange Fees", Journal of Industrial Economics, vol. 50, no. 2 (June), pp. 103-122.

[10] WRIGHT J. (2002): "Optimal Payment Card Systems," European Economic Review, vol. 47, no. 4, August, pp. 587-612.

[11] WRIGHT J. (2004): "Determinants of Optimal Interchange Fees in Payment Systems", Journal of Industrial Economics, vol. 52, no. 1, March, pp. 1-26.

6 Appendix

6.1 Appendix A: A basic model of bypass by a local monopolist

6.1.1 Appendix A-1: Proof of Lemma 1

We study the merchant's decision to accept payment cards, if he does not issue private cards. If he accepts payment cards, a monopolistic merchant makes profit

$$\pi_m = (p - c)\left(D^C + D^{Cash}\right) + D^C(b_S - m),$$

where D^C denotes the demand of card users, and D^{Cash} denotes the demand of cash users. Whereas, if he refuses payment cards, he makes profit

$$\pi_m = (p - c)\, D^{Cash}.$$

If the merchant refuses payment cards, the consumers only buy the good if $p \leq v$, therefore the merchant maximises its profit by choosing $p^* = v$. Hence, the market is covered, and the merchant makes profit $\pi_m = v - c$.

We now determine the price that is chosen by a monopolistic merchant if he accepts payment cards. There are three cases. Either the monopolistic merchant sets $p \in [0; v]$, and the market is covered. In this case, the demand of card users is $D^C = 1 - f^C$, while the demand of cash users is $D^{Cash} = f^C$. If the monopolistic merchant sets $p \in \left[v; 1 + v - f^C\right]$, the good is not bought by cash users. Hence, in this case, the demand of card users is $D^C = 1 + v - p - f^C$, and the demand of cash users is $D^{Cash} = 0$. If the monopolistic merchant sets $p \in \left[1 + v - f^C; +\infty\right)$, the good is not bought by the consumers, and the merchant makes zero profit. The profit of a merchant who accepts payment cards is therefore

$$\pi_m = \begin{cases} p - c + (b_S - m)(1 - f^C) & \text{if} \quad p \in [0; v] \\ (p - c + b_S - m)\left(1 + v - p - f^C\right) & \text{if} \quad p \in \left[v; 1 + v - f^C\right] \\ 0 & \text{if} \quad p \in \left[1 + v - f^C; +\infty\right) \end{cases}$$

The merchant chooses the price that maximises its profit. We determine the maximum profit that can be made by the merchant on the intervals $[0; v]$ and $\left[v; 1 + v - f^C\right]$. Since π_m is increasing in p over $[0; v]$, π_m is maximal for $p^* = v$ over $[0; v]$, and this maximum is equal to $\pi_m = v - c + (b_S - m)(1 - f^C)$.

We now determine the maximum of π_m over $\left[v; 1 + v - f^C\right]$. If $v - c - \left(1 - f^C\right) \leq m - b_S \leq v - c + \left(1 - f^C\right)$,[23] the profit is maximised for $p^* = (1 - f^C + m + v + c - b_S)/2$, and this maximum is equal to

$$\pi_m = \frac{1}{4}\left(1 - f^C + v + b_S - m - c\right)^2.$$

If $v - c - \left(1 - f^C\right) \geq m - b_S$, the profit is maximal for $p^* = v$, and $\pi_m = v - c + (b_S - m)\left(1 - f^C\right)$. If $m - b_S \geq v - c + \left(1 - f^C\right)$, the profit is maximal for $p^* = 1 + v - f^C$. Since $D^C = 0$, the merchant makes zero profit.

We now determine the optimal price for the merchant. The merchant makes more profit by choosing $p^* = (1 - f^C + m + v + c - b_S)/2$ than $p^* = v$ if and only if

$$\frac{1}{4}\left(1 - f^C + v + b_S - m - c\right)^2 \geq v - c + (b_S - m)\left(1 - f^C\right).$$

[23] This corresponds to the condition $p^* \in \left[v; 1 + v - f^C\right]$.

Since $1 - f^C + v + b_S - m - c \geq 0$, this condition is equivalent to

$$1 - f^C + v - c - 2\sqrt{v - c + (b_S - m)(1 - f^C)} \geq m - b_S. \tag{A1}$$

Hence, $p^* = (1 - f^C + m + v + c - b_S)/2$ maximises the merchant's profit if and only if

$$v - c - \left(1 - f^C\right) \leq m - b_S \leq 1 - f^C + v - c - 2\sqrt{v - c + (b_S - m)(1 - f^C)}. \tag{A2}$$

If this condition does not hold, the merchant's profit is maximised for $p^* = v$.

We now study the decision of a merchant to accept cards. If (A2) does not hold, the merchant makes more profit by accepting payment cards if and only if

$$v - c + (b_S - m)\left(1 - f^C\right) \geq v - c.$$

Since $f^C \in [0; 1]$, this condition is equivalent to $m \leq b_S$.

Otherwise, if (A2) holds, the merchant makes more profit by accepting payment cards if

$$\frac{1}{4}\left(1 - f^C + v + b_S - m - c\right)^2 \geq v - c.$$

Since $1 - f^C + v + b_S - m - c \geq 0$, this condition can be restated as

$$m - b_S \leq 1 - f^C + v - c - 2\sqrt{v - c}.$$

This condition cannot be verified since $m - b_S \geq v - c - \left(1 - f^C\right)$. Indeed, otherwise, we would have $1 - f^C > \sqrt{v - c}$, which is impossible since $1 - f^C \in [0; 1]$ and $v - c > 2$ by assumption. Hence, if (A2) holds, the payment card is refused by the merchants.

6.1.2 Appendix A-2: Proof of Lemma 2

If merchant M_0 issues a private card, and if $f^{PC} > f^C$, the private card is never used by the consumers. If $f^{PC} \leq f^C$, consumers always prefer using the private card to the payment card. A consumer obtains a utility of $v - p + b_B - f^{PC}$ if he pays with the private card, whereas he obtains $v - p$ if he pays cash. There are three cases. Either merchant M_0 sets $p \in [0; v]$, and both private card users and cash users buy the good. In this case, the demand of private card users is $D^{PC} = 1 - f^{PC}$, while the demand of cash users is $D^{Cash} = f^{PC}$. If merchant M_0 sets $p \in \left[v; v + 1 - f^{PC}\right]$, the good is not bought by cash users. Hence, in this case, the demand of private card users is $D^{PC} = 1 + v - f^{PC} - p$, and the demand of cash users is $D^{Cash} = 0$.

If merchant M_0 sets $p \in \left[v + 1 - f^{PC}; +\infty\right)$, the good is not bought by the consumers. The profit of the merchant is therefore

$$\pi_{M_0}^{PC} = \begin{cases} p - c + (b_S - c_M + f^{PC})(1 - f^{PC}) - F & \text{if} \quad p \in [0; v] \\ \left(p - c + b_S - c_M + f^{PC}\right)\left(1 + v - f^{PC} - p\right) - F & \text{if} \quad p \in \left[v; v + 1 - f^{PC}\right] \\ -F & \text{if} \quad p \in \left[v + 1 - f^{PC}; +\infty\right) \end{cases}$$

Merchant M_0 chooses the price that maximises its profit. We determine the maximum profit on the intervals $[0; v]$ and $\left[v; v + 1 - f^{PC}\right]$.

Since π_m is increasing in p over $[0; v]$, π_m is maximal for $p^* = v$ over $[0; v]$. If $p \in \left[v; 1 + v - f^{PC}\right]$, we also find that the profit is maximal for $p^* = v$. Indeed, the first order condition yields $p^* = -f^{PC} + (1 + v + c_M + c - b_S)/2$, but this expression is lower than v since $b_S - c_M \in [0, 1]$ and $v - c \geq 2$. Therefore, merchant M_0 sets $p^* = v$ and makes profit

$$\pi_{M_0}^{PC} = v - c + (b_S - c_M + f^{PC})(1 - f^{PC}) - F.$$

6.1.3 Appendix A-3: Proof of Lemma 3

If $f^{PC} > f^C$, the choice of f^{PC} is irrelevant as no consumer pays with the private card at merchant M_0's. If $f^{PC} \leq f^C$, merchant M_0 chooses the private card fee that maximises its profit, $\pi_m = v - c + (b_S - c_M + f^{PC})(1 - f^{PC}) - F$. Solving for the first order condition[24] gives an optimal private card fee of $(f^{PC})^* = \min\left\{(1 - b_S + c_M)/2, \left(f^C\right)^*\right\}$. Merchant M_0 makes profit $\pi_{M_0}^{PC} = v - c + (1 + b_S - c_M)^2/4 - F$ if $(f^{PC})^* = (1 - b_S + c_M)/2$; otherwise, he makes profit $\pi_{M_0}^{PC} = v - c + (b_S - c_M + (f^C)^*)\left(1 - (f^C)^*\right) - F$.

6.1.4 Appendix A-4: Bypass conditions with other market structures.

If there is perfect competition on the acquisition side, the merchant fee is equal to the acquirers' perceived marginal cost, that is $m^* = a^P + c_A$, and the card fee chosen by the monopolistic issuer is equal to $\left(f^C\right)^* = (1 - a^P + c_I)/2$. Substituting for m^* in the card acceptance condition, we obtain that merchants accept cards if $a^P \leq b_S - c_A$. At stage 1, the payment platform chooses the interchange fee that maximises banks' joint profits, subject to $a^P \leq b_S - c_A$, $\Pi_A \geq 0$ and $\Pi_I \geq 0$. Substituting for $\left(f^C\right)^*$ and m^* in Π_I and Π_A respectively, we obtain that $\Pi_A + \Pi_I = (1 + a^P - c_I)^2/4$. Therefore, the payment platform chooses the maximum interchange fee that is compatible with merchants' acceptance of payment cards, that is $\left(a^P\right)^* = b_S - c_A$.

[24] The second order condition is verified.

Hence, with the same card fee and interchange fee, the bypass conditions remain the same as in Proposition 1.

If there is perfect competition on the issuing side, the card fee is $\left(f^C\right)^* = c_I - a^P$, and a monopolistic acquirer chooses the maximum merchant fee that is compatible with merchants' acceptance of payment cards, that is $m^* = b_S$. Merchant M_0 sets $(f^{PC})^* = \min\left\{(1 - b_S + c_M)/2; \left(f^C\right)^*\right\}$. At stage 1, the payment platform chooses the interchange fee that maximises banks' joint profit, subject to $\Pi_A \geq 0$ and $\Pi_I \geq 0$. Substituting for $\left(f^C\right)^*$ and m^* in Π_I and Π_A respectively, we obtain that $\Pi_A + \Pi_I = (b_S - a^P - c_A)(1 + a^P - c_I)$. Solving for the first order condition yields to an unconstrained optimum of $\left(a^P\right)^* = (-1 + b_S - c_A + c_I)/2$. For this value of the interchange fee, the acquirers' profit is positive, as $m^* - c_A - a^P = (1 + (b_S - (c_I + c_A)))/2 \geq 0$ since $|b_S - (c_I + c_A)| \in [0, 1]$ by assumption. Hence, the payment platform chooses $\left(a^P\right)^* = (-1 + b_S - c_A + c_I)/2$. We have therefore $\left(f^C\right)^* = (1 - b_S + c_I + c_A)/2$. Therefore, merchant M_0 sets $(f^{PC})^* = \left(f^C\right)^*$ if $c_M > c_I + c_A$ and $(f^{PC})^* = (1 + b_S + c_M)/2$, otherwise. Replacing for $\left(f^{PC}\right)^*$ in merchant M_0 's profit, we obtain the bypass condition $(1 + b_S - c_M)^2/4 \geq F$ if $c_M \leq c_I + c_A$ and

$$(1 + b_S + c_I + c_A - 2c_M)(1 + b_S - c_I - c_A)/4 \geq F,$$

otherwise. This is the same bypass condition as in Proposition 1.

6.2 Appendix B: Proof of Proposition 2

Assume that both merchants accept payment cards at stage 5. Consumers such that $b_B \in \left[0; f^C\right]$ always pay cash, while consumers such that $b_B \in \left[f^C; 1\right]$ always pay by card. Each consumer trades off between shopping at merchant 1's and shopping at merchant 2's. A consumer with benefit b_B, and located at x, buys from merchant 1 if and only if $-p_1 - tx \geq -p_2 - t(1 - x)$. For $(i; j) \in \{1; 2\}^2$ and $i \neq j$, we define $w_i = [t + (p_j - p_i)]/(2t)$. Consumers such that $b_B \geq f^C$ purchase by card, therefore the demand of card payments for merchant i is $D_i^C = (1 - f^C)w_i$. The total demand for card payments is $D_T^C = D_1^C + D_2^C = 1 - f^C$. Similarly, consumers such that $b_B \leq f^C$ pay cash, hence the demand for cash payments of merchant i is $D_i^{Cash} = f^C w_i$. Each merchant chooses the price that maximises its profit,

$$\pi_i^{C,C} = (1 - f^C)w_i(p_i - c - m + b_S) + f^C w_i(p_i - c).$$

Writing the first order condition, we obtain the prices chosen at the equilibrium of the subgame[25], $p_i = c + t + (m - b_S)(1 - f^C)$, and the equilibrium profits,

$$\pi_i = \frac{t}{2}, \tag{7}$$

for $(i; j) \in \{1; 2\}^2$ and $i \neq j$. Note that assumption 1 ensures that no merchant corners the market in equilibrium.

Now, suppose that merchant 1 deviates from this presumed equilibrium, and decides to refuse payment cards. A consumer located at x with benefit $b_B \geq f^C$ wants to use his payment card, therefore he buys from merchant 1 if and only if $-p_1 - tx \geq -p_2 - t(1-x) + b_B - f^C$.

Aggregating over all customers such that $b_B \geq f^C$, we obtain the demand of the consumers who wish to use their payment cards, and still choose to shop at merchant 1, even if the latter refuses cards:

$$(1 - f_C)w_1 - \frac{1}{4t}(1 - f^C)^2.$$

The demand of the consumers who wish to use cash and choose merchant 1 is equal to $f^C w_1$. Merchant 1 and merchant 2 choose respectively the prices p_1 and p_2 that maximise their profits:

$$\pi_1^{NC,C} = \left(w_1 - \frac{1}{4t}(1 - f^C)^2\right)(p_1 - c),$$

and

$$\pi_2^{NC,C} = \left((1 - f^C)w_2 + \frac{1}{4t}(1 - f^C)^2\right)(p_2 - c + b_S - m) + f_C w_2 (p_2 - c).$$

Solving for the first order conditions[26] yields equilibrium prices

$$\begin{aligned} p_1 &= t + c + \frac{1}{3}((m - b_S)(1 - f^C) - \frac{(1 - f^C)^2}{2}), \\ p_2 &= t + c + \frac{1}{3}(2(m - b_S)(1 - f^C) + \frac{(1 - f^C)^2}{2}), \end{aligned}$$

and equilibrium profits

$$\begin{aligned} \pi_1^{NC,C} &= \frac{1}{2t}\left[t + \frac{1}{3}((m - b_S)(1 - f^C) - \frac{(1 - f^C)^2}{2})\right]^2, \\ \pi_2^{NC,C} &= \frac{1}{2t}\left[t + \frac{1}{3}((m - b_S)(1 - f^C) + \frac{(1 - f^C)^2}{2})\right]^2 + \frac{(b_S - m)f^C(1 - f^C)^2}{4t}. \end{aligned}$$

Merchant 1 has no incentive to deviate from the equilibrium in which both merchants accept

[25] The second order condition is always satisfied.

[26] The second order conditions are always satisfied.

cards if and only if $\pi_1^{C,C} \geq \pi_1^{NC,C}$, that is, if and only if

$$\frac{t}{2} \geq \frac{1}{2t}(t + \frac{1}{3}((m - b_S)(1 - f^C) - \frac{(1 - f^C)^2}{2}))^2,$$

which can be written, if $f^C \neq 1$, as

$$m \leq b_S + \frac{(1 - f^C)}{2}. \tag{8}$$

This condition is the same for merchant 2.

At stage 3, the issuer and the acquirer maximise their profits, $\Pi_I = (1 - f^C)(f^C + a^P - c_I)$, and $\Pi_A = (1 - f^C)(m - a^P - c_A)$, with respect to f^C and m, respectively, subject to (8). The constraint is binding for the acquirer since $d\Pi_A/dm = 1 - f^C \geq 0$. Therefore, the best response of the acquirer is to choose $m = b_S + (1 - f^C)/2$. Solving for the first-order condition of profit maximisation for the issuer yields the best response[27]

$$f^C = \frac{1 + c_I - a^P}{2}. \tag{9}$$

In this case, the optimal merchant fee is

$$m = b_S + \frac{1 - c_I + a^P}{4}. \tag{10}$$

At stage 1, the payment card system chooses the interchange fee that maximises banks' joint profits,

$$\Pi_I + \Pi_A = \frac{1}{2}\left(b_S + \frac{3 + c_I - a^P}{4} - (c_I + c_A)\right)\left(1 + a^P - c_I\right),$$

subject to $\Pi_i \geq 0$, where $i = I, A$. Substituting for f^C and m given by (9) and (10) into Π_I, we have $\Pi_I = \left(1 - c_I + a^P\right)^2/4$, which shows that $\Pi_I \geq 0$ for all $a^P \geq 0$. Therefore, the problem of the payment system can be restated as maximizing $\Pi_I + \Pi_A$ subject to $\Pi_A \geq 0$.

We form the Lagrangian $L = \Pi_I + \Pi_A + \lambda\Pi_A$. The first order conditions are $\partial L/\partial a^P = 0$, $\lambda\Pi_A = 0$, $\Pi_A \geq 0$ and $\lambda \geq 0$. If $\Pi_A > 0$, then we have necessarily $\lambda = 0$. It can be shown that the optimal a^P is then $a^P = 2(b_S - c_A) + 1 - c_I$. Substituting for this expression into the Acquirer's margin, $m - c_A - a^P$, yields $m - c_A - a^P = -b_S + (c_I + c_A - 1)$, which is strictly negative as $b_S \geq 0$ and $c_I + c_A < 1$. Since this contradicts $\Pi_A > 0$, it follows that the constraint is binding, that is, we have $\Pi_A = 0$ at the optimum. Substituting for f^C and m given by (9)

[27] The second order condition is verified.

and (10) into Π_A, we have

$$\Pi_A = \frac{1-c_I+a^P}{2} \times \left(b_S - c_A + \frac{1-c_I-3a^P}{4}\right).$$

We have $1-c_I+a^P > 0$ as $c_I < 1$, therefore $\Pi_A = 0$ implies that $\left(a^P\right)^B = (4b_S - 4c_A + 1 - c_I)/3$. The optimal transaction fees are then $\left(f^C\right)^B = (1 + 2(c_I + c_A - b_S))/3 > 0$, and $m^B = (4b_S + 1 - (c_I + c_A))/3 > 0$.

6.3 Appendix C: Equilibrium profits

Both merchants accept cards If both merchants accept cards, and $f^{PC} > f^C$, the equilibrium profits are given by (7). Otherwise, if $f^{PC} \leq f^C$, the equilibrium profits are

$$\begin{aligned}\pi_1^{C,C} &= \frac{1}{2t}\left(t + \frac{1}{3}\left(\frac{(\Delta f)^2}{2} + \left(f^{PC} - c_M\right)(1 - f^{PC}) + (\Delta f + m)(1 - f^C) + b_S \Delta f\right)\right)^2 \\ &\quad + \frac{(\Delta f)(f^{PC} + b_S - c_M) f^{PC}}{2t} \times \left(\frac{\Delta f}{2} + 1 - f^C\right),\end{aligned}$$

and

$$\begin{aligned}\pi_2^{C,C} &= \frac{1}{2t}\left(t + \frac{1}{3}\left(-\frac{(\Delta f)^2}{2} - \left(f^{PC} - c_M\right)(1 - f^{PC}) - (\Delta f + m)(1 - f^C) - b_S \Delta f\right)\right)^2 \\ &\quad + \frac{(m - b_S)(1 - f^C)(f^C - f^{PC})\left(f^C + f^{PC}\right)}{4t}.\end{aligned}$$

Merchant 1 does not accept payment cards, while merchant 2 accepts them If $f^{PC} \leq f^C$, profits are identical to the previous case. Otherwise, if $f^{PC} > f^C$, the equilibrium profits are

$$\begin{aligned}\pi_1^{NC,C} &= \frac{1}{2t}\left(t + \frac{1}{3}\left((m - b_S)(1 - f^C) - \frac{(\Delta f)^2}{2} + (f^{PC} + b_S - c_M)(1 - f^{PC}) + \left(1 - f^{PC}\right)\Delta f\right)\right)^2 \\ &\quad + \frac{(f^{PC} - c_M + b_S)}{4t}(\Delta f)(1 - f^{PC})(f^C + f^{PC}),\end{aligned}$$

and

$$\begin{aligned}\pi_2^{NC,C} &= \frac{1}{2t}\left(t + \frac{1}{3}\left(-(m - b_S)(1 - f^C) + \frac{(\Delta f)^2}{2} - (f^{PC} + b_S - c_M)(1 - f^{PC}) - \left(1 - f^{PC}\right)\Delta f\right)\right)^2 \\ &\quad + \frac{f^C(\Delta f)(m - b_S)}{2t}\left(1 - \frac{f^{PC} + f^C}{2}\right).\end{aligned}$$

Merchant 1 accepts all cards, while merchant 2 refuses them, or both merchants refuse cards If merchant 1 accepts all cards and merchant 2 refuses payment cards and

$f^{PC} \leq f^C$, or if both merchants refuse cards, the equilibrium profits are

$$\begin{aligned}\pi_1^{C,NC} &= \pi_1^{NC,NC} = \frac{1}{2t}\left(t + \frac{1}{3}\left(\frac{(1-f^{PC})^2}{2} + (f^{PC} + b_S - c_M)(1-f^{PC})\right)\right)^2 \\ &+ \frac{f^{PC}(f^{PC} + b_S - c_M)(1-f^{PC})^2}{4t},\end{aligned}$$

and

$$\pi_2^{C,NC} = \pi_2^{NC,NC} = \frac{1}{2t}\left(t + \frac{1}{3}\left(-\frac{(1-f^{PC})^2}{2} - (f^{PC} + b_S - c_M)(1-f^{PC})\right)\right)^2.$$

6.4 Appendix D: Proof of Proposition 4

6.4.1 Appendix D1: π_1 decreases with f^{PC} if $f^{PC} < f^C$.

Both merchants accept cards If $f^{PC} < f^C$, consumers who shop at merchant's 1 pay with the private card, hence, whether merchant 1 accepts cards or not is irrelevant. Merchant 1's profit is

$$\begin{aligned}\pi_1^{C,C} &= \frac{1}{2t}\left(t + \frac{1}{3}\left(\frac{(\Delta f)^2}{2} + \left(f^{PC} - c_M\right)\left(1 - f^{PC}\right) + (m + \Delta f)(1 - f^C) + b_S(\Delta f)\right)\right)^2 \\ &+ \frac{f^{PC}(f^{PC} + b_S - c_M)(\Delta f)}{2t}\left[(1 - f^C) + \frac{\Delta f}{2}\right].\end{aligned}$$

Derivating with respect to f^{PC}, we obtain

$$\frac{\partial \pi_1^{C,C}}{\partial f^{PC}} = \frac{-H_1}{36t},$$

where $H_1 = 4\Delta f\,(b_S)^2 + Xb_S + Y$, $X_1 = X_1\left(t, f^C, f^{PC}, m, c_M\right)$, and $Y_1 = Y_1\left(t, f^C, f^{PC}, m, c_M\right)$.

We want to prove that $H_1 \geq 0$, which would lead that $\partial\pi_1^{C,C}/\partial f^{PC} \leq 0$. We do it in a few steps. First, we prove that

$$\left.\frac{\partial \pi_1^{C,C}}{\partial f^{PC}}\right|_{f^{PC}=0} \leq 0.$$

Indeed, we have

$$\left.\frac{\partial \pi_1^{C,C}}{\partial f^{PC}}\right|_{f^{PC}=0} = -\frac{(b_S - c_M)}{36t}K_1,$$

where $K_1 = 12t + 4m\left(1 - f^C\right) + 4\left(b_S - c_M\right) - \left[4b_S\left(1 - f^C\right) + 14f^C - 7\left(f^C\right)^2\right]$. Given that $b_S \leq 1$ and $f^C \in [0,1]$, it can be shown that the term into brackets is always strictly lower than

8. Hence, $3t \geq 2$ implies that $K_1 > 0$. Since $b_S > c_M$ by assumption, we have

$$\left.\frac{\partial \pi_1^{C,C}}{\partial f^{PC}}\right|_{f^{PC}=0} \leq 0.$$

Second, we prove that

$$\left.\frac{\partial^2 \pi_1^{C,C}}{\partial \left(f^{PC}\right)^2}\right|_{f^{PC}=0} \leq 0. \tag{11}$$

Indeed, we have

$$\left.\frac{\partial^2 \pi_1^{C,C}}{\partial \left(f^{PC}\right)^2}\right|_{f^{PC}=0} = \frac{-M_1}{9t},$$

where

$$M_1 = 3t+9\left(b_S - c_M\right)+\left(b_S - c_M\right)\left(1-\left(b_S - c_M\right)\right)+m\left(1-f^C\right)-\left[\left(b_S+4f^C\right)\left(1-f^C\right)+4f^C\right].$$

The last term into brackets is lower than 5. Hence, if $3t \geq 5$, and given that $b_S \geq c_M$, we have $M_1 \geq 0$, which implies that (11) holds.

Third, we find that the third-order derivative of $\pi_1^{C,C}$, denoted by $\pi_1^{(3)}$, has the sign of $114f^{PC} - 54 + 33\left(b_S - c_M\right)$. When $f^{PC} = 0$, we have $\pi_1^{(3)} < 0$ as $b_S - c_M \leq 1$. When $f^{PC} = 1$, we have $\pi_1^{(3)} > 0$ as $b_S - c_M > 0$. Therefore, we have $\pi_1^{(3)} < 0$ for low values of f^{PC} and $\pi_1^{(3)} > 0$ for high values of f^{PC}, which implies that $\pi_1^{(2)}$ is first decreasing then increasing.

Given these properties, we know that either $\pi_1^{(1)}$ is always negative, or it is first negative then positive (as a function of f^{PC}). The second case occurs when $\pi_1^{(2)}$ becomes positive for high values of f^{PC} and $\pi_1^{(1)}$ increases sufficiently to become positive. Therefore, the global optimum of $\pi_1(f^{PC})$ when $f^{PC} \in \left[0, f^C\right)$ is either 0 or f^{C-}. We have

$$\pi_1^{C,C}(0) = \frac{1}{2t}\left[t + \frac{1}{3}\left(m\left(1-f^C\right) + \left(f^C - c_M\right)\left(1-f^C\right) + \left(b_S - c_M\right)f^C + \frac{\left(f^C\right)^2}{2}\right)\right]^2,$$

and

$$\pi_1^{C,C}\left(f^{C-}\right) = \frac{1}{2t}\left[t + \frac{1}{3}\left(m\left(1-f^C\right) + \left(f^C - c_M\right)\left(1-f^C\right)\right)\right]^2,$$

hence $\pi_1^{C,C}(0) > \pi_1^{C,C}\left(f^{C-}\right)$ if and only if $f^C + 2\left(b^S - c_M\right) > 0$, which is true (for all $f^C \geq 0$) since $b^S > c_M$.

Merchant 2 refuses all payment cards If $f^{PC} \leq f^C$, merchant 1's profit is

$$\pi_1^{C,NC} = \frac{1}{2t}\left(t + \frac{1}{3}\left(\frac{(1-f^{PC})^2}{2} + (f^{PC} + b_S - c_M)(1-f^{PC})\right)\right)^2 + \frac{f^{PC}(f^{PC}+b_S-c_M)(1-f^{PC})^2}{4t}.$$

Derivating with respect to f^{PC}, we obtain

$$\frac{\partial \pi_1^{C,NC}}{\partial f^{PC}} = \frac{-H_2}{36t},$$

where $H_2 = 4(1-f^{PC})(b_S)^2 + X_2 b_S + Y_2$, $X_2 = X_2\left(t, f^{PC}, c_M\right)$, and $Y_2 = Y_2\left(t, f^{PC}, c_M\right)$.

We want to prove that for any $b_S \geq 0$, $f^{PC} \in [0,1]$, we have $\partial \pi_1^{C,NC}/\partial f^{PC} \leq 0$. We use the same steps as above. First, we prove that

$$\left.\frac{\partial \pi_1^{C,NC}}{\partial f^{PC}}\right|_{f^{PC}=0} \leq 0.$$

Indeed, we have

$$\left.\frac{\partial \pi_1^{C,NC}}{\partial f^{PC}}\right|_{f^{PC}=0} = -\frac{(b_S - c_M)}{36t} K_2,$$

where $K_2 = 12t - 7 - 8c_M + 4(b_S + c_M)$. Since $4(b_S + c_M) > 0$, and since $c_M < 1$, $t \geq 5/4$ implies that $K_2 > 0$. Since $b_S > c_M$ by assumption, we have

$$\left.\frac{\partial \pi_1^{C,NC}}{\partial f^{PC}}\right|_{f^{PC}=0} \leq 0.$$

Second, we prove that

$$\left.\frac{\partial^2 \pi_1^{C,NC}}{\partial \left(f^{PC}\right)^2}\right|_{f^{PC}=0} \leq 0. \tag{D1}$$

Indeed, we have

$$\left.\frac{\partial^2 \pi_1^{C,NC}}{\partial \left(f^{PC}\right)^2}\right|_{f^{PC}=0} = \frac{-M_2}{36t},$$

where

$$M_2 = 12t - 16 + (b_S - c_M)(40 - 4b_S + 4c_M).$$

Since $b_S < 1$, then $40 - 4b_S + 4c_M > 0$. Hence, given that $b_S > c_M$, by Assumption 1, we have $M_2 \geq 0$, which implies that (D1) holds. Third, we find that the third-order derivative of π_1, denoted by $\pi_1^{(3)}$, has the sign of $114 f^{PC} + 33\left(b_S - c_M\right) - 54$.

When $f^{PC} = 0$, we have $\pi_1^{(3)} < 0$ as $b_S - c_M \leq 1$. When $f^{PC} = 1$, we have $\pi_1^{(3)} > 0$ as $b_S - c_M \geq 0$. Therefore, $\pi_1^{(3)} < 0$ for low values of f^{PC} and $\pi_1^{(3)} > 0$ for high f^{PC}. It implies that $\pi_1^{(2)}$ is first decreasing then increasing. Given these properties, we know that either $\pi_1^{(1)}$ is always negative, or it is first negative then positive (as a function of f^{PC}). The second case occurs when $\pi_1^{(2)}$ becomes positive for high values of f^{PC} and $\pi_1^{(1)}$ increases sufficiently to become positive. Therefore, the global optimum of $\pi_1^{C,NC}\left(f^{PC}\right)$ when $f^{PC} \in \left[0, f^{C}\right)$ is either

0 or f^{C-}. We have

$$\pi_1^{C,NC}(0) = \frac{1}{2t}\left[t + \frac{1}{3}\left(b_S - c_M + \frac{1}{2}\right)\right]^2,$$

and

$$\pi_1^{C,NC}\left(f^{C-}\right) = \frac{1}{2t}\left[t + \frac{1}{3}\left(b_S - c_M + \frac{1}{2} - f^C(b_S - c_M) - \frac{(f^C)^2}{2}\right)\right]^2.$$

Since $b^S - c_M > 0$, we have $\pi_1(0) > \pi_1\left(f^{C-}\right)$.

To sum up, in cases 1-4, the global maximum of $\pi_1^{C,NC}\left(f^{PC}\right)$ over $\left[0, f^C\right)$ is obtained at $f^{PC} = 0$.

6.4.2 Appendix D2: Merchant 1 undercuts f^C by setting $f^{PC} < f^C$

We show that, in all cases, merchant 1 always makes more profit if he undercuts the Issuer by setting $f^{PC} < f^C$.

Case 1: Both merchants accept payment cards. If $f^{PC} > f^C$, merchant 1 makes profit $\pi_1^{C,C} = t/2$. If $f^{PC} < f^C$, we know from Appendix B1 that merchant 1's profit is maximum for $f^{PC} = 0$, in which case he makes

$$\pi_1^{C,C} = \frac{1}{2t}\left(t + \frac{1}{3}\left(\frac{(f^C)^2}{2} + (b_S - c_M) + (f^C + m - b_S)(1 - f^C)\right)\right)^2.$$

Let $\gamma = m - a - c_A$ and $\delta = f^C + a - c_I$ be the Acquirer's and Issuer's margins, respectively. Since the margins are positive, we have $\gamma \geq 0$ and $\delta \geq 0$. We also have $f^C + m - b_S = \delta + \gamma + c_I + c_A - b_S$. Since $b_S \leq c_I + c_A$ by assumption, it follows that $f^C + m - b_S \geq 0$. As we have $b_S > c_M$ too, then merchant 1 makes more profit if he undercuts the Issuer by setting $f^{PC} < f^C$.

Case 2: Merchant 2 is the only one who accepts cards. If $f^{PC} < f^C$, merchant 1 makes profit

$$\begin{aligned}\pi_1^{NC,C} &= \frac{1}{2t}\left(t + \frac{1}{3}\left(\frac{(\Delta f)^2}{2} + (f^{PC} - c_M)(1 - f^{PC}) + (\Delta f + m)(1 - f^C) + b_S \Delta f\right)\right)^2 \\ &\quad + \frac{(\Delta f)(f^{PC} + b_S - c_M)f^{PC}}{2t} \times \left(\frac{\Delta f}{2} + 1 - f^C\right),\end{aligned}$$

whereas if $f^{PC} > f^C$, merchant 1 makes profit

$$\pi_1^{NC,C} = \frac{1}{2t}\left(t + \frac{1}{3}\left(\frac{(\Delta f)^2}{2} + (f^{PC} - c_M)(1 - f^{PC}) + (\Delta f + m)(1 - f^C) + b_S \Delta f\right)\right)^2 + \frac{(f^{PC} + b_S - c_M)}{4t}(\Delta f)(1 - f^{PC})(f^C + f^{PC}).$$

We show that merchant 1 makes more profit if $f^{PC} < f^C$. Since $b_S \geq c_M$, we have $f^{PC} + b_S - c_M \geq 0$. If $f^{PC} < f^C$, then $(\Delta f) \geq 0$. So,

$$\frac{(\Delta f)(f^{PC} + b_S - c_M)f^{PC}}{2t} \times \left(\frac{\Delta f}{2} + 1 - f^C\right) \geq 0.$$

If $f^{PC} > f^C$, then $(\Delta f) \leq 0$. So, we have

$$\frac{(f^{PC} + b_S - c_M)}{4t}(\Delta f)(1 - f^{PC})(f^C + f^{PC}) \leq 0.$$

Therefore, merchant 1 makes more profit if he chooses $f^{PC} < f^C$.

Case 3: Merchant 1 is the only one who accepts cards. If $f^{PC} < f^C$, merchant 1 makes profit

$$\pi_1^{C,NC} = \frac{1}{2t}\left(t + \frac{1}{3}\left(\frac{(1 - f^{PC})^2}{2} + (f^{PC} + b_S - c_M)(1 - f^{PC})\right)\right)^2 + \frac{f^{PC}(f^{PC} + b_S - c_M)(1 - f^{PC})^2}{4t},$$

whereas if $f^{PC} > f^C$, he makes profit

$$\pi_1^{C,NC} = \frac{1}{2t}\left[t + \frac{1}{3}((b_S - m)(1 - f^C) + \frac{(1 - f^C)^2}{2})\right]^2 + \frac{(b_S - m)f^C(1 - f^C)^2}{4t}.$$

Notice that this situation is possible if and only if the non deviation condition in the Benchmark Case is not verified, that is, if we have $m \geq b_S + (1 - f^C)/2$. Therefore, in case 3, if $f^{PC} > f^C$, we have $(b_S - m) \leq 0$. So, $(b_S - m)f^C(1 - f^C)^2/(4t) \leq 0$. Consequently, to prove that merchant 1 makes more profit if he undercuts f^C, it suffices to prove that $C \geq D$, where

$$C = (1 - f^{PC})^2/2 + (f^{PC} + b_S - c_M)(1 - f^{PC}),$$

and $D = (b_S - m)(1 - f^C) + (1 - f^C)^2/2$. Rearranging C, and using that $1 - f^{PC} = 1 - f^C + \Delta f$, we obtain

$$C = \frac{(1 - f^C)^2}{2} + (f^{PC} + b_S - c_M)(1 - f^C) + \frac{(\Delta f)^2}{2} + (f^{PC} + b_S - c_M + 1 - f^C)(\Delta f).$$

Since $(f^{PC} + b_S - c_M)(1 - f^C) \geq (b_S - m)(1 - f^C)$, and since $\frac{(\Delta f)^2}{2} + (f^{PC} + b_S - c_M + 1 - f^C)(\Delta f) \geq 0$, we have $C \geq D$. Therefore, merchant 1 makes more profit if he chooses $f^{PC} < f^C$.

Case 4: Both merchants refuse payment cards. This case is not relevant, as both merchants refuse cards (and hence, merchant 1's profit does not depend on whether $f^{PC} < f^C$ or $f^{PC} > f^C$).

To sum up, in all cases, merchant 1 makes more profit if he undercuts f^C by setting $f^{PC} < f^C$.

6.5 Appendix E: Proof of Lemma 5

Assume that merchant 1 sets $f^{PC} = 0$. Merchant 2 does not change his decision to accept cards if and only if his profit is higher if it accepts cards than if it does not, that is,

$$\begin{aligned}
&\frac{1}{2t}\left(t + \frac{1}{3}\left(-\frac{(f^C)^2}{2} + c_M - (f^C + m)(1 - f^C) - b_S f^C\right)\right)^2 \\
&+\frac{(m - b_S)(1 - f^C)(f^C)^2}{4t} \geq \frac{1}{2t}\left(t + \frac{1}{3}\left(-\frac{1}{2} - (b_S - c_M)\right)\right)^2.
\end{aligned}$$

This condition is equivalent to $g(m, f^C) \geq 0$, where

$$\begin{aligned}
g(m, f^C) &= \left(t + \frac{1}{3}\left(-\frac{(f^C)^2}{2} + c_M - (f^C + m)(1 - f^C) - b_S f^C\right)\right)^2 \\
&\quad +\frac{(m - b_S)(1 - f^C)(f^C)^2}{2} \\
&\quad -\left(t + \frac{1}{3}\left(-\frac{1}{2} - (b_S - c_M)\right)\right)^2.
\end{aligned}$$

Condition under which the demand is positive We know that, if both merchants accept cards and $f^{PC} = 0$, the demand for card payments at merchant 2's is

$$\begin{aligned}
D_2^C &= (1 - f^C)w_2 - \frac{1}{2t}(1 - f^C)f^C \qquad \text{(E1)} \\
&= \frac{1}{2t}(1 - f^C)\left(t + \frac{1}{3}(-(b_S + 1 + f^C)f^C + c_M - m(1 - f^C))\right).
\end{aligned}$$

Therefore, we have $D_2^C \geq 0$ if and only if $m \leq \overline{m}$, where

$$\overline{m} = \frac{3t + c_M - (b_S + 1 + f^C)f^C}{(1 - f^C)}.$$

Existence and characterization of $\widetilde{m}(f^C)$ First, we show that there exists an $\widetilde{m}(f^C)$ such that merchant 2 does not deviate from the equilibrium in which he accepts cards for $m \leq \widetilde{m}(f^C)$. Indeed, note that g is a convex polynomial function of m of degree 2, as $\partial^2 g/\partial m^2 = 2\left(1-f^C\right)^2/9 > 0$. Besides, we have

$$g(\overline{m}, f^C) = \frac{\left(f^C\right)^4}{4} + \frac{(f^C)^2}{2}\left[3t + c_M - b_S - f^C(1+f^C)\right] - \left(\frac{3t - b_S + c_M - 1/2}{3}\right)^2.$$

We are going to show that $g(\overline{m}, f^C) \leq 0$. To prove that, we show that $g(\overline{m}, f^C)$ is increasing with f^C and that $g(\overline{m}, 1) \leq 0$. We have

$$\frac{\partial g(\overline{m}, f^C)}{\partial f^C} = f^C\left[3t - b_S + c_M - \left(f^C\right)^2 - \frac{3}{2}f^C\right].$$

Since $c_M - b_S \geq -1$, and $\left(f^C\right)^2 + \frac{3}{2}f^C \in [0, 5/2]$, to have $\partial g(\overline{m}, f^C)/\partial f^C \geq 0$, it suffices that $t \geq 7/6$, which is true by Assumption 1. Now, replacing for $f^C = 1$ in $g(\overline{m}, f^C)$, we obtain

$$g(\overline{m}, 1) = \frac{-1}{18}\left(6t - 7 + 2c_M - 2b_S\right)\left(3t - 2 - b_S + c_M\right).$$

Assumption 1 implies that both parenthesis are positive, therefore, we have $g(\overline{m}, 1) \leq 0$. Hence, $g(\overline{m}, f^C) \leq 0$.

Now, notice that $b_S + 1 - f^C \leq \overline{m}$. Indeed, this condition is equivalent to

$$3t - b_S + c_M - f^C(1+f^C) - (1-f^C)^2 \geq 0,$$

which is true if $t \geq 4/3$, by Assumption 1. We have

$$g(b_S + \frac{3(1-f^C)}{4}, f^C) = \frac{-(1-f^C)^2}{144}\left(24t - 55\left(f^C\right)^2 - 8\left(b_S - c_M\right) + 5 - 2f^C\right). \quad \text{(E3)}$$

We have $\left(f^C\right)^2 \leq 1$, $(b_S - c_M) \in [0, 1]$ and $2f^C \leq 2$, therefore, (E3) is negative if $t > 5/2$, which is true by Assumption 1. Finally, we obtain that

$$g(b_S + \frac{1-f^C}{2}, f^C) = \frac{(1-f^C)^2(f^C)^2}{4} \geq 0.$$

This shows that $g\left(m, f^C\right)$ is first positive then negative over $[0, \overline{m}]$, and that it crosses $y = 0$ only once, at $\widetilde{m}(f^C)$. Besides, since $g(b_S + \frac{3(1-f^C)}{4}, f^C) < 0$ and $g(b_S + \frac{1-f^C}{2}, f^C) \geq 0$, we have

$$\widetilde{m}(f^C) \in \left(b_S + \frac{(1-f^C)}{2}; b_S + \frac{3(1-f^C)}{4}\right).$$

6.6 Appendix F: Proof of Proposition 3

The first order conditions of profit maximisation for the Acquirer and the Issuer are

$$\frac{dD_2^C}{dm}(m - a^P - c_A) + D_2^C = 0, \tag{F1}$$

and

$$\frac{dD_2^C}{df^C}(f^C + a^P - c_I) + D_2^C = 0, \tag{F2}$$

respectively. Proposition 4 shows that $f^{PC} = 0$ is a dominant strategy for merchant 1. Therefore, we replace for $f^{PC} = 0$ in (F1) and (F2). We have

$$D_2^C = \frac{1}{2t}(1 - f^C)\left(t + \frac{1}{3}(-(b_S + 1 + f^C)f^C + c_M - m(1 - f^C))\right).$$

We define

$$R = \frac{2t}{(1 - f^C)} D_2^C. \tag{F3}$$

Since $\frac{dD_2^C}{dm} = \frac{-(1-f^C)^2}{6t}$ and $\frac{dD_2^C}{df^C} = \frac{-R}{2t} + \frac{(1-f^C)}{6t} \times (m - 1 - b_S - 2f^C)$, by simplifying (F1) and (F2), we obtain

$$\begin{aligned} \frac{-(1-f^C)}{3}(m - a^P - c_A) + R &= 0, \\ (f^C + a^P - c_I)(-R + \frac{(1-f^C)}{3} \times (m - b_S - 1 - 2f^C)) + (1 - f^C)R &= 0. \end{aligned}$$

Before solving for the equilibrium, we start by showing that the Issuer's and the Acquirer's profit functions are concave.

6.6.1 Appendix F1: Concavity of profit functions

Writing the second derivative of Π_A with respect to m, we obtain

$$\frac{\partial^2 \Pi_A}{\partial^2 m} = \frac{-(1-f^C)^2}{3t} < 0,$$

so the second order condition for the Acquirer is verified.

Writing the second derivative of Π_I with respect to f^C, we obtain

$$\begin{aligned} \frac{\partial^2 \Pi_I}{\partial^2 f^C} &= -1 - \frac{1}{3t}\left[(f^C + a^P - c_I)(m - b_S - 3f^C) - (b_S + 1 + f^C)f^C\right] \\ &\quad + \frac{1}{3t}\left[-c_M + (1 - f^C)(2m - b_S - 1 - 2f^C)\right]. \end{aligned}$$

The third derivative of Π_I with respect to f^C is given by

$$\frac{\partial^3 \Pi_I}{\partial^3 f^C}(m, f^C) = \frac{1}{t}\left(4f^C + a^P - c_I - m + b_S\right).$$

Replacing for $f^C = 0$ yields

$$\frac{\partial^3 \Pi_I}{\partial^3 f^C}(m, 0) = \frac{1}{t}\left(a^P - c_I - m + b_S\right).$$

Since the Acquirer's profit must be positive, we have $m - a^P - c_A \geq 0$. So

$$a^P - c_I - m + b_S \leq b_S - c_I - c_A.$$

Since $b_S - c_I - c_A < 0$ by assumption, we have

$$\frac{\partial^3 \Pi_I}{\partial^3 f^C}(m, 0) < 0.$$

Replacing for $f^C = 1$ yields

$$\frac{\partial^3 \Pi_I}{\partial^3 f^C}(m, 1) = \frac{1}{t}\left(4 + a^P - c_I - m + b_S\right) = \frac{1}{t}(3 + a^P - c_I + 1 + b_S - m).$$

In Appendix C, we proved that $\widetilde{m}(f^C) \leq b_S + 3\left(1 - f^C\right)/4$, so $m \leq \widetilde{m}(f^C) \leq 1 + b_S$. Since the margin of the Issuer, $f^C + a^P - c_I$, must be positive, and $f^C \in [0, 1]$, we have $3 + a^P - c_I \geq 0$. So

$$\frac{\partial^3 \Pi_I}{\partial^3 f^C}(m, 1) > 0.$$

Therefore, as $\frac{\partial^3 \Pi_I}{\partial^3 f^C}$ is increasing with f^C, there exists a unique $\widetilde{f}^C \in (0; 1)$ such that $\frac{\partial^3 \Pi_I}{\partial^3 f^C}(m, f^C) > 0$ if $f^C > \widetilde{f}^C$ and $\frac{\partial^3 \Pi_I}{\partial^3 f^C}(m, f^C) \leq 0$ otherwise. To show that $\frac{\partial^2 \Pi_I}{\partial^2 f^C}(m, f^C) \leq 0$, it suffices to prove that $\frac{\partial^2 \Pi_I}{\partial^2 f^C}(m, 0) \leq 0$, and that $\frac{\partial^2 \Pi_I}{\partial^2 f^C}(m, 1) \leq 0$. Replacing for $f^C = 0$ yields

$$\frac{\partial^2 \Pi_I}{\partial^2 f^C}(m, 0) = \frac{-1}{3t}(3t + (m - b_S)(a^P - c_I) + 1 + b_S - m + c_M - m).$$

We know from Appendix C that $1 + b_S - m > 0$. We now show that $\left|a^P - c_I\right| \leq 1$. Since the Issuer's margin is positive, $1 + a^P - c_I \geq f^C + a^P - c_I \geq 0$. So $-1 \leq a^P - c_I$. Since the Acquirer's margin is positive, we have $a^P - c_I \leq m - c_A - c_I$. Hence, $a^P - c_I \leq 1 + b_S - c_A - c_I$. By assumption, $b_S - c_A - c_I \leq 0$. Therefore, $-1 \leq a^P - c_I \leq 1$. Since $\left|a^P - c_I\right| \leq 1$ and $|m - b_S| \leq 1$ then $(m - b_S)(a^P - c_I) \geq -1$. We also know that $-m \geq -b_S - 1 \geq -2$.

Therefore, to prove that $\partial^2\Pi_I/\partial^2 f^C(m, 0, f^{PC}) \leq 0$, it suffices that $3t - 3 \geq 0$, which is equivalent to $t \geq 1$. This is true by Assumption 1. Replacing for $f^C = 1$ yields

$$\frac{\partial^2\Pi_I}{\partial^2 f^C}(m, 1) = \frac{-1}{3t}(3t + m(1 + a^P - c_I) - (3 + b_S)(1 + a^P - c_I) - (b_S - c_M) - 2)).$$

Since $3 + b_S \leq 4$, and $1 + a^P - c_I \leq 2$, we have $-(3 + b_S)(1 + a^P - c_I) \geq -8$. We also have $-(b_S - c_M) \geq -1$. Therefore, to show that $\frac{\partial^2\Pi_I}{\partial^2 f^C}(m, 1) \leq 0$, it suffices that $3t - 11 \geq 0$, which is equivalent to $t \geq \frac{11}{3}$. This is true by Assumption 1.

To sum up, by Assumption 1, Π_I and Π_A are concave with respect to f^C and m, respectively.

6.6.2 Appendix F2: The best response of the Issuer is strictly positive.

We have that

$$\left.\frac{\partial\Pi_I}{\partial f^C}\right|_{f^C=0} = \frac{1}{2t}\left[\left(1 + a^P - c_I\right)\left(t + \frac{1}{3}(c_M - b_S)\right) + \frac{(b_S + 1 - m)}{3}\right].$$

Since $\widetilde{m}(f^C) \leq b_S + \frac{3}{4}$, then $b_S + 1 - m > 0$. Since the margin of the Issuer must be positive, we also know that $1 + a^P - c_I \geq 0$. Since, by Assumption 1, t is sufficiently high such that $t + (c_M - b_S)/3 \geq 0$, we can conclude that

$$\left.\frac{\partial\Pi_I}{\partial f^C}\right|_{f^C=0} > 0.$$

Therefore, the best response of the Issuer is strictly positive.

6.6.3 Appendix F3: The Acquirer chooses the maximum merchant fee compatible with merchant acceptance.

Assume that the constraint $m \leq \widetilde{m}(f^C)$ is not binding. The best response of the Acquirer is to play m^{BR} which satisfies to the first order condition, that is

$$\frac{-(1 - f^C)}{3}(m^{BR} - a^P - c_A) + R = 0,$$

where R is defined in (F3). Rearranging the first order condition, we get

$$\frac{-2(1 - f^C)m^{BR}}{3} + t + \frac{1}{3}(-(b_S + 1 + f^C)f^C + c_M + (1 - f^C)(a^P + c_A)) = 0.$$

So, we have $m^{BR}(f^C) = \left(a^P + c_A\right)/2 + y(f^C)$, where

$$y(f^C) = \frac{3}{2(1-f^C)}\left(t + \frac{1}{3}(-(b_S + 1 + f^C)f^C + c_M\right).$$

To show that the constraint is binding if the Acquirer plays its best response, it is sufficient to prove that for $m = y(f^C)$, the non deviation condition is not verified, that is, $y(f^C) > \widetilde{m}(f^C)$ (since $m^{BR}(f^C) > y(f^C)$). A simple way of showing that the non deviation condition is violated for $m = y(f^C)$ is to prove that $y(f^C) > b_S + 1 - f^C$, as we know that $b_S + 1 - f^C \geq \widetilde{m}$. We have

$$y - b_S = \frac{3}{2(1-f^C)}\left(t + \frac{1}{3}(-(b_S - c_M) - (1+f^C)f^C - b_S(1-f_C)\right).$$

To show that $y(f^C) - b_S > 1 - f^C$, it is equivalent to prove that $T \equiv (y - b_S)(1-f^C) - (1-f^C)^2 > 0$. We have

$$T = \frac{3}{2}t - \frac{1}{2}\left(b_S(1-f^C) + (b_S - c_M) + 2(f^C)^2 + (1-f^C)(2-f^C)\right).$$

Since $b_S(1-f^C) < 1$, $(b_S - c_M) < 1$, $2(f^C)^2 < 2$, and $(1-f^C)(2-f^C) < 2$, we have $T > 3t/2 - 3$. To have $T > 0$, it suffices that $t > 2$. So if Assumption 1 holds, the Acquirer chooses the maximum merchant fee compatible with merchant acceptance.

6.6.4 Appendix F4: The equilibrium

We can now solve for the equilibrium. We start by showing that two lemmas.

Lemma 7 *$\widetilde{m}(f^C)$ is decreasing with f^C.*

Proof. The function $\widetilde{m}(f^C)$ is defined implicitly by the non deviation condition. Using the implicit function theorem, we obtain

$$\frac{\partial \widetilde{m}(f^C)}{\partial f^C} = -\left(\left.\frac{\partial g}{\partial m}\right|_{m=\widetilde{m}}\right)^{-1} \times \left.\frac{\partial g}{\partial f^C}\right|_{m=\widetilde{m}}.$$

Since g is decreasing with m over $[0, \widetilde{m}]$, the sign of $\frac{\partial \widetilde{m}(f^C)}{\partial f^C}$ has the same as $\left.\frac{\partial g}{\partial f^C}\right|_{m=\widetilde{m}}$. Taking the derivative of g with respect to f^C, we obtain

$$\left.\frac{\partial g}{\partial f^C}\right|_{m=\widetilde{m}} = \frac{2Y}{3}(\widetilde{m}(f^C) - (b_S + 1 - f^C)) + \frac{\widetilde{m}(f^C) - b_S}{2}\left(-3(f^C)^2 + 2f^C\right),$$

where

$$Y = t - \frac{1}{3}\left[\frac{1}{2} + (b_S - c_M) - (1-f^C)(\frac{1-f^C}{2} + b_S - \widetilde{m}(f^C))\right].$$

We now show that $\left.\frac{\partial g}{\partial f^C}\right|_{m=\widetilde{m}} < 0$. First, we have $Y \geq 0$ by Assumption 1.

Indeed, since $\widetilde{m}(f^C) - \frac{3}{4}(1-f^C) < 0$, we have $\frac{(1-f^C)}{2} - \widetilde{m}(f^C) > \frac{-(1-f^C)}{4}$. Hence, $\frac{(1-f^C)}{3}\left(\frac{(1-f^C)}{2} - \widetilde{m}(f^C)\right) > \frac{-(1-f^C)^2}{12} \geq \frac{-1}{12}$. Since $\frac{1}{2} + (b_S - c_M) < \frac{3}{2}$, if $t - \frac{7}{12} \geq 0$, then $Y \geq 0$. Therefore, it suffices that $t \geq \frac{7}{12}$, which is true by Assumption 1.

Besides, we have $\widetilde{m}(f^C) - (b_S + 1 - f^C) \leq 0$, so $\left.\frac{\partial g}{\partial f^C}\right|_{m=\widetilde{m}} < 0$ if and only if

$$Y \geq \frac{3}{4}\frac{\widetilde{m}(f^C) - b_S}{1 - f^C + b_S - \widetilde{m}(f^C)}\left(-3(f^C)^2 + 2f^C\right). \tag{F4-1}$$

We have $1 - f^C + b_S - \widetilde{m}(f^C) \leq b_S - \widetilde{m}(f^C)$ as $\widetilde{m}(f^C) - b_S \geq \left(1 - f^C\right)/2$. Therefore, a sufficient condition for (F4-1) to hold is

$$Y \geq \frac{3}{4}\left(-3f^C + 2\right) f^C. \tag{F 4-2}$$

We have $\left(-3f^C + 2\right) f^C \leq 1/3$, so (F 4-2) is equivalent to $Y \geq 1/4$, that is, $t \geq 5/6$, which is true by Assumption 1. If this condition holds, then $\widetilde{m}(f^C)$ is decreasing with f^C. ■

Lemma 8 *$(f^C)^{BR}$ is increasing with m.*

Proof. The function $(f^C)^{BR}$ is defined implicitly by the first order condition of the maximisation of the Issuer's profit. Using the implicit function theorem, we obtain

$$\frac{\partial (f^C)^{BR}}{\partial m} = -\left(\left.\frac{\partial^2 \Pi_I}{\partial^2 f^C}\right|_{f^C=(f^C)^{BR}}\right)^{-1} \times \left.\frac{\partial^2 \Pi_I}{\partial f^C \partial m}\right|_{f^C=(f^C)^{BR}}.$$

Since we have shown that the second order condition is verified, the sign of $\frac{\partial (f^C)^{BR}}{\partial m}$ is the same as the sign of $\left.\frac{\partial^2 \Pi_I}{\partial f^C \partial m}\right|_{f^C=(f^C)^{BR}}$. Taking the derivative of the first order condition with respect to m, we obtain

$$\left.\frac{\partial^2 \Pi_I}{\partial f^C \partial m}\right|_{f^C=(f^C)^{BR}} = \frac{(1-(f^C)^{BR})}{6t}\left[3(f^C)^{BR} + 2(a^P - c_I) - 1\right].$$

So, if $(f^C)^{BR} \leq \frac{1 + 2c_I - 2a^P}{3}$, then $\frac{\partial (f^C)^{BR}}{\partial m} \leq 0$, and $\frac{\partial (f^C)^{BR}}{\partial m} > 0$ otherwise. We are going to show that $(f^C)^{BR} > \frac{1 + 2c_I - 2a^P}{3}$, which will prove that $\frac{\partial (f^C)^{BR}}{\partial m} > 0$. To do so, we replace for $f^C = \dfrac{1+2c_I-2a^P}{3}$ in the first order condition. Since π_I is concave, if

$$\frac{\partial \Pi_I}{\partial f^C}(m, \frac{1+2c_I-2a^P}{3}) > 0$$

then we know that $(f^C)^{BR} > \left(1+2c_I-2a^P\right)/3$.

We have

$$\frac{\partial \Pi_I}{\partial f^C}(m, \frac{1+2c_I-2a^P}{3}) = \frac{\left(1-c_I+a^P\right)H}{162t}, \qquad \text{(F 4-3)}$$

where

$$H = 27t - 9\left(b_S - c_M\right) - 14 + 8a\left(1-c_I\right) + 4\left(a^2 + \left(c_I\right)^2\right) - 8c_I.$$

We have $1 - c_I + a^P \geq f^C - c_I + a^P \geq 0$, therefore, (F 4-3) is positive if and only if $H \geq 0$. Since $0 \leq 9\left(b_S - c_M\right) \leq 9$, and $8c_I \leq 8$, then a sufficient condition for $H \geq 0$ is $t \geq 31/27$, which is true by Assumption 1. ■

Define $\widetilde{f}$ such that $\widetilde{m}(\widetilde{f}) = 0$. Then we want to prove that $\widetilde{f} > f^*(m=0)$. The card fee $\widetilde{f}$ is defined by the non deviation condition, in which $\widetilde{m}(\widetilde{f}) = 0$, that is

$$\begin{aligned}\left(t+\frac{1}{3}\left(-\frac{1}{2}-b_S+c_M\right)\right)^2 \;=\; & \left(t+\frac{1}{3}\left(-\frac{1}{2}-b_S+c_M+b_S(1-\widetilde{f})-\widetilde{f}(1-\widetilde{f})-\frac{(\widetilde{f})^2}{2}\right)\right)^2 \\ & -\left[b_S(1-\widetilde{f})(\widetilde{f})^2\right]/2.\end{aligned}$$

This equation can be rewritten as

$$(1-\widetilde{f})\left\{\left[\frac{2}{3}Z+\frac{1}{9}+\left(\frac{1-\widetilde{f}}{9}\right)\left(\frac{1-\widetilde{f}}{2}+b_S\right)\right]\left(\frac{1-\widetilde{f}}{2}+b_S\right)-b_S\frac{\left(\widetilde{f}\right)^2}{4}\right\}=0,$$

where $Z = t + \frac{1}{3}\left(-\frac{1}{2} - b_S + c_M\right)$. It can be shown that the terms in the second parenthesis are strictly positive. Hence, the only solution of this equation is obtained for $\widetilde{f} = 1$. Therefore, $\widetilde{f} \geq f^*(m=0)$. Therefore, we have shown that there is a unique equilibrium such that: $\left(f^{PC}\right)^* = 0$; $\left(f^C\right)^* \in (0,1)$; $m^* = \widetilde{m}$.

6.7 Appendix G: Proof of Proposition 4

We already proved that $\widetilde{m}(f^C) > b_S + \left(1 - f^C\right)/2$, which shows that for a given f^C, the Acquirer's best response is to choose a higher merchant fee than in the benchmark case. We now compare $(f^C)^{BR}$ with the best response of the Issuer in the benchmark case, that is

$f^C = \left(1 + c_I - a^P\right)/2$. We have

$$\frac{\partial \Pi_I}{\partial f^C}(m, \frac{1 + c_I - a^P}{2}) = \frac{\left(1 - c_I + a^P\right)^2}{24t}\left(m - b_S - 1 - (1 + c_I - a^P)\right).$$

Since $m - b_S - 1 < 0$, and $1 + c_I - a^P > 0$, we have

$$\frac{\partial \Pi_I}{\partial f^C}(m, \frac{1 + c_I - a^P}{2}) < 0.$$

Since π_I is concave, this proves that $(f^C)^{BR} < \dfrac{1 + c_I - a^P}{2}$. So, for a given m, the Issuer chooses a lower transaction fee than in the benchmark case.

To sum up, for a given f^C, the Acquirer's best response is to choose a higher m than in the benchmark case. Besides, for a given m, the Issuer's best response is to set a lower f^C than in the benchmark case, so the equilibrium merchant fee is higher than in the benchmark case, while the card fee is lower.

6.8 Appendix H: Proof of Lemma 6

We start by showing that $(f^C)^{BR}$ is increasing with a^P. The function $(f^C)^{BR}(m, a^P)$ is defined implicitly by the first order condition of the maximisation of the Issuer's profit. Using the implicit function theorem, we obtain

$$\frac{\partial (f^C)^{BR}(m, a^P)}{\partial a^P} = -\left(\frac{\partial^2 \Pi_I}{\partial^2 f^C}(m, f^C, a^P)\right)^{-1} \frac{\partial^2 \Pi_I}{\partial f^C \partial a^P}(m, (f^C)^{BR}, a^P).$$

Since we have shown in Appendix D1 that π_I is concave, the sign of $\dfrac{\partial (f^C)^{BR}(m, a^P)}{\partial a^P}$ is the same as the sign of $\dfrac{\partial^2 \Pi_I}{\partial f^C \partial a^P}(m, (f^C)^{BR}, a^P)$. Taking the derivative of the first order condition with respect to a^P, we obtain

$$\frac{\partial^2 \Pi_I}{\partial f^C \partial a^P}(m, (f^C)^{BR}, a^P) = \frac{1}{2t}\left[-R + \frac{(1 - (f^C)^{BR})}{3}(m - (b_S + 1 + 2(f^C)^{BR}))\right],$$

where R is given by (F3). Since $m < 1 - f^C + b_S$, we know that $m - (b_S + 1 + 2(f^C)^{BR}) < 0$. Since $R \geq 0$, then it follows that $-R + \dfrac{(1 - (f^C)^{BR})}{3}(m - (b_S + 1 + 2(f^C)^{BR})) < 0$. This shows that

$$\frac{\partial^2 \Pi_I}{\partial f^C \partial a^P}(m, (f^C)^{BR}, a^P) < 0.$$

This proves that $(f^C)^{BR}$ is decreasing with a^P. We also know that $(f^{PC})^{BR}(f^C, m)$ does not depend on a^P as it is equal to 0. Besides, $\widetilde{m}(f^C)$ does not depend on a^P either, as the non deviation condition does not depend on a^P (see the expression of g in Appendix C). So, if a^P increases, the best response of the Acquirer remains unchanged, while the best response of the Issuer decreases. As shown in Lemma 7, $\widetilde{m}(f^C)$ is decreasing with f^C, which proves that $(f^C)^*$ is lower and that m^* is higher if the interchange fee is higher.

6.9 Appendix I: Entry condition

6.9.1 Entry condition

Merchant 1 enters the market if and only if he makes higher profit with the private card at the equilibrium of stage 3 than in the benchmark case. This condition is obtained by replacing for $f^{PC} = 0$, $(f^C)^*$ and m^* in π_1 (case L-1), that is $\pi_1^{C,C}(m^*, (f^C)^*, 0) - F \geq t/2$, which is equivalent to

$$\left(t + \frac{1}{3}\left(-c_M + \left((f^C)^* + m^*\right)\left(1 - (f^C)^*\right) + \frac{((f^C)^*)^2}{2} + b_S (f^C)^*\right)\right)^2 - 2tF \geq t^2.$$

6.10 Appendix J: Proof of Lemma 5

We start by rearranging $(EC)'(a^P)$. Solving for $\widetilde{m}(f^C)$ (see Appendix E), we find that $\widetilde{m}(f^C) = b_S + \left(1 - f^C\right)/2 - U(f^C)$, where

$$U(f^C) = \frac{(-2Q + \frac{3}{2}(f^C)^2) + \sqrt{D}}{2(1 - f^C)/3},$$

$$D = (2Q - \frac{3}{2}(f^C)^2)^2 - (1 - f^C)^2 (f^C)^2,$$

and $Q = t + (-1/2 - b_S + c_M)/3$. Since $\widetilde{m}(f^C) \geq b_S + \left(1 - f^C\right)/2$, we have $U(f^C) \leq 0$.

We have $m^* = \widetilde{m}(\left(f^C\right)^*)$ and $\partial\widetilde{m}/\partial a^P = 0$, therefore,

$$\frac{dm^*}{da^P} = \left.\frac{d\widetilde{m}(f^C)}{df^C}\right|_{f^C = (f^C)^*} \times \frac{d\left(f^C\right)^*}{da^P}.$$

Replacing for this expression in $(EC)'(a^P)$ and replacing for $\widetilde{m}(\left(f^C\right)^*)$, we find that

$$(EC)'(a^P) = \frac{2}{3}\Psi \times \left[(b_S + 1 - (f^C)^* - \widetilde{m}(\left(f^C\right)^*)) + (1 - (f^C)^*)\left.\frac{d\widetilde{m}(f^C)}{df^C}\right|_{f^C = (f^C)^*}\right] \frac{d(f^C)^*(a^P)}{da^P}.$$

We know that $\Psi \geq 0$ and $d(f^C)^*/da^P \leq 0$, therefore, we have $(EC)'(a^P) \leq 0$ if and only if the term into brackets is positive. Replacing for $\widetilde{m}(\left(f^C\right)^* = b_S + \left(1 - (f^C)^*\right)/2 - U((f^C)^*)$, we find that $(EC)'(a^P) \leq 0$ if and only if

$$(1 - f^C)\left(\frac{1}{2} + \left.\frac{d\widetilde{m}(f^C)}{df^C}\right|_{f^C=(f^C)^*}\right) + U((f^C)^*) \geq 0.$$

Since

$$\left.\frac{d\widetilde{m}(f^C)}{df^C}\right|_{f^C=(f^C)^*} = -\frac{1}{2} - \left.\frac{dU(f^C)}{df^C}\right|_{f^C=(f^C)^*},$$

we have that $(EC)'(a^P) \leq 0$ if and only if

$$(1 - (f^C)^*)\left.\frac{dU(f^C)}{df^C}\right|_{f^C=(f^C)^*} - U((f^C)^*) \leq 0. \tag{J1}$$

We have

$$(1 - f^C)\frac{dU(f^C)}{df^C} - U(f^C) = \frac{9}{2}f^C + \frac{3}{4}D^{-1/2}\frac{dD}{df^C},$$

where

$$\frac{dD}{df^C} = -f^C\left(12Q - 5\left(f^C\right)^2 - 6f^C + 2\right).$$

Replacing for Q, it can be shown that $2Q - 5\left(f^C\right)^2 - 6f^C + 2 \geq 0$ for $t \geq 5/4$, which is always true by assumption 1. Hence, $dD/df^C \leq 0$. It follows that (J1) holds, hence $(EC)'(a^P) \leq 0$, if and only if

$$12\left(1 - 2\left(f^C\right)^*\right)Q + \left(5\left(\left(f^C\right)^*\right)^3 + 8\left(\left(f^C\right)^*\right)^2 - 5\left(f^C\right)^* + 1\right) \geq 0. \tag{J2}$$

We have $5\left(f^C\right)^3 + 8\left(f^C\right)^2 - 5f^C + 1 \geq 0$ for any $f^C \in [0,1]$. If $\left(f^C\right)^* \leq 1/2$, the first term in (J2) is also positive, hence (J2) holds always. Therefore, if $\left(f^C\right)^* \leq 1/2$, EC is decreasing in a^P. If $\left(f^C\right)^* > 1/2$, then (J2) is the sum of a negative term and a positive term. Condition (J2) holds if and only if $Q \leq \widetilde{Q}\left(\left(f^C\right)^*\right)$, where

$$\widetilde{Q}\left(f^C\right) = \frac{\left(5\left(f^C\right)^3 + 8\left(f^C\right)^2 - 5f^C + 1\right)}{12\left(2f^C - 1\right)}.$$

Therefore, $(EC)'(a^P) \geq 0$ if $Q \geq \widetilde{Q}\left(\left(f^C\right)^*\right)$. Since $t > 11/3$ by Assumption 1 and $b_S - c_M \in [0,1]$, then we have $Q \geq 19/6$. We find that $\widetilde{Q}\left(f^C\right) > 19/6$ for $f^C \in (0.5, 0.516)$ and $\widetilde{Q}\left(f^C\right) \leq 19/6$ for $f^C \in (0.516, 1]$. Hence, if $\left(f^C\right)^* \in (0.516, 1]$, we have $Q \geq \widetilde{Q}\left(\left(f^C\right)^*\right)$, therefore, EC increasing with a^P. If $\left(f^C\right)^* \in (0.5, 0.516)$, we have EC increasing with a^P if t is sufficiently high, and EC decreasing with a^P otherwise.

6.11 Appendix K: the impact of the market structure on entry

If there is perfect competition on both sides of the market, both banks charge fees that are equal to their perceived marginal cost, that is $(f^C)^* = a^P - c_I$, and $m^* = a^P + c_A$. If merchant 1 decides to issue private cards, he makes a profit (gross of the entry cost) of

$$\pi_1^{C,C}(m^*, (f^C)^*, 0) = \frac{1}{2t}\left(t + \frac{1}{3}\left(\frac{(c_I - a^P)^2}{2} - c_M + c(1 + a^P - c_I) + b_S(c_I - a^P)\right)\right)^2.$$

We now determine the level of the interchange fee that minimises the profit of merchant 1. Differentiating $\pi_1^{C,C}$ with respect to a^P yields

$$\frac{\partial \pi_1^{C,C}}{\partial a^P} = \left(t + \frac{1}{3}\left(\frac{(c_I - a^P)^2}{2} - c_M + c(1 + a^P - c_I) + b_S(c_I - a^P)\right)\right)\frac{(a^P + c_A - b_S)}{3t}.$$

Our assumption on t ensures that the term in the first parenthesis is positive, therefore $\pi_1^{C,C}$ is minimal for $a^P = b_S - c_A$. This means that, if the payment platform chooses Baxter's interchange fee, the probability that merchant 1 enters the market is minimized.

6.12 Appendix L: the reaction of merchant 2.

If merchant 2 issues private cards, he never chooses a price for the private card that is higher than the card fee, otherwise, the private card is never used by the consumers. After elimination of the dominated strategies, we find that there are two cases in which both merchants issue private cards that are used by consumers

- Case a: $f_1^{PC} \leq f_2^{PC} \leq f^C$
- Case b: $f_2^{PC} \leq f_1^{PC} \leq f^C$.

We start by studying Case a. The second case can be solved in a similar way by symmetry. We assume that, if a consumer is indifferent between the payment card and the private card, he chooses to use the private card. Using the same method as in Section 3.3.1, we determine the demand for merchant 1's and the demand for merchant 2's. Consumers trade off between shopping at merchant 1's and paying cash or with its private card, and shopping at merchant

2's and paying cash or with merchant 2's private card. We find that

$$\begin{aligned}
D_1^{PC} &= w_1(1-f_1^{PC}) + \frac{(f_2^{PC}-f_1^{PC})^2}{4t} + \frac{(f_2^{PC}-f_1^{PC})(1-f_2^{PC})}{2t}, \\
D_1^{Cash} &= f_1^{PC} w_1, \\
D_2^{PC} &= w_2(1-f_2^{PC}) - \frac{(f_2^{PC}-f_1^{PC})(1-f_2^{PC})}{2t}, \\
D_2^{Cash} &= f_2^{PC} w_2 - \frac{(f_2^{PC}-f_1^{PC})^2}{4t}.
\end{aligned}$$

Since the price of the private card is lower at merchant 1's, the latter attracts cash users from merchant 2's (the second term of D_1^{PC}) and private card users from merchant 2's (the third term in D_1^{PC}). At stage 4, each merchant chooses the price that maximises its profit, that is

$$\pi_i^{PC} = (f_i^{PC} + b_S - c_M) D_i^{PC} + (p_i - c)(D_i^{PC} + D_i^{Cash}).$$

We find that at the equilibrium of stage 4, the prices are

$$\begin{aligned}
p_1 &= t + c + \frac{1}{3}\left[-2(f_1^{PC} + b_S - c_M)(1-f_1^{PC}) - (f_2^{PC} + b_S - c_M)(1-f_2^{PC})\right] \\
&\quad + \frac{1}{3}\left[\frac{(f_2^{PC}-f_1^{PC})^2}{2} + (f_2^{PC}-f_1^{PC})(1-f_2^{PC})\right],
\end{aligned}$$

and

$$\begin{aligned}
p_2 &= t + c + \frac{1}{3}\left[-(f_1^{PC} + b_S - c_M)(1-f_1^{PC}) - 2(f_2^{PC} + b_S - c_M)(1-f_2^{PC})\right] \\
&\quad + \frac{1}{3}\left[\frac{-(f_1^{PC}-f_2^{PC})^2}{2} + (f_1^{PC}-f_2^{PC})(1-f_2^{PC})\right].
\end{aligned}$$

Merchant 1 makes profit

$$\begin{aligned}
\pi_1^{PC} &= 2t\left[\frac{1}{2} + \frac{1}{6t}((b_S - c_M)(f_2^{PC} - f_1^{PC}) + \frac{(f_2^{PC})^2 - (f_1^{PC})^2}{2}\right]^2 \\
&\quad + f_1^{PC}(f_1^{PC} + b_S - c_M)\left[\frac{(f_2^{PC}-f_1^{PC})^2}{4t} + \frac{(f_2^{PC}-f_1^{PC})(1-f_2^{PC})}{2t}\right] - F,
\end{aligned}$$

whereas merchant 2 makes profit

$$\begin{aligned}
\pi_2^{PC} &= 2t\left[\frac{1}{2} + \frac{1}{6t}((b_S - c_M)(f_1^{PC} - f_2^{PC}) + \frac{(f_1^{PC})^2 - (f_2^{PC})^2}{2}\right]^2 \\
&\quad - (f_2^{PC} + b_S - c_M)(1-f_2^{PC})\left(\left(f_2^{PC}\right)^2 - \left(f_1^{PC}\right)^2\right)/(4t) - F_2.
\end{aligned}$$

If the merchants choose the same price for the private card, merchant 2 makes profit $\pi_2^{PC} = t/2 - F_2$. Since $f_1^{PC} - f_2^{PC} \leq 0$, we have $\pi_2^{PC} \leq t/2 - F_2$. Hence, if merchant 1 chooses $f_1^{PC} \in [0;1]$, the strategy to choose $f_2^{PC} > f_1^{PC}$ is dominated for merchant 2. We now show that merchant 2 has an incentive to undercut the price that is chosen by merchant 1. If merchant 2 chooses a price that is equal to $\left(f_1^{PC}\right) - \varepsilon$, for $\varepsilon > 0$ small, he makes profit

$$\begin{aligned}\pi_2^{PC} &= 2t\left[\frac{1}{2} + \frac{\varepsilon}{6t}((b_S - c_M) + f_1^{PC} - \varepsilon/2)\right]^2 \\ &\quad + (f_1^{PC} - \varepsilon)(f_1^{PC} - \varepsilon + b_S - c_M)\left[\frac{\varepsilon^2}{4t} + \frac{\varepsilon(1 - f_1^{PC})}{2t}\right] - F_2.\end{aligned}$$

For $\varepsilon > 0$ sufficiently small and $f_1^{PC} > 0$, this profit is strictly higher than $t/2 - F_2$, as $b_S - c_M \geq 0$. Hence, merchant 2 has an incentive to undercut the price chosen by merchant 1. By symmetry of case a and b, it can also be shown that merchant 1 has an incentive to undercut the price that is chosen by merchant 2. Hence, at the equilibrium of Stage 4, the best response of each merchant i is to set $f_i^{PC} = 0$. Merchant 1 then makes profit $\pi_1^{PC} = t/2 - F$, while merchant 2 makes profit $\pi_2^{PC} = t/2 - F_2$. To determine if merchant 2 issues private cards at stage 3, we compare its profit in the two cases. We find that merchant 2 does not issue private cards if $\pi_2^{C,C} \geq \pi_2^{PC}$. Hence, merchant 2 does not react to merchant 1's decision if

$$F_2 \geq k((f^C)^*((a^P)^{PC}),$$

where,

$$\begin{aligned}k(f^C) &= \frac{t}{2} - \frac{1}{4t}(\frac{1-f^C}{2} - U(f^C))(1-f^C)(f^C)^2 \\ &\quad -\frac{1}{2t}\left[t + \frac{1}{3}(-\frac{(f^C)^2}{2} + c_M - (b_S + \frac{1+f^C}{2} - U(f^C))(1-f^C) - b_S f^C\right]^2.\end{aligned}$$

V. <u>CHAPITRE IV :</u> INFLUENCE DES INTERCHANGES SUR LES MECANISMES DE SUBSTITUTION ENTRE LA CARTE ET LES ESPECES.

Dans ce chapitre, nous étudions l'influence des interchanges paiement et retrait sur les mécanismes de substitution entre la carte et les espèces. Le système de paiement par carte propose aux consommateurs une carte de paiement qui permet d'effectuer des transactions de paiement et de retrait. Dans notre modèle, nous montrons que la possibilité d'engranger des profits sur les retraits déplacés peut inciter les banques à choisir une commission d'interchange trop faible pour les transactions de paiement par carte. Du point de vue du bien-être social, l'interchange sur les transactions de paiement est trop faible, tandis que l'interchange sur les retraits est trop élevé. La carte de paiement n'est donc pas suffisamment utilisée par rapport aux espèces. Nous montrons aussi que les intérêts des banques émettrices ne sont pas identiques en matière de choix des commissions d'interchange, à cause des asymétries de leurs réseaux de distributeurs automatiques de billets, ou bien à cause de leurs activités sur le segment de l'acquisition.

Optimal interchange fees for card payments and cash withdrawals.

Marianne Verdier*

November 3, 2008

Abstract

In this paper, I study the optimal interchange fees (IF) for card payments and cash withdrawals in a payment card association that organizes the interactions between issuers, acquirers, and ATM owners. In my model, the card issuers may also be ATM owners and the acquirers are perfectly competitive. The main result of this paper is to show that the possibility to make profit on displaced withdrawals may encourage banks to lower the interchange fee on card payments. From a social welfare point of view, the IF on card payments is too low, while the IF on withdrawals is too high. We also show that the interests of the issuers may diverge because of their activities on the ATM side or on the acquisition side of the market.

JEL Codes: G21, L31, L42.

Keywords: Payment card systems, interchange fees, two-sided markets, money demand, ATMs.

*Telecom ParisTech, Department of Economics and Social Sciences, 46 rue Barrault, 75634 Paris Cedex 13, France; E-mail: marianne.verdier@telecom-paristech.fr.

1 Introduction:

Payment cards are widely hold and used in developed countries. In Europe, for instance, in 2006, there were around 1.38 payment card per inhabitant.[1] Two reasons account for the success of payment cards on the demand side. First, payment cards are a convenient substitute for cash at the Point Of Sales (POS). For instance, it enables consumers to avoid holding large amounts of currency in their pockets before shopping. Also, banks provide consumers with various services associated with the card, such as insurance, or rewards. Second, in many countries, banks have bundled the payment card with a withdrawal service. The consumers can use their payment cards to withdraw cash from Automatic Teller Machines (ATMs), in particular because banks have reached compatibility agreements to share their ATM networks. Therefore, payment cards offer the consumers a possibility to trade off between cash and card usage at the POS, and empirical evidence shows that consumers often use their cards to withdraw cash (see Table 1).

Table 1: Examples of card usage in european countries in 2006 (number in billion).[2]

	DE	FR	BE	SE	GB	IT
Total number of card transactions[3]	4.95	6.91	1	1.273	9.55	1.24
Percentage of cash withdrawals	49.9%	21.1%	25.7%	24%	28.8%	37.9%

Payment card systems organize the interactions between the issuing and the acquiring banks by choosing an interchange fee for card transactions.[4] The interchange fee is paid by the acquirer to the issuer, in order to allocate optimally the total cost of a card transaction. If the payment card system manages an ATM network, it may also choose a level of interchange fee for cash withdrawals. This interchange fee on withdrawals is paid by the issuer of the card to the ATM owner, each time a consumer withdraws cash.

This article studies the optimal interchange fees of a payment card system that also offers withdrawal services. My purpose is to show that optimal interchange fees on card payments and cash withdrawals are interrelated. My aim is also to build a model of a payment card system that takes into account the consumers' costs of getting, holding and using cash. This issue has never been studied in the literature on payment card systems.

The theoretical literature on payment card systems is divided into two branches: the literature on interchange fees for card payments, and the literature on ATMs.

[1] Source: ECB Blue Book. This figure does not include e-purse cards.

[2] *Source ECB Blue Book 2006, except for the United Kingdom APACS 2007.*

[3] Number in billion of POS+withdrawal transactions proceeded in the country with a card issued in the country (all types of cards included).

[4] Agreements on Multilateral Interchange Fees are used in most payment systems. Notable exceptions include the Netherlands, where discussions are ongoing with the NMa (competition authority) to authorize bilateral interchange fees.

In the literature on interchange fees for card payments,[5] payment card systems are modelled as two-sided platforms, which use interchange fees to solve usage externalities that arise between consumers and merchants, when they diverge on their payment instrument choice. The interchange fees are used by the payment platform to allocate optimally the total cost of a payment card transaction between the issuer of the card and the acquirer of the transaction. The purpose of interchange fees on card payments is to encourage the usage of payment cards by subsidizing the consumers' side.

The other branch of the theoretical literature studies the impact of ATM networks on banks' competition for deposits.[6] According to this literature, interchange fees on withdrawals encourage banks to deploy ATMs and build compatible networks, while competing for deposits. For instance, Matutes and Padilla (1994) show that, without interchange fees, full ATM compatibility does not emerge as an equilibrium. This is because banks' incentives to share their ATMs depend on a trade-off between a positive network effect, and a negative substitution effect due to the competition on deposits. Once banks' ATM are compatible, Massoud and Bernhardt (2002) show that banks set high account fees for their customers, but do not charge them for ATM usage. Banks choose to impose high surcharges on non members in order to increase their market share on deposits. Donze and Dubec (2006) develop a model to study the deployment of shared ATMs with interchange fees. They show that the size of the ATM network may exceed the socially optimal level, if the level of interchange fees is chosen to maximise banks' joint profits.

These two branches of the theoretical literature on payment cards miss some important aspects of the substitution between cash and payment cards. First, in the literature on interchange fees for card payments, the provision of cash is considered as exogenous. It is assumed that consumers always hold cash if the payment card is refused. The fact that the payment card may also be used to withdraw cash from ATMs is not taken into account. Also, the payment card system is not considered as being involved in the choice of an interchange fee on cash withdrawals. Second, the costs of using and holding cash are normalized to zero. A consumer chooses to pay by card if his net benefit is positive, but the benefit of paying by card depends only on the characteristics of the individual. A consumer uses either cash or the card, but never both. In the literature on ATMs, the fact that the same card can be used to withdraw cash and

[5] For a review of the literature, see Rochet (2003). The optimal interchange fees for card payments depend in particular on the nature of the strategic interactions between merchants (Rochet and Tirole (2002), Wright (2002)), on the nature of competition between banks (Rochet and Tirole (2002)), on the ability of the payment platform to surcharge (Wright (2002)), on banks' investments in quality (Verdier (2007)), and on the existence of competing payment platform (Rochet and Tirole (2003), Guthrie and Wright (2007), Chakravorti and Roson (2006)).

[6] For a review of this literature, see MacAndrews (2003).

to pay at the Point of Sales is never taken into account.

The analysis of the empirical literature suggests that cash provision should not be treated as exogenous when modelling payment card systems. The payment card system often organizes the interactions between the issuers, the acquirers and the ATM owners, and withdrawal statistics show that, in many countries, the payment card is widely used to obtain cash.[7] Also, there is empirical evidence that the benefit of paying by card does not only depend on the characteristics of the individual, but also on the characteristics of the transaction (see Bounie and François (2006), Borzegowski and Kiser (2006)). In particular, Schuh and Stavins (2007) have even shown that the transaction characteristics predict better the choice of the payment instrument than the sociodemographic variables.

My paper tries to bridge the gap between the two branches of the literature by modelling the payment card system as a three-sided platform, which organizes the interactions between the issuers, the acquirers and the ATM owners. Also, consistent with the empirical findings, I assume that the consumers' decision to subsitute the card for cash depends on the size of the transaction. This enables me also to fully account for the trade-offs between cash withdrawals and card payments for the consumers and the payment platform.

I consider two issuing banks, that compete "à la Hotelling" on the market for deposits. The issuers may also be ATM owners. A consumer who opens an account is delivered a payment card, which enables him to pay at the POS and to withdraw cash from ATMs, which are compatible. I assume that consumers make an exogenous percentage of withdrawals in the ATM network of the other bank. This percentage may be equal to one if a bank does not own any ATM. In their decision to open an account, the consumers take into account the fixed fee they have to pay for account handling services, and the transaction fees they pay each time they make a withdrawal or they pay by card. Hence, it is as if the issuing banks competed in two-part tariffs on the market for deposits. The acquisition side is assumed to be perfectly competitive. The payment system chooses the levels of interchange fees for cash withdrawals and card payments. I assume that there exists a maximum level of interchange fee on card payments such that all merchants accept cards.

To model the consumers' demand, I use the framework of Whitesell (1989)[8], who assumes that consumers make transactions of variable sizes, which can be paid either cash or by card. The consumers incur fixed and variable costs that depend on their choice of a payment instrument. The variable costs depend on the size of the transaction. Consistent with the empirical literature,

[7]See for instance Table 1 and Appendix J for examples of market structures in various european countries.
[8]Empirical evidence of the Whitesell model has been provided by Raa and Shestalova (2004).

consumers pay cash transactions of small values, and pay by card transactions of higher values. Following Baumol (1952) and Tobin (1956), Whitesell assumes that consumers may withdraw cash in several times, and that there is an opportunity cost associated to the storage of cash. A consumer chooses the number of withdrawals and the threshold above which he uses the card so as to minimise its total costs.

Solving for the equilibrium of the game, I start by determining the number of withdrawals and the threshold that separates cash and card payments, which depend on the transaction prices. The higher is the withdrawal price, the lower is the number of withdrawals, and the threshold above which consumers pay by card. Then, I study how banks choose their prices. An issuing bank that is also an ATM owner trades off between

- the profit that it makes on "home" consumers through the fixed deposit fee and the transaction fees for card payments and cash withdrawals,
- the profit that it makes on "foreign" consumers through the interchange fee that is paid by its competitor each time a "foreign" consumer makes a displaced withdrawal.

Since banks cannot price discriminate between "home" and "foreign" withdrawals, competition in two-part tariffs leads to pricing at the average perceived marginal cost. Banks can encourage efficient use of cash and the payment card when consumers make transactions at the last stage of the game, while extracting a part of their surplus through the deposit fee. The deposit fee charged by a bank depends on the average surplus that a consumer obtains from opening an account and on the opportunity cost for the bank of loosing a "foreign" consumer when it attracts a new consumer.

At stage one, the payment platform chooses the interchange fees that maximise banks' joint profit. I show that the choice of the optimal interchange fees for card payments and cash withdrawals is influenced by the trade-off that each bank makes between the profits made on deposits and the profits made on displaced withdrawals.

If banks offer the same payment and withdrawal services, they share half the market for deposits, while making some profit on displaced withdrawals. In this case, I prove that it is optimal for the payment platform to choose the monopoly price for the interchange fee on withdrawals, and to set an interchange fee on card payments that is equal to zero. This is because a zero interchange fee on card payments softens the competition for deposits, while the monopoly price for withdrawals enables the banks to extract the maximum surplus from consumers, when they withdraw cash from a "foreign" ATM.

If banks are differentiated, I show that the interests of the issuers are not perfectly aligned.

To attract "home" consumers, the bank that has the lowest rate of "home" withdrawals tends to prefer a higher interchange fee on card payments, while the other bank prefers a higher interchange fee on withdrawals. The optimal levels of interchange fees balance the profits that each bank makes on deposits and the profits that both banks make on displaced withdrawals.

I also show that, from the point of view of a social planner, the interchange fee on card payments is too low if it is chosen by a profit maximising payment platform, while the interchange fee on cash withdrawals is too high.

These results provide new elements for the debate about optimal interchange fees for payment card systems. First, my paper shows that the competition on deposits must be taken into account, in order to determine the optimal level of interchange fees. Second, the payment card market should not be analyzed separately from the cash market, because there are substitution effects between cash and cards, especially if the payment platform organizes the interactions between the issuers, the acquirers and the ATM owners.

The rest of the article is organized as follows. In Section 2, I start by presenting the model and the assumptions. In Section 3, I solve for the equilibrium of the game and determine the levels of interchange fees that maximise banks' joint profits and that maximise social welfare. In Section 4, I give extensions of the results obtained in Section 3, by assuming different market structures. Finally, I conclude.

2 The model

I model a payment system that provides payment card services, and that manages an ATM network. The payment system organizes the interactions between the issuing side, the acquiring side and the ATM owners, by choosing the level of interchange fees for card payments and cash withdrawals. If a consumer pays by card, an interchange fee is paid by the acquirer of the transaction to the issuer of the card. If a consumer pays cash, an interchange fee is paid by the issuer of the card to the ATM owner.

On the issuing side, two banks are differentiated "à la Hotelling" and compete in prices on the market for deposits. The issuers may also be ATM owners. The acquisition side is assumed to be perfectly competitive. The consumers can use their cards to pay for their expenses, and to withdraw cash. They make transactions of variable sizes, and choose how to pay according to the fixed and variable net costs incurred per transaction.

Banks: Two issuing banks, denoted by 1 and 2, are located at the extremities of a linear city of length one. Each bank proposes a package of account services at a price P_i, where $i \in \{1; 2\}$.

This package comprises the provision of a payment card, which enables consumers to pay by card at the POS, and to withdraw cash from ATMs. Banks' ATMs are assumed to be compatible.[9] A bank charges its consumers the same price, w_i, for each withdrawal, whether they withdraw from a foreign ATM or not. I also assume that surcharges are not allowed.[10] The price of a card transaction is denoted by f_i. Each time a consumer uses its card for a payment, the issuer of the card bears the cost c_I of providing the payment card service. A withdrawal transaction costs c_W to the ATM owner. The acquisition side is assumed to be perfectly competitive, and the marginal cost of acquiring a card transaction is denoted by c_A.

Consumers Consumers are uniformely located along the linear city. They incur a transportation cost $t > 0$ when they travel to open an account either at bank 1 or at bank 2. If a consumer opens an account, he obtains a benefit $B > 0$. I assume that B is sufficiently large, such that the market is covered. I also assume that it is never in the interest of a consumer to open an account in both banks.

Once they have opened an account, consumers own a payment card, which enables them to pay at the POS, or to withdraw cash from ATMs. A consumer who has opened an account at bank i makes a percentage $\varphi_i \in [0,1]$ of withdrawals in bank i's ATMs, and a percentage $1 - \varphi_i$ of withdrawals in bank j's ATMs, for all $(i;j) \in \{1;2\}^2$ and $i \neq j$. I assume that φ_i is exogenous, and that $\varphi_i + \varphi_j \leq 1$. If $\varphi_i = 0$, bank i has no ATMs, whereas if $\varphi_i > 0$, bank i owns some ATMs.[11]

Following Whitesell (1989), I assume that consumers make transactions of variable sizes. The amount of a transaction is denoted by T, and it is distributed according to the probability density $F(T)$ over $\left[0, \overline{\lambda}\right]$, where $\overline{\lambda} > 0$ denotes the maximum value of a transaction. I also assume that F is concave and twice differentiable over $\left[0, \overline{\lambda}\right]$.

The total spending of a consumer is denoted by S, where from the assumptions on F,

$$S = \int_0^{\overline{\lambda}} F(T) dT.$$

[9] This is now commonplace in this industry.

[10] In the literature on ATMs, a surcharge is the price that is charged by a bank to "foreign" consumers, when they withdraw cash from one of its ATMs. In the literature on payment cards, merchants are said to surcharge if they are allowed to choose a higher price if the consumer pays by card. In this paper, I assume that there are no surcharges (either on card payments or on withdrawals).

[11] The focus of this paper is to study the effects of the ex post asymmetries of banks' ATM capacities. Hence, I assume φ_i to be exogenous, which means that banks have already invested in ATMs. But it could also be interesting to study banks' investment choices ex ante. If the percentage of displaced withdrawals depends only on the relative number of ATMs possessed by each bank $\varphi_1 + \varphi_2 = 1$. In my model, the ATM withdrawal service may also be provided by a firm that is different from the two issuing banks. Therefore, I allow for the possibility to have $\varphi_1 + \varphi_2 < 1$. The APACS report "The way we pay" (2008) shows that, for instance in the United-Kingdom, asymmetries between banks are common place as regards the percentage of "on-us" transactions.

A consumer obtains a surplus V from his purchases, which is assumed to be sufficiently large, such that the consumers always bear the transaction costs needed to spend S.

Consumers may pay by card or use cash, provided they withdraw some cash from the ATM network. Following Whitesell (1989), Baumol (1952), and Tobin (1956), I assume that a consumer can store cash in order to pay for the following transactions, but that there is an opportunity cost $r > 0$, associated to the detention of cash.[12] Therefore, the consumer may decide to withdraw the total amount of cash he needs in several times. I denote the number of withdrawals of a consumer who has an account at bank i by n_i. For each withdrawal, the consumer pays the price w_i to his bank. He bears also an exogenous fixed cost $b > 0$, which can be interpreted as the time needed to find an ATM.

Consumers incur fixed and variable transaction costs, which differ if they use cash or if they pay by card. The variable costs depend only on the size of the transaction, as in Whitesell (1989).[13] I assume that, if a consumer pays by card, he has to pay the fixed fee f_i to its bank, and that he obtains a variable net benefit $v_i > 0$, which depends on the size of the transaction.[14] The net benefit v_i can be interpreted as the insurance services or the rewards, which depend on the size of the transaction, net of the transaction costs. If a consumer pays cash, he has to bear a fixed cost $k > 0$. For instance, the fixed cost k can reflect the costs for the consumer of looking in his wallet to find the amount of money he needs.

Given this cost structure, a consumer who has an account at bank i decides to pay by card if the value of the transaction exceeds some threshold λ_i, where λ_i belongs to $\left[0, \overline{\lambda}\right]$, as in Whitesell (1989).

The consumers of each bank i decide on the optimal values of the threshold λ_i and on the number of withdrawals n_i so as to minimise their transaction costs, which are denoted by C_i, for all $i \in \{1; 2\}$.[15]

Payment system: The payment system organizes the interactions between the issuers, the acquirers and the ATM owners by choosing the level of the interchange fee on card payments,

[12] In this model, I assume that r is not a strategic variable that can be decided by the bank which manages the deposit account.

[13] Variable costs could also depend on other characteristics of the transaction, such as the spending place or the type of good which is purchased. Bounie and François (2006) investigated empirically the determinants of the use of payment instruments at POS. They found strong evidence of the effect of the transaction size on the choice of the payment instrument. The other variables that influences significantly the choice of the payment instrument are: the type of good and the spending place, the restrictions on the supply-side and the organization of the payment process. Boeschoten (1998) also demonstrates the importance of the transaction size.

[14] The variable net benefit paying by card v_i depens on the bank where the consumer holds an account. We allow for some differentiation between the banks for the "card payment" service, but for simplicity, this differentiation is assumed to be exogenous.

[15] The consumer's surplus, V, and the other costs are neglected in this analysis, since V is assumed to be sufficiently high such that consumers always proceed to all transactions.

a^P, and the interchange fee on cash withdrawals, a^W. The interchange fee on card payments is paid to the issuer of the card by the acquirer of the transaction each time the consumer pays by card. The interchange fee on cash withdrawals is paid by the issuer of the card to the ATM owner, and is assumed to be higher or equal to the marginal cost c_W.[16] The interchange fees are assumed to be positive and to be paid on a "per-transaction" basis.[17] As in Rochet and Tirole (2002), I assume that there exists a maximum level of interchange fee on card payments, $\overline{a}$, such that symmetric merchants accept cards for all $a^P \leq \overline{a}$.[18]

I also make the following assumptions:

(A1) $c_I > k$.

(A2) For all $i \in \{1, 2\}$, $c_I \leq k + \overline{\lambda}(v_i + \sqrt{r(c_W + b)/2S(\overline{\lambda})})$.

(A3) The distribution of the transaction prices, F, does not depend on the level of interchange fees.

The first assumption means that, even if the issuer sets the card transaction fee at its marginal cost, it is less costly to use cash in some cases, because the fixed cost of cash is lower than the fixed cost of cards.[19]

The second assumption is verified if the variable card benefit, v_i, is high enough. It ensures that consumers do not use only cash to pay for their expenses if a withdrawal transaction is priced at the marginal cost of the ATM owner, c_W, and if a card payment is priced at the marginal cost of the issuer, c_I.[20]

The third assumption means that the level of interchange fees does not impact the retail prices. Therefore, interchange fees impact the consumers' choices only through the prices of the payment instruments. Empirical studies have shown that the links between the level of interchange fees and retail prices are difficult to measure. In Australia, for instance, a fall in the level of interchange fees has not triggered a reduction of retail prices.[21] I will discuss this assumption in Section 4, and explain why this assumption would not modify the qualitative results obtained when the payment platform maximises banks' joint profits.

[16] Otherwise, it would not be profitable for banks to invest in ATM deployment.

[17] We will discuss in Section 4 the impact of the structure of the interchange fee, by allowing the payment platform to choose a two-part tariff for the interchange fee on card payments.

[18] In Rochet and Tirole (2002), the existence of an $\overline{a}$ such that all merchants accept cards for all $a^P \leq \overline{a}$ is endogenous to the model. Here, it is exogenous.

[19] The validity of this assumption is confirmed by the empirical evidence that consumers perceive cash as an inexpensive way to pay (see Jonker (2005)), whereas issuing banks have to incur positive transaction costs.

[20] I will show in the proof of Proposition 1 that the right side of the inequality represents the average cost of cash, if the consumer pays all his expenses cash and if the withdrawals are priced at the marginal cost of the ATM owner.

[21] See Chang, Evans, and Swartz (2005).

Timing: The timing of the game is as follows:

1. The payment platform chooses the interchange fee for card payments, a^P, and the interchange fee for cash withdrawals, a^W.

2. The issuing banks choose the fees P_i, f_i, and w_i.

3. Consumers choose the bank from which to hold an account and a payment card.

4. Consumers make their purchases. They choose the number of cash withdrawals, and the threshold which separates card and cash payments.

   I look for the subgame perfect equilibrium, and solve the game by backward induction.

3 The equilibrium:

3.1 Stage 4: payments and withdrawals

In this section, I study the consumers' payment decisions. At the last stage of the game, the consumer already holds a card, which is issued by bank i, for $i \in \{1, 2\}$. He has to choose how to pay for a total amount of expenses, S, in order to minimize its costs, as in Whitesell (1989). The consumer's costs consist of the fixed costs paid for each card or cash payment transaction, the variable benefit of paying by card, the opportunity cost of cash detention, and the costs of cash withdrawals.

A consumer pays cash if the transaction amount T belongs to $[0, \lambda_i]$, and pays by card if T belongs to $\left[\lambda_i, \overline{\lambda}\right]$. From the assumptions on F, the volume of transactions that is paid by card, $S(\lambda_i)$, is given by

$$S(\lambda_i) = \int_0^{\lambda_i} F(T)dT,$$

whereas the volume of transactions that is paid cash is given by

$$S - S(\lambda_i) = \int_{\lambda_i}^{\overline{\lambda}} F(T)dT.$$

I now precise the total fixed costs born by a consumer for his payment transactions. There are $F(T)/T$ transactions of size T. Since a consumer pays cash if T belongs to $[0, \lambda_i]$ and by card otherwise, the fixed costs of cash payments are

$$k \int_0^{\lambda_i} \frac{F(T)}{T} dT,$$

while the fixed costs of card payments are

$$f_i \int_{\lambda_i}^{\overline{\lambda}} \frac{F(T)}{T} dT.$$

The total cost is reduced by the variable benefits of paying by card, $-v_i(S - S(\lambda_i))$.

Finally, the consumer has to bear the costs of withdrawing and holding cash. In average, if $n_i > 0$, the consumer holds a quantity $S(\lambda_i)/(2n_i)$ of cash in his pocket, so the opportunity cost of cash detention is $rS(\lambda_i)/(2n_i)$, as in Baumol (1952). Each time the consumer goes to an ATM, he bears a fixed exogenous cost b, and he pays the price w_i to his bank, so the total cost of cash withdrawals is $n_i^*(w_i + b)$. To sum up, if $n_i > 0$, the costs of withdrawing and holding cash are

$$\frac{r}{2n_i} S(\lambda_i) + n_i(w_i + b).$$

If $n_i > 0$ and λ_i belongs to $\left[0, \overline{\lambda}\right]$, I can express the total transaction costs of a consumer that holds an account at bank i as a function of λ_i and n_i, that is

$$C_i(\lambda_i, n_i) = \frac{r}{2n_i} S(\lambda_i) + n_i(w_i + b) + k \int_0^{\lambda_i} \frac{F(T)}{T} dT + f_i \int_{\lambda_i}^{\overline{\lambda}} \frac{F(T)}{T} dT - v_i(S - S(\lambda_i)).$$

The consumer determines the optimal number of cash withdrawals, n_i^*, and the optimal value of the transaction, λ_i^*, which minimize its total transaction costs, that is, $C_i(\lambda_i, n_i)$. The following proposition summarises the results, which are similar to Whitesell (1989).

Proposition 1 *If $f_i > k$ and if f_i is not too high compared to the average cost of using only cash, there exists a unique transaction value λ_i^* above which the consumer of bank i pays his expenses by card.*
If $f_i \leq k$, the consumer pays all his expenses by card. If the card fee is sufficiently high compared to the average cost of using only cash, the consumer does not pay by card.

Proof. See Appendix A-1. ■

Consumers trade off between cash and the payment card at the POS. Proposition 1 shows that, if the card fee is higher than the fixed cost of paying cash, a consumer pays by card if the amount of the transaction is high, and pays cash otherwise. This is because the variable benefit of paying by card, v_i, depends on the amount of the transaction. Also, the cost of holding cash $(rS(\lambda_i)/2n_i)$ increases with the value of the expenses that are paid cash.

From Appendix A-1, if $f_i \geq k$, the optimal number of withdrawals, n_i^*, is given by

$$n_i^* = \sqrt{\frac{rS(\lambda_i^*)}{2(w_i + b)}}.$$

The optimal number of withdrawals is expressed as in Baumol (1952)'s model, except that the volume of transactions that is paid cash, $S(\lambda_i^*)$, depends on the trade-off that consumers make between cash and the payment card, as in Whitesell (1989).

Lemma 1 *Both the optimal threshold, λ_i^*, and the number of withdrawals, n_i^*, increase with the card fee and decrease with the withdrawal fee.*

Proof. See Appendix A-2. ■

When the card fee decreases, a consumer chooses more often to pay by card, and withdraws cash less frequently.

Lemma 2 *Both the optimal threshold, λ_i^*, and the number of withdrawals, n_i^*, decrease with the variable benefit of paying by card, v_i.*

Proof. See Appendix A-3. ■

When the variable benefit of paying by card becomes higher, the transaction amount above which consumers pay by card is reduced, while the number of cash withdrawals decreases.

Now that I have determined the optimal usage of payment instruments, I can express the total cost that is born by a consumer as a function of λ_i^*. If the consumer uses both payment instruments, that is, if λ_i^* belongs to $(0, \overline{\lambda})$, we have at the optimum,

$$C_i^*(n_i^*, \lambda_i^*) = C_i^*(\lambda_i^*) = \sqrt{2r(b + w_i)S(\lambda_i^*)} + k \int_0^{\lambda_i^*} \frac{F(T)}{T} dT + f_i \int_{\lambda_i^*}^{\overline{\lambda}} \frac{F(T)}{T} dT - v_i(S - S(\lambda_i^*)).$$

If the consumer pays all his transactions by card, we have that $\lambda_i^* = 0$, and $n_i^* = 0$. The consumer's costs are

$$C_i^*(0, 0) = C_i^*(0) = f_i \int_0^{\overline{\lambda}} \frac{F(T)}{T} dT - v_i S.$$

Finally, if the consumer pays cash all his expenses, we have that $\lambda_i^* = \overline{\lambda}$, and $n_i^* = \sqrt{rS/2(w_i + b)}$, and the consumer's costs are

$$C_i^*(n_i^*, \overline{\lambda}) = C_i^*(\overline{\lambda}) = \sqrt{2r(b + w_i)S(\overline{\lambda})} + k \int_0^{\overline{\lambda}} \frac{F(T)}{T} dT.$$

Lemma 3 *The consumer's payment costs, C_i^*, increase with the withdrawal fee and the card fee, but decrease with the variable benefit that a consumer obtains from paying by card.*

Proof. See Appendix A-4. ■

Now that I have expressed the transaction costs that are born by the cardholders, I study their decision to open an account.

3.2 Stage 3: Choice of the bank

At stage 3, prior to making transactions, consumers have to decide on opening an account either at bank 1 or at bank 2. When they make their affiliation decision, consumers take also into account the expected transaction costs at stage 4, the fixed deposit fee P_i, and the transportation cost, which depends on their location. A consumer located at point $x \in [0; 1]$, that opens an account at bank i located at d_i, bears a cost $S + t\,|x - d_i| + P_i + C_i^*(\lambda_i^*)$, and obtains a surplus $V + B$. The marginal consumer is given by

$$V - S + B - tx - P_1 - C_1^*(\lambda_1^*) = V - S + B - t(1 - x) - P_2 - C_2^*(\lambda_2^*),$$

that is,

$$x = \frac{1}{2} + \frac{1}{2t}(P_2 - P_1 + C_2^*(\lambda_2^*) - C_1^*(\lambda_1^*)). \tag{1}$$

The market share of bank 1 is equal to $\gamma_1 = x$ and the market share of 2 is given by $\gamma_2 = 1 - \gamma_1$, provided no firm corners the market. Banks compete on the market for deposits on the total level of utility that they offer to their consumers. The bank that offers the highest level of utility has the highest market share.

3.3 Stage 2: Bank fees

In this section, I start by determining how banks price the transactions and the deposits. Then, I analyse how the prices affect the consumers' payment decisions at stage 4.

At stage 2, each bank $i \in \{1; 2\}$ chooses the fees P_i, f_i and w_i that maximise its profit,

$$\pi_i = \gamma_i M_{HC}^i + (1 - \gamma_i) M_{FC}^i, \tag{2}$$

where M_{HC}^i denotes the profit made on a consumer that holds an account at bank i ("home" consumer), that is

$$M_{HC}^{i}=P_{i}+(f_{i}+a^{P}-c_{I})\int_{\lambda_i^*}^{\overline{\lambda}}\frac{F(T)}{T}dT+n_{i}^{*}(w_{i}-\varphi_{i}c_{W}-(1-\varphi_{i})a^{W}), \tag{3}$$

while M_{FC}^{i} denotes the profit made on a consumer that holds an account at bank j ("foreign" consumer), that is

$$M_{FC}^{i}=n_{j}^{*}(1-\varphi_{j})(a^{W}-c_{W}). \tag{4}$$

A "home" consumer pays to bank i the deposit fee P_i and the transaction fees f_i and w_i for each card payment and each withdrawal, respectively. A "foreign" consumer does not pay any transaction fee to bank i, since I assumed that surcharges are not allowed. But bank i makes profit each time a "foreign" consumer proceeds to a displaced withdrawal, through the interchange fee that is paid by bank j, if $a^W > c_W$.

Proposition 2 gives the equilibrium deposit fee P_i^*, and the equilibrium transaction fees f_i^* and w_i^* that are chosen by each bank i at stage 2. I also denote by $\left(M_{HC}^{i}\right)^*$ and $\left(M_{FC}^{i}\right)^*$ the profit that bank i makes at the equilibrium of stage 2 on "home" and "foreign" consumers, respectively.

Proposition 2 *In equilibrium, banks price the transactions at the average perceived marginal cost, that is* $f_i^* = c_I - a^P$ *and* $w_i^* = \varphi_i c_W + (1-\varphi_i)a^W$, *for all* $i \in \{1;2\}$.
The deposit fee is $P_i^* = t + \left[2\left(M_{FC}^{i}\right)^* + \left(M_{FC}^{j}\right)^* + C_j^*(\lambda_j^*) - C_i^*(\lambda_i^*)\right]/3$.

Proof. See Appendix B. ■

Each issuing bank that also owns ATMs trades off between the revenues obtained from "home" consumers, and the revenues obtained from "foreign" consumers (See Equation (2)). Banks set both a deposit fee P_i and variable fees f_i and w_i to attract "home" consumers. Therefore, it is as if the issuers competed in two-part tariffs on the market for deposits. However, the competition on deposits is softened by the possibility to make profit on "foreign" consumers through the displaced withdrawals, as in Massoud and Bernhardt (2002).

Competition in two-part tariffs generates pricing at the average perceived marginal cost for the variable part.[22] Consumers internalize the expected transaction costs born at stage 4 when they choose to open an account either at bank 1 or at bank 2 at stage 3. Hence, a bank can encourage efficient usage of payment instruments at stage 4 by pricing the transactions at the

[22] The withdrawals are priced at the "average" perceived marginal cost because a bank cannot price discriminate between "home" and "foreign" withdrawals that are made by its consumers.

average perceived marginal cost, while extracting surplus from consumers through the deposit fee.

Finally, the profit that each bank makes on "home" consumers depends only on the deposit fee, that is

$$\left(M_{HC}^{i}\right)^{*}=P_{i}^{*},$$

for all $i \in \{1;2\}$. Bank i extracts a part of the surplus that a consumer obtains from opening an account at bank i rather than at bank j through the deposit fee. At the same time, the possibility to make profit on "foreign" consumers lowers the gain of attracting a new consumer. Hence, a consumer has to pay the opportunity cost for bank i of loosing a "foreign" consumer (term $\left(M_{FC}^{i}\right)^{*}$ in the deposit fee).

Remark that banks perceive the same marginal cost, $c_I - a^P$, for payment card transactions, whereas they do not perceive the same marginal cost in average for withdrawals, if $a^W > c_W$ and $\varphi_1 \neq \varphi_2$.[23] If $a^W > c_W$, the marginal cost of a displaced withdrawal for the issuer is higher than for a "home" withdrawal. This is because the issuing bank has to pay the interchange fee a^W to the ATM owner, while a "home" withdrawal costs c_W. If consumers make different percentages of displaced withdrawals, banks do not perceive the same average marginal cost for withdrawal transactions. The exogenous rates of displaced withdrawals act as a source of differenciation for banks which may generate an imbalance in the market shares.

Corollaries 1 and 2 explain how the consumers make their payment decisions, given the transaction fees that are chosen at the equilibrium of stage 2.

Corollary 1 *If $a^P < c_I - k$ and $a^W \geq c_W$, consumers may use both cash and cards to pay for their expenses, while if $a^P \geq c_I - k$ consumers use only their cards.*

Proof. If $a^W \geq c_W$, from Assumption (A2), the interchange fee on card payments is never small enough such that consumers use only cash at the equilibrium.

If $a^P < c_I - k$, since $f_i^* = c_I - a^P$, in some cases, the card fee may be higher than the fixed cost of paying cash. Hence, from Proposition 1, consumers may use both cash and cards at the equilibrium.

If $a^P \geq c_I - k$, then $f_i^* \leq k$. Hence, from Proposition 1, consumers pay only by card. ■

If the interchange fee on card payments is high enough, consumers pay only by card.[24] In this case, there are no displaced withdrawals. If $v_1 = v_2$ banks are perfectly symmetric: each

[23] Notice that if a^P is higher than c_I, a consumer obtains rewards when he uses his payment card at the POS.

[24] Notice that consumers may use only cards in this model, because I do not consider that merchants can impose a threshold for the value of the transaction below which card usage is refused. Such an assumption would challenge this result.

bank i obtains half of the market of deposits, and $\pi_i = t/2$, for $i \in \{1; 2\}$. If $v_1 \neq v_2$, each bank i makes profit $\pi_i = 2t(\gamma_i^*)^2$.

Otherwise, if $a^P < c_I - k$, consumers may use both cash and cards, and from Proposition 2, bank i's equilibrium profit is

$$\pi_i = 2t(\gamma_i^*)^2 + \left(M_{FC}^i\right)^*, \tag{5}$$

where

$$\gamma_i^* = \frac{1}{2} + \frac{1}{6t}\left\{\left(M_{FC}^j\right)^* - \left(M_{FC}^i\right)^* + C_j^*(\lambda_j^*) - C_i^*(\lambda_i^*)\right\}, \tag{6}$$

for $(i, j) \in \{1; 2\}^2$ and $j \neq i$. Notice that, if $\varphi_1 = \varphi_2$ and $v_1 = v_2$, banks offer exactly the same services with the payment card, hence they share half the market for deposits and $\gamma_1^* = \gamma_2^* = 1/2$.

Corollary 2 *Assume that consumers use both cash and cards to pay for their expenses and that* $a^W > c_W$ *. If* $\varphi_i > \varphi_j$ *and* $v_1 = v_2$*, or if* $v_j > v_i$ *and* $\varphi_1 = \varphi_2$ *, the consumers of bank* j *pay more often by card and make fewer withdrawals than the consumers of bank* i*, for* $(i, j) \in \{1; 2\}^2$ *and* $j \neq i$*.*

Proof. From Proposition 2, if $a^W > c_W$, and if $\varphi_i > \varphi_j$, we have that $w_j > w_i$. Hence, from Lemma 1, we have that $n_j^* < n_i^*$ and $\lambda_j^* < \lambda_i^*$. From Lemma 2, since λ_i^* and n_i^* are decreasing with v_i, then $n_i^* > n_j^*$ and $\lambda_j^* > \lambda_i^*$ if $v_j > v_i$ and $\varphi_1 = \varphi_2$. ■

If the level of interchange fee on withdrawals is higher than the marginal cost, and if $v_1 = v_2$, the bank that has the lowest rate of "home" withdrawals has the highest volume of card payments, and the lowest volume of withdrawals.

If the consumers of bank 1 obtain a higher variable benefit of paying by card than the consumers of bank 2, they pay more often by card and make fewer withdrawals, if they are not differentiated on the ATM side ($\varphi_1 = \varphi_2$).

3.4 Stage one: interchange fees

In this section, I start by conducting some comparative statics with respect to the interchange fees. First, I study how the level of interchange fees impact the consumers' payment decisions at stage 4. Second, I analyse how the interchange fees impact the competition for deposits.

Then, I determine the optimal interchange fees for card payments and cash withdrawals that maximise banks' joint profits, and I compare them with the levels of interchange fees that maximise social welfare.

In all this section, I assume that the distribution F is chosen such that the second order conditions of profit maximisation are verified.[25] I also define $\widehat{a}^P$ the level of interchange fee on card payment above which consumers of both banks pay for all their expenses by card.

3.4.1 Impact of interchange fees on consumers' payment decisions

I start by analyzing the effect of the interchange fees on consumers' trade-off between using cash or the payment card at stage 4. The levels of interchange fees impact the consumers' payment decisions and the consumers' transaction costs through the transaction fees that are chosen by the banks at stage 2.

Lemma 4 *If the interchange fee on withdrawals increases, consumers choose more often to pay by card, and make fewer withdrawals. If the interchange fee on card payments increases, the threshold above which consumers pay by card decreases, and consumers make fewer withdrawals.*

Proof. See Appendix C-1. ■

The effect of an increase in a^P is to reduce the perceived marginal cost of each bank for card payments. Since banks price the transactions at the perceived marginal cost, the card fee is lowered and consumers choose more often to pay by card, hence, make fewer withdrawals. An increase in a^W raises the average perceived marginal cost of each bank, if consumers make displaced withdrawals. The withdrawal fee is higher and consumers reduce the volume of cash payments.

Lemma 5 *Consumers' transaction costs increase with the interchange fee on withdrawals and decrease with the interchange fee on card payments.*

Proof. See Appendix C-2. ■

3.4.2 Impact of interchange fees on the competition for deposits

The level of interchange fees also impacts the trade-off that each bank makes at stage 2 between the profits made on "home" consumers and the profits made on "foreign" consumers.

First, interchange fees impact the profit that each bank makes on "home" consumers, through the deposit fee. From Proposition 2, we know that the deposit fee that is chosen by bank i, P_i^*, depends on the average surplus that a consumer obtains from being affiliated at bank i rather than at bank j when he proceeds to transactions (which depends on $C_j^* - C_i^*$), and on the opportunity cost for bank i of loosing a "foreign" consumer.

[25] This is the case, for instance, with the distribution $F(T) = 2ST$ over the interval $[0; 1]$. See Appendix I.

Lemma 6 *The benefits that a consumer obtains at stage 4 from opening an account at bank i increase with* a^P *if* $\lambda_j^* \geq \lambda_i^*$*, whereas they decrease with* a^W *if* $(1-\varphi_i)n_i^* > (1-\varphi_j)n_j^*$.

Proof. See Appendix C-3. ■

For instance, if bank i has the highest rate of displaced withdrawals, its consumers use more the payment card that the consumers of bank j (See Corollary 2), all other things being equal. Lemma 6 shows that the effect of an increase in a^P is to raise the surplus that consumers obtain from opening an account at bank i, because it lowers their transactions costs. An increase in a^W raises the surplus that consumers obtain from opening an account at bank i, only if the consumers of bank i make fewer displaced withdrawals than the consumers of bank j.

This explains how the level of interchange fees impacts the competition for "home" consumers. If we neglect the competition for "foreign" consumers, the bank that has the highest rate of displaced withdrawals benefits from an increase in a^P, while it benefits from an increase in a^W only if its consumers make relatively fewer displaced withdrawals.

Second, the level of interchange fees also impact the competition for "foreign" consumers.

Lemma 7 *The profit per "foreign" consumer,* $\left(M_{FC}^i\right)^*$*, decreases with* a^P*, but it may either increase or decrease with* a^W*.*

Proof. See Appendix C-4. ■

The intuition of Lemma 7 is the following one. If a^P increases, we know from Lemma 4 that the volume of card payments rises, while the number of displaced withdrawals falls. This reduces the profit that each bank obtains per "foreign" consumer. A direct consequence of Lemma 7 is that a higher a^P toughens the competition on deposits, because "foreign" consumers become less attractive.

An increase in a^W raises the margin that a bank makes on "foreign" consumers, but reduces the volume of displaced withdrawals. Therefore, the impact of an increase in a^W on the profit obtained per "foreign" consumer is ambiguous. It may either soften or toughen the competition for deposits.

The impact of interchange fees on banks' market shares depends on the result of the trade-off that we analysed previously between the profits made on "home" and "foreign" consumers (See Appendix C-5 for the expressions of $\partial\gamma_1^*/\partial a^P$ and $\partial\gamma_1^*/\partial a^W$).

Table 2: Impact of the interchange fees on the competition for deposits

Effect of...	On the profit made on "FC"	On the benefit of opening an account at bank i .
An increase in a^P	"-"	"+" if $\lambda_j^* \geq \lambda_i^*$.
An increase in a^W	Ambiguous	"+" if $(1-\varphi_i)n_i^* < (1-\varphi_j)n_j^*$.

3.4.3 The optimal interchange fee on card payments if the issuers do not control the ATM network

I start by studying the benchmark case in which the payment card network does not control the ATM network. I assume that the issuers do not own ATMs, and that a^W is exogenously fixed by another payment association, which provides the ATM services, and that banks have signed compatibility agreements that enable their consumers to withdraw cash from ATMs.[26]

The payment platform chooses the interchange fee on card payment that maximises banks' joint profits,

$$\pi = \pi_1 + \pi_2 = \begin{cases} 2t(\gamma_1^*)^2 + 2t(1-\gamma_1^*)^2 & \text{if} \quad a^P \in \left[0, \widehat{a}^P\right) \\ t & \text{if} \quad a^P \geq \widehat{a}^P. \end{cases}$$

Proposition 3 *If banks do not control the ATM network and if $v_1 \neq v_2$, the payment platform chooses the maximum interchange fee compatible with merchants' acceptance of payment cards, that is,* $\max(\overline{a}, \widehat{a}^P)$. *If $v_1 = v_2$, the interchange fee on card payments has no impact on banks' profits.*

Proof. See Appendix D. ■

If banks do not control the ATMs, all consumers withdraw cash from "foreign" ATMs. The cost of the interchange fee on withdrawals is completely passed through to consumers through the withdrawal fee. The ATM side of the market is not a source of profit for the issuers. Hence, banks obtain more profit by encouraging consumers to pay by card, since they do not provide the same services for card payments if $v_1 \neq v_2$.[27] Otherwise, if banks do not offer differentiated services, the level of interchange fee has no impact on banks' profits.

3.4.4 The profit maximising interchange fees if the issuers control the ATM network

Now, I assume that the payment platform also controls the ATM network. The payment platform chooses the level of interchange fees to maximise banks' joint profits, $\pi = \pi_1 + \pi_2$, where

$$\pi = \begin{cases} \underbrace{2t(\gamma_1^*)^2 + 2t(1-\gamma_1^*)^2}_{A} + \underbrace{\left(M_{FC}^1\right)^* + \left(M_{FC}^2\right)^*}_{B} & \text{if} \quad a^P \in \left[0, \widehat{a}^P\right) \\ t & \text{if} \quad a^P \geq \widehat{a}^P \end{cases}. \tag{7}$$

[26] Note that, under these assumptions, we do not allow for platform competition between the platform that provides the ATM services and the platform that provides the "payment" services. This would be an interesting extension of this model.

[27] This analysis is standard in an "Hotelling" framework.

If $a^P \geq \widehat{a}^P$, $\pi = t$. Consumers use only their cards, and banks' joint profit does not depend on the level of interchange fees. If $a^P < \widehat{a}^P$, consumers may use both cash and payment cards. In this case, the first term of π, A, depends on the impact of interchange fees on banks' market shares. The second term, which we denote by $B = M_{FC}$, corresponds to the sum of banks' profits per "foreign" consumer.

Solving for the first order conditions for the maximum of joint profits yields[28]

$$\frac{\partial \pi}{\partial a^P} = 4t(2\gamma_1^* - 1)\frac{\partial \gamma_1^*}{\partial a^P} + \frac{\partial M_{FC}}{\partial a^P} = 0, \tag{8}$$

and

$$\frac{\partial \pi}{\partial a^W} = 4t(2\gamma_1^* - 1)\frac{\partial \gamma_1^*}{\partial a^W} + \frac{\partial M_{FC}}{\partial a^W} = 0. \tag{9}$$

The choice of the interchange fees depends in particular on banks' differentiation. Therefore, I consider two cases. In the first case, banks offer the same payment and withdrawal services. In this case, they share half the market of deposits. In the second case, bank are differentiated either because $\varphi_1 \neq \varphi_2$, or $v_1 \neq v_2$.

Case 1: banks offer the same payment and withdrawal services I start by studying the case of a perfect symmetry between banks, that is if $\varphi_1 = \varphi_2$ and $v_1 = v_2$. The consumers of each bank make exactly the same payment decisions, and banks share half the market of deposits. Proposition 4 gives the level of interchange fees that maximise banks' joint profits in the symmetric case.

Proposition 4 *If $\varphi_1 = \varphi_2$ and $v_1 = v_2$, the interchange fee on withdrawals that maximises banks' joint profit is the monopoly price, that is*

$$\frac{a^W - c_W}{a^W} = -\frac{1}{\nu},$$

where ν denotes the elasticity of the number of withdrawals to the withdrawal interchange fee, a^W. The interchange fee on card payments that maximises banks' joint profits is equal to zero.

Proof. See Appendix E. ■

The possibility to make profit on displaced withdrawals encourages the issuers to lower the interchange fee on card payments, which is optimally equal to zero. The intuition of Proposition 4 is as follows. Since banks share half the market for deposits, banks' joint profit on "home" consumers is constant (term A in (7)), while banks' profit on "foreign" consumers (term B in

[28] In Appendix C-2, I prove that the optimum is interior.

(7)) depends on the level of interchange fees. From Lemma 7, we know that banks' profits on "foreign" consumers decrease with a^P. Hence, by setting $a^P = 0$ and a^W equal to the monopoly price, the payment platform softens as much as possible the competition for "home" consumers, while extracting the maximum surplus from the displaced transactions that are made by the consumers.

The result obtained in Proposition 4 is in sharp constrat with the literature on interchange fees for card payments, in which it is never in the interest of the issuers to choose an interchange fee on card payments that is equal to zero. Since the issuers trade off between the profits made on displaced withdrawals and the profits made on card payments, this provides them with an incentive to lower the interchange fee.

Case 2: banks offer differentiated payment services Now, I assume that banks have asymmetric rates of displaced withdrawals, that is, $\varphi_1 \neq \varphi_2$, or that the variable benefits of paying by card are different, that is $v_1 \neq v_2$.

Proposition 5 *If $\varphi_1 \neq \varphi_2$ or $v_1 \neq v_2$, the level of interchange fees that maximise banks' joint profits verify*

$$\frac{\mu_{FC}(a^W)}{\Gamma(a^W)} = \frac{\mu_{FC}(a^P)}{\Gamma(a^P)},$$

where $\Gamma(a^j)$ denotes the elasticity of the market share of bank 1 to the interchange fee a^j and $\mu_{FC}(a^j)$ the elasticity of M_{FC} to a^j.

Proof. See Appendix F. ■

Proposition 5 shows that if banks are differentiated, the interchange fee on card payments is no longer set to zero. This is because the interests of the issuers are not perfectly aligned. As explained in Section 3.4.2, other things being equal, the bank that has the highest rate of displaced withdrawals benefits relatively more from an increase in the interchange fee on card payments than its competitor. It may also benefit relatively more from an increase in a^W if its consumers make relatively fewer displaced withdrawals. When the payment platform maximises banks' joint profit, it tries to trade-off between the profit that each bank makes on "home" consumers and the profit that both banks make on displaced withdrawals.

To illustrate this, consider the case in which bank 2 owns all the ATM network, that is if $\varphi_1 = 0$ and $\varphi_2 = 1$, and $v_1 = v_2 = v$. Bank 1 makes no profit on displaced withdrawals, and its consumers withdraw cash from the ATM network of bank 2. Hence, its interest is to benefit from a high interchange fee on card payments and a low interchange fee on withdrawals, in order to increase its share of deposits. On the contrary, bank 2 prefers to set a higher interchange fee on withdrawals to increase its share of deposits, and to make more profit on displaced withdrawals, provided that the demand for withdrawals from the consumers of bank 1 does not fall too much.

I have considered that banks' differentiation depends only on the services that are offered to consumers. But, in practice, there might also be asymmetries linked to the acquisition activity. For instance, an issuer could be the acquirer of all the transactions, which would affect the results and the equilibrium. Or, the issuers could compete on the acquisition side of the market. I will discuss this issue in Section 4.

3.4.5 The welfare maximising interchange fees

I now determine the level of interchange fees that maximise social welfare, the sum of bank's profits and consumers' utility,

$$W = \pi + V + B - S - \gamma_1(P_1^* + C_1^*) - (1-\gamma_1)(P_2^* + C_2^*).$$

The results are summarized in Proposition 5.

Proposition 6 *For sufficiently high values of* t*, the interchange fee on withdrawals that maximises social welfare is equal to the marginal cost* c_W*. The welfare maximising interchange fee for card payments is equal to* $\max(\overline{a}, \widehat{a}^P)$*.*

Proof. See Appendix G. ■

Proposition 6 shows that, from the point of view of a social planner, the interchange fee on card payments that is chosen by a profit maximising payment platform is too low, while the interchange fee on cash withdrawals is too high.

A welfare maximising payment platform chooses levels of interchange fees such that the volume of card payments is maximal, given merchants' acceptance of payment cards. If merchants accept cards for sufficiently high levels of a^P, that is, if $\overline{a} \geq \widehat{a}^P$, all transactions are paid by card at the welfare maximising interchange fees. Otherwise, consumers use a mix of cash and card payments, and the volume of card payments is the maximum that is compatible with merchants' acceptance of payment cards.

If $a^W > c_W$, banks make profits on displaced withdrawals, while consumers' surplus may be reduced by two effects when a^W increases. The first effect is that they pay a higher transaction fee for withdrawals, which increases their transaction costs, as shown in Lemma 5. The second effect is that they pay a higher deposit fee, because a higher a^W may soften the competition for deposits. Proposition 6 shows that the reduction of the consumers' surplus is too high to be offset by an increase in banks' joint profit. Hence, a welfare maximising payment platform chooses an interchange fee on withdrawals that is equal to the marginal cost c_W. A higher a^P benefits the consumers, since its toughens the competition for deposits, and reduces the costs of card payments. This effect dominates the reduction in the profits that banks make on displaced withdrawals. As a consequence, a welfare maximising social planner chooses the maximum interchange fee on card payments compatible with merchants' acceptance.

4 Extensions and discussions

4.1 A monopolistic acquirer

So far, I have assumed that the acquirers were perfectly competitive, and that the issuers were not active on the acquisition market. In this section, I assume that bank 1 acquires all the transactions paid by card. In this case, bank 1 is active on the three sides of the market, the consumer side, the ATM side, and the merchant side. The acquisition activity is another source of differentiation in banks' competition for deposits.

I assume that there is a maximum merchant fee $\overline{m}(a^P)$ such that all merchants accept cards. The decisions of the consumers at stage 3 and 4 remain unchanged. I study how banks choose the deposit fee and the transaction fees at stage 2.

At stage 2, the profit of bank 2 remains unchanged. On the contrary, bank 1's profit per "home" consumer changes, because bank 1 need not pay an interchange fee when its consumers pay by card, while it obtains the merchant fee m_1, net of the acquisition cost c_A, that is

$$M^1_{HC} = P_1 + (f_1 + m_1 - c_A - c_I)\int_{\lambda_1^*}^{\overline{\lambda}} \frac{F(T)}{T} dT + n_1^*(w_1 - \varphi_1 c_W - (1-\varphi_1)a^W).$$

Bank 1's profit per "foreign" consumer is also modified, because bank 1 has to pay the interchange fee a^P to bank 2 each time the consumers of bank 2 pay by card, while it obtains the merchant fee m_1. For bank 1, the margin per "foreign" consumer is

$$M^1_{FC} = n_2^*(1-\varphi_2)(a^W - c_W) + (m_1 - c_A - a^P)\int_{\lambda_2^*}^{\overline{\lambda}} \frac{F(T)}{T} dT.$$

Bank 1 chooses the prices m_1, f_1 and w_1 that maximise its profit. Since bank 1 is a monopolist, it chooses the maximum merchant fee compatible with merchant acceptance, that is $m_1 = \overline{m}(a^P)$. The same reasoning as in Section 3.3 shows that it is optimal for bank 1 to price the transactions at the average perceived marginal cost, that is

$$f_1 = c_I + c_A - \overline{m}(a^P),$$

and

$$w_1 = \varphi_1 c_W + (1 - \varphi_1) a^W.$$

As in the previous case, the deposit fee is given by $P_1 = 2t\gamma_1^* + M_{FC}^1$.

In Appendix H, I show that the optimal interchange fees still verify equation (29). But the effects of interchange fees on the profit per "foreign" consumer are different for bank 1. I denote by M_A^1 the margin that bank 1 makes through the payment card transactions made by the consumers of bank 2, where

$$M_A^1 = (\overline{m}(a^P) - c_A - a^P) \int_{\lambda_2^*}^{\overline{\lambda}} \frac{F(T)}{T} dT.$$

The effect of the interchange fees on bank 1's margin per "foreign" consumer are given by

$$\frac{\partial M_{FC}^1}{\partial a^P} = (1 - \varphi_2)(a^W - c_W) \frac{\partial n_2^*}{\partial a^P} + \frac{\partial M_A^1}{\partial a^P},$$

and

$$\frac{\partial M_{FC}^1}{\partial a^W} = (1 - \varphi_2)(a^W - c_W) \frac{\partial n_2^*}{\partial a^W} + (1 - \varphi_2) n_2^* + \frac{\partial M_A^1}{\partial a^W}.$$

If the interchange fee on card payments increases, the volume of transactions that are paid by card by the consumers of bank 2 increases. The profit that bank 1 obtains through its acquisition activity may either increase or decrease. Bank 1 obtains a higher merchant fee but has to pay a higher interchange fee to bank 2. Because of the effect of a^P on M_A^1, the profit that bank 1 makes on "foreign" consumers does not necessarily decrease, as in section 3.

When the issuers are not active on the acquisition market, they tend to lower the interchange fee on card payments to make more profit on displaced withdrawals. If one of them is a monopolistic acquirer, this effect is offset by the fact that there are also displaced payment card transactions, which are a source a profit on the acquisition side.

If the interchange fee on cash withdrawals increases, the margin that bank 1 obtains on card payments made by "foreign" consumers rises, because this increases the volume of transactions that are paid by card. Because of this effect, it is not necessarily optimal for a social planner to set $a^W = c_W$ as in Proposition 3 (See Appendix H).

4.2 The effect of interchange fees on retail prices

In the setting, I have assumed that the interchange fees did not impact the level of the retail prices. However, if the payment platform modifies the levels of interchange fees, the distribution of the transaction prices, F, may be modified. For instance, if the interchange fee on card payments increases, this may result in a higher merchant fee, which raises the merchants' marginal costs. This cost increase may be passed to consumers through higher retail prices. The existence of a link between the level of interchange fee on cash withdrawals and the level of retail prices is less clear.

I explain how this consideration could affect the results obtained in Propositions 4, 5 and 6.[29] The results obtained in Proposition 4 and 5 remain unchanged. If banks are symmetric, the distortion of the distribution F is comprised in the elasticity ν of the number of withdrawals to the interchange fees, whereas if banks are asymmetric, it is taken into account in the ratio $\mu_{FC}(a^W)/\Gamma(a^W) = \mu_{FC}(a^P)/\Gamma(a^P)$. The formula may lead to different levels of profit maximising interchange fees, but the effects are the same. As regards welfare maximising interchange fees, if we consider that a higher interchange fee on card payments raises retail prices, it may also increase consumers' total costs. Hence, in this case, a higher a^P may also harm consumers, which means that the welfare maximising interchange fee may be lower than $\max(\overline{a}, \widehat{a}^P)$.

5 Conclusion

This article shows that optimal interchange fees for card payments and cash withdrawals are interrelated if a payment card system also manages an ATM network. Banks' asymmetries on the ATM side and on the acquisition side tend to soften the competition on deposits because banks can make profit on the transactions made by foreign consumers. To maximise banks' joint profits, a payment platform chooses interchange fees as a trade-off between the revenues on foreign consumers and the revenues on deposits. From a social welfare point of view, interchange fees on card payments may be too low, if the competition on deposits and the ATM side are not taken into account.

This model suggests that empirical studies on the price of card transactions should also consider the substitution effects between cash and payment cards, through the price of the ATM transactions. Also, it could be interesting to build a model that takes into account more

[29] Remark that the results obtained from stage 4 to stage 2 remain unchanged. However, Lemma 4 is not verified anymore. The impact of interchange fees on consumers' costs must take into account the distortion of the transaction prices. Since I do not use Lemma 4 to obtain the profit maximising interchange fees, Proposition 4 and 5 are still verified.

precisely the merchants' side, for instance by assuming that both banks are acquirers, and that merchants are heterogeneous as regards their card acceptance benefit.

My paper is a first step to understand better the pricing strategies of a payment card platform that provides also withdrawal services. Further research is necessary to understand the economic effects of surcharges and platform competition on this type of payment card system.

References

[1] APACS, The way we pay 2008, "UK Cash & Cash Machines".

[2] BAXTER W. (1983): "Bank Interchange of Transactional Paper: Legal and Economic Perspectives", Journal of Law & Economics, vol. 26, no. 3, October, pp. 541-588.

[3] BAUMOL W. (1952): "The Transactions Demand for Cash: An Inventory Theoretic Approach", The Quaterly Journal of Economics, vol. 66, no. 4, November, pp. 545-556.

[4] BOUNIE D. & FRANCOIS A. (2006): "Cash, Check or Bank Card? The effect of transaction characteristics on the use of payment instruments", mimeo.

[5] BORZEKOWSKI R., KISER E., AHMED S. (2006): "Consumers' Use of Debit Cards: Patterns, Preferences, and Price Response", Finance and Economics Discussion Series, Federal Reserve Board, Washington, D.C.

[6] BERNHARDT D. & MASSOUD N. (2002): ""Rip-off" ATM surcharges", The RAND Journal of Economics, vol. 33, Spring, no. 1, pp. 96-115.

[7] CHAKRAVORTI S. & ROSON R. (2006): "Platform Competition in Two-Sided Markets: The Case of Payment Networks", Review of Network Economics, vol. 5(1), March, pp. 118-143.

[8] CHANG H., EVANS D. S., & SWARTZ D. GARCIA (2005): "The Effect of the Regulatory Intervention in Two-Sided Markets: An Assessment of Interchange-Fee Capping in Australia", Review of Network Economics, vol. 4, no. 4, December, pp. 328-358.

[9] DONZE J. & DUBEC I. (2006) "The Role of Interchange Fees in ATM networks", International Journal of Industrial Organization, vol. 24, January, pp. 29-43.

[10] GUTHRIE G. & WRIGHT J. (2007): "Competing Payment Schemes", Journal of Industrial Economics, vol. 55, pp. 37-67.

[11] JONKER, N. (2005): "Payment Instruments as Perceived by consumers - a Public Survey", DNB Working Paper 53.

[12] LAFFONT J-J., REY P., TIROLE J. (1998): "Network competition: Overview and nondiscriminatory pricing", RAND Journal of Economics, vol. 29, Spring 1998, pp. 1-37.

[13] McANDREWS J. (2003) "Automated Teller Machine Network Pricing - A Review of the Literature", Review of Network Economics, vol. 2, Issue 2, June, pp. 146-158.

[14] MATUTES C. & PADILLA A.J (1994): "Shared ATM networks and Banking Competition", European Economic Review, vol. 38, pp. 1113-1138.

[15] RAA ten, T. & SHESTALOVA, V. (2004): "Empirical evidence on payment media costs and switch points," Journal of Banking & Finance, Elsevier, vol. 28, Issue 1, January, pp. 203-213.

[16] ROCHET J-C. (2003): "The Theory of Interchange Fees: A synthesis of recent contributions", Review of Network Economics, vol. 2, no. 2, June, pp. 97-124.

[17] ROCHET J-C. & TIROLE J. (2002): "Cooperation Among Competitors: The Economics of Payment Card Associations", The RAND Journal of Economics, vol. 33, no. 4, winter, pp. 549-570.

[18] ROCHET J-C & TIROLE (2003): "Platform Competition in Two-Sided Markets", Journal of the European Economic Association, vol. 1, no. 4, pp. 990-1029.

[19] ROCHET J-C. & TIROLE J. (2006a): "Externalities and Regulation in Card Payment Systems", Review of Network Economics, vol. 5, no. 1, March, pp. 1-14.

[20] ROCHET J-C. & TIROLE J. (2006b): "Two-sided markets: a progress report", RAND Journal of Economics, vol. 37, no. 3, March, pp. 645-667.

[21] SCHUH S. & STAVINS J. (2007): "Why Are (Some) Consumers (Finally) Writing Fewer Checks? The Role of Payment Characteristics.", Federal Reserve Bank of Boston, Working Paper.

[22] TOBIN J. (1956): "The Interest-Elasticity of Transactions Demand For Cash", The Review of Economics and Statistics, vol. 38, no. 3 (August), pp. 241-247.

[23] VERDIER M. (2007): "Interchange fees and incentives to invest in quality of a payment card system", Working Paper ESS-06-14.

[24] WHITESELL (1989): "The Demand for Currency versus Debitable Account: Note", Journal of Money, Credit and Banking, vol. 21, no. 2 (May), pp. 246-251.

[25] WRIGHT J. (2002): "Optimal Payment Card Systems," European Economic Review, vol. 47, no. 4, August, pp. 587-612.

[26] WRIGHT J. (2004): "Determinants of Optimal Interchange Fees in Payment Systems", Journal of Industrial Economics, vol. 52, no. 1, March, pp. 1-26.

6 Appendix

Appendix A: Proof of Proposition 1 and some comparative statics

Appendix A-1: Proof of Proposition 1 The consumer chooses the threshold λ_i and the number of withdrawals n_i that minimize its costs. I start by determining the equations verified by an interior optimum, if $\lambda_i > 0$ and $n_i > 0$. Then I derive the conditions that are necessary and sufficient for this optimum to exist. Solving for the first order conditions of profit maximisation[30], I obtain

$$\frac{\partial C_i(\lambda_i, n_i)}{\partial n_i} = w_i + b - \frac{rS(\lambda_i)}{2(n_i)^2} = 0, \tag{10}$$

and

$$\frac{\partial C_i(\lambda_i, n_i)}{\partial \lambda_i} = \frac{r}{2n_i}\frac{\partial S(\lambda_i)}{\partial \lambda_i} + (k - f_i)\frac{F(\lambda_i)}{\lambda_i} + v_i\frac{\partial S(\lambda_i)}{\partial \lambda_i} = 0. \tag{11}$$

From (10), I obtain the optimal number of withdrawals,

$$n_i^* = \sqrt{\frac{rS(\lambda_i^*)}{2(w_i + b)}}. \tag{12}$$

Since $\partial S(\lambda_i)/\partial \lambda_i = F(\lambda_i)$, and replacing for n_i^* in (11), if there is an interior solution, λ_i^*, then it must satisfy

$$F(\lambda_i^*)\left[\sqrt{\frac{r(w_i + b)}{2S(\lambda_i^*)}} + \frac{k - f_i}{\lambda_i^*} + v_i\right] = 0. \tag{13}$$

I now show that, under some conditions, there exists a unique λ_i^* that verifies equation (13). For this purpose, let

$$g(\lambda) = \lambda\sqrt{\frac{r(w_i + b)}{2S(\lambda)}} + k - f_i + \lambda v_i.$$

[30] The Hessian matrix is semi definite negative as in Whitesell (1989).

My aim is to derive the conditions under which there exists a unique λ_i^* such that $g(\lambda_i^*) = 0$. The function g is differentiable over $\left(0;\overline{\lambda}\right]$, and its first derivative is

$$g^{'}(\lambda) = v_i + \sqrt{\frac{r(w_i+b)}{2S(\lambda)}}\left(1 - \frac{\lambda F(\lambda)}{2S(\lambda)}\right).$$

I now study the function $h(\lambda) = 2S(\lambda) - \lambda F(\lambda)$ over $\left[0,\overline{\lambda}\right]$. Since $S^{'}(\lambda) = F(\lambda)$, then $h^{'}(\lambda) = F(\lambda) - \lambda F^{'}(\lambda)$, and $h^{"}(\lambda) = -\lambda F^{"}(\lambda)$. Since F is concave by assumption, h is convex. So $h^{'}$ is increasing over $\left[0,\overline{\lambda}\right]$. Since $h^{'}(0) = F(0) \geq 0$, $h^{'}$ is positive over $\left[0,\overline{\lambda}\right]$. Hence, h is increasing over $\left[0;\overline{\lambda}\right]$. Since $h(0) = 0$, h is positive over $\left[0,\overline{\lambda}\right]$. Hence, $g^{'}$ is strictly positive over $\left(0,\overline{\lambda}\right]$ and consequently, g is increasing over $\left(0,\overline{\lambda}\right]$. Since F is continuous over $\left[0,\overline{\lambda}\right]$, F is bounded, and it is possible to prove that[31]

$$\lim_{\lambda \longrightarrow 0}(\lambda/\sqrt{S(\lambda)}) = 0.$$

Hence g can be prolongated to $g(0) = k - f_i$. If $k - f_i < 0$, and $g(\overline{\lambda}) > 0$, using the bijection theorem, there exists a unique $\lambda_i^* \in \left(0,\overline{\lambda}\right]$ such that $g(\lambda_i^*) = 0$. If $k - f_i \geq 0$, or $g(\overline{\lambda}) < 0$, the equation $g(\lambda) = 0$ does not admit any solution over $\left[0,\overline{\lambda}\right]$. The condition $g(\overline{\lambda}) > 0$ is equivalent to $f_i < k + v_i\overline{\lambda} + \overline{\lambda}\sqrt{r(w_i+b)/2S(\overline{\lambda})}$. It can be interpreted as follows. The card fee must be lower than the average cost of cash if the consumer decides to pay everything cash. The average cost of cash comprises the fixed cost of a transaction k, the opportunity cost of renouncing to the variable benefit v, and the opportunity cost of cash detention. The condition $k - f_i < 0$ means that the fixed cost of paying cash must be lower than the card fee.

If the fixed cost of paying cash is higher than the card fee, that is if $k - f_i > 0$, the consumer's total cost increases with λ_i. Hence, the optimal threshold λ_i^* is equal to zero, and the consumer pays by card all his expenses. If the card fee is higher than the average cost of paying everything cash, the consumer does not use his card for payments. The optimal threshold is $\overline{\lambda}$, and the number of withdrawals is $n_i^* = \sqrt{\dfrac{rS}{2(w_i+b)}}$.

Appendix A-2: Proof of Lemma 1. I now show that λ_i^* and n_i^* increase with f_i and decrease with w_i.

I start by showing that λ_i^* and n_i^* increase with f_i. Taking the derivative of (13) with respect to f_i, I obtain

$$-1 + v_i\frac{\partial\lambda_i^*}{\partial f_i} + \frac{\partial\lambda_i^*}{\partial f_i}\sqrt{\frac{r(w_i+b)}{2S(\lambda_i^*)}}\left(1 - \frac{F(\lambda_i^*)\lambda_i^*}{2S(\lambda_i^*)}\right) = 0,$$

[31] Hint: if F is bounded by m and M, then $m\sqrt{\lambda} \leq \sqrt{S(\lambda)} \leq M\sqrt{\lambda}$.

that is, after some rearrangements,

$$\frac{\partial \lambda_i^*}{\partial f_i}\left(v_i+\sqrt{\frac{r(w_i+b)}{2S(\lambda_i^*)}}\frac{h(\lambda_i^*)}{2S(\lambda_i^*)}\right)=1, \tag{14}$$

where $h(\lambda)=2S(\lambda)-\lambda F(\lambda)$. I have already shown that h is positive over $\left[0,\overline{\lambda}\right]$. Therefore, all the terms in the parenthesis of (14) are positive, and I can conclude that $\partial\lambda_i^*/\partial f_i \geq 0$. Taking the derivative of (12) with respect to f_i, I find that

$$\frac{\partial n_i^*}{\partial f_i}=\frac{F(\lambda_i^*)n_i^*}{2S(\lambda_i^*)}\frac{\partial \lambda_i^*}{\partial f_i}.$$

Since $\partial\lambda_i^*/\partial f_i \geq 0$, the number of withdrawals increases with f_i.

Then I show that λ_i^* and n_i^* decrease with w_i. Taking the derivative of (13) with respect to w_i, I obtain

$$\frac{\partial \lambda_i^*}{\partial w_i}\left(v_i+\sqrt{\frac{r(w_i+b)}{2S(\lambda_i^*)}}\left(1-\frac{F(\lambda_i^*)\lambda_i^*}{2S(\lambda_i^*)}\right)\right)=-\lambda_i^*\sqrt{\frac{r(w_i+b)}{2S(\lambda_i^*)}}\frac{1}{2(w_i+b)}.$$

The expression in the parenthesis is positive, as in (14). The right side of the equation is negative. So $\partial\lambda_i^*/\partial w_i \leq 0$. If the price of withdrawals rises, this reduces the threshold above which consumers pay by card.

Taking the derivative of (12) with respect to w_i, I obtain

$$\frac{\partial n_i^*}{\partial w_i}=\frac{F(\lambda_i^*)n_i^*}{2S(\lambda_i^*)}\frac{\partial \lambda_i^*}{\partial w_i}-\frac{n_i^*}{2(w_i+b)},$$

Since $\partial\lambda_i^*/\partial w_i \leq 0$, $\partial n_i^*/\partial w_i \leq 0$. If the price of withdrawals rises, the number of withdrawals decreases unambiguously.

Appendix A-3: Proof of Lemma 2. I now show that λ_i^* and n_i^* decrease with v_i. Taking the derivative of (13) with respect to v_i, I obtain

$$-\lambda_i^*+v_i\frac{\partial \lambda_i^*}{\partial v_i}+\frac{\partial \lambda_i^*}{\partial v_i}\sqrt{\frac{r(w_i+b)}{2S(\lambda_i^*)}}\left(1-\frac{F(\lambda_i^*)\lambda_i^*}{2S(\lambda_i^*)}\right)=0,$$

that is, after some rearrangements,

$$\frac{\partial \lambda_i^*}{\partial v_i}\left(v_i+\sqrt{\frac{r(w_i+b)}{2S(\lambda_i^*)}}\frac{h(\lambda_i^*)}{2S(\lambda_i^*)}\right)=-\lambda_i^*.$$

Using the same reasoning as in Appendix A-2, I obtain that $\partial\lambda_i^*/\partial v_i \leq 0$ and that $\partial n_i^*/\partial v_i \leq 0$.

Appendix A-4: Proof of Lemma 3. Using the envelop's theorem, I find that

$$\left.\frac{dC_i(\lambda_i, n_i, w_i)}{dw_i}\right|_{(\lambda_i^*, n_i^*)} = \left.\frac{\partial C_i(\lambda_i, n_i)}{\partial w_i}\right|_{(\lambda_i^*, n_i^*)},$$

and that

$$\frac{\partial C_i^*(\lambda_i^*)}{\partial w_i} = n_i^* \geq 0. \tag{15}$$

Using the same reasoning, I obtain that

$$\frac{\partial C_i^*(\lambda_i^*)}{\partial f_i} = \int_{\lambda_i^*}^{\overline{\lambda}} \frac{F(T)}{T} dT \leq 0. \tag{16}$$

Similarly, I have that

$$\frac{\partial C_i^*(\lambda_i^*)}{\partial v_i} = -(S - S(\lambda_i^*)) \leq 0.$$

Appendix B: Proof of proposition 2 I start by showing that no cornered market equilibrium exists. For instance, suppose that bank i corners the market. Then, necessarily $f_i = c_I - a^P$ and $w_i = \varphi_i c_W + (1-\varphi_i)a^W$, otherwise, bank j could undercut the prices proposed by bank i, and make a profit. Now, assume that bank i prices the account handling services at $P_i > 0$. Then $\pi_i = P_i$ and $\pi_j = 0$. But bank j could charge $f_j = c_I - a^P$, $w_j = \varphi_j c_W + (1-\varphi_j)a^W$, and $P_j = P_i - \varepsilon$, and make strictly positive profits. If ε is small enough, the profit of bank j is $P_j/2$, which is strictly positive. This shows that the situation in which bank i corners the market is not an equilibrium.

I now study the existence of an equilibrium in which the market shares are strictly positive. I determine the candidate equilibrium by solving the first order conditions of profit maximisation. Then, I will verify the second order conditions. The function π_i is twice differentiable over $\left]0; \overline{\lambda}\right[$. To simplify the computations, I write

$$\pi_i = \gamma_i A_i(P_i; f_i; w_i) + n_j^*(1-\varphi_j)(a^W - c_W),$$

where

$$A_i(P_i; f_i; w_i) = P_i + (f_i + a^P - c_I)\int_{\lambda_i^*}^{\overline{\lambda}} \frac{F(T)}{T} dT + n_i^*(w_i - \varphi_i c_W - (1-\varphi_i)a^W) - n_j^*(1-\varphi_j)(a^W - c_W).$$

The number of withdrawals made by the consumers of bank j, n_j^*, is independent of f_i, w_i and

P_i. Solving for the first order conditions of profit maximisation with respect to P_i, f_i and w_i yields

$$\frac{\partial \pi_i}{\partial P_i} = \frac{\partial \gamma_i}{\partial P_i} A_i(P_i; f_i; w_i) + \gamma_i \frac{\partial A_i(P_i; f_i; w_i)}{\partial P_i} = 0, \tag{17}$$

$$\frac{\partial \pi_i}{\partial f_i} = \frac{\partial \gamma_i}{\partial f_i} A_i(P_i; f_i; w_i) + \gamma_i \frac{\partial A_i(P_i; f_i; w_i)}{\partial f_i} = 0, \tag{18}$$

and

$$\frac{\partial \pi_i}{\partial w_i} = \frac{\partial \gamma_i}{\partial w_i} A(P_i; f_i; w_i) + \gamma_i \frac{\partial A(P_i; f_i; w_i)}{\partial w_i} = 0. \tag{19}$$

I start by equation (17). From (1), I find that $\partial \gamma_i / \partial P_i = -1/2t$. Since $\partial A(P_i; f_i; w_i)/\partial P_i = 1$, replacing in (17), I obtain

$$A(P_i; f_i; w_i) - 2t\gamma_i = 0. \tag{20}$$

Now consider equation (18). From (1), I find that $\partial \gamma_i / \partial f_i = -(1/2t)\partial C_i^*(\lambda_i^*)/\partial f_i$. Hence, using (16), I have that $\frac{\partial \gamma_i}{\partial f_i} = -\frac{1}{2t}\int_{\lambda_i^*}^{\overline{\lambda}} \frac{F(T)}{T} dT$. Since

$$\frac{\partial A(P_i; f_i; w_i)}{\partial f_i} = \int_{\lambda_i^*}^{\overline{\lambda}} \frac{F(T)}{T} dT - \frac{\partial \lambda_i^*}{\partial f_i} \frac{F(\lambda_i^*)}{\lambda_i^*}(f_i + a^P - c_I) + \frac{\partial n_i^*}{\partial f_i}(w_i - \varphi_i c_W - (1-\varphi_i)a^W),$$

replacing in (18), and using (20), after a simplification by $\gamma_i > 0$, equation (18) can be rewritten as

$$\frac{\partial A(P_i; f_i; w_i)}{\partial f_i} - \frac{\partial C_i^*(\lambda_i^*)}{\partial f_i} = 0,$$

hence,

$$\frac{\partial \lambda_i^*}{\partial f_i} \frac{F(\lambda_i^*)}{\lambda_i^*}(f_i + a^P - c_I) - \frac{\partial n_i^*}{\partial f_i}\left[w_i - \varphi_i c_W - (1-\varphi_i)a^W\right] = 0. \tag{21}$$

From (12), I obtain

$$\frac{\partial n_i^*}{\partial f_i} = \sqrt{\frac{rS(\lambda_i^*)}{2(w_i + b)}} \times \frac{S'(\lambda_i^*)}{2S(\lambda_i^*)} \frac{\partial \lambda_i^*}{\partial f_i}.$$

Replacing for this expression in (21), since $S'(\lambda_i^*) = F(\lambda_i^*)$, I get the equation that defines the card fee

$$\frac{\partial \lambda_i^*}{\partial f_i} F(\lambda_i^*) \left[f_i + a^P - c_I - \frac{n_i^* \lambda_i^*}{2S(\lambda_i^*)}(w_i - \varphi_i c_W - (1-\varphi_i)a^W) \right] = 0.$$

Therefore,

$$f_i + a^P - c_I - \frac{n_i^* \lambda_i^*}{2S(\lambda_i^*)}(w_i - \varphi_i c_W - (1-\varphi_i)a^W) = 0. \tag{22}$$

I now study equation (19). From (1), I obtain $\partial \gamma_i / \partial w_i = -(1/2t)\partial C_i^*(\lambda_i^*)/\partial w_i$. Using (15), I find that $\partial\gamma_i/\partial w_i = -n_i^*/(2t)$. Since

$$\frac{\partial A(P_i; f_i; w_i)}{\partial w_i} = -\frac{\partial \lambda_i^*}{\partial w_i}\frac{F(\lambda_i^*)}{\lambda_i^*}(f_i + a^P - c_I) + \frac{\partial n_i^*}{\partial w_i}(w_i - \varphi_i c_W - (1-\varphi_i)a^W) + n_i^*,$$

replacing in (19), and using (20), equation (19) can be rewritten as

$$\frac{\partial \lambda_i^*}{\partial w_i}\frac{F(\lambda_i^*)}{\lambda_i^*}(f_i + a^P - c_I) - \frac{\partial n_i^*}{\partial w_i}(w_i - \varphi_i c_W - (1-\varphi_i)a^W) = 0. \tag{23}$$

From (12), I have $\frac{\partial n_i^*}{\partial w_i} = \sqrt{\frac{rS(\lambda_i^*)}{2(w_i+b)}} \times \frac{S'(\lambda_i^*)}{2S(\lambda_i^*)}\frac{\partial \lambda_i^*}{\partial f_i} - \frac{n_i^*}{2(w_i+b)}$. Hence, $\frac{\partial n_i^*}{\partial w_i} = \frac{n_i^* F(\lambda_i^*)}{2S(\lambda_i^*)}\frac{\partial \lambda_i^*}{\partial f_i} - \frac{n_i^*}{2(w_i+b)}$. Replacing in (23), I obtain

$$\frac{\partial \lambda_i^*}{\partial w_i}F(\lambda_i^*)\left[f_i + a^P - c_I - \frac{n_i^*\lambda_i^*}{2S(\lambda_i^*)}(w_i - \varphi_i c_W - (1-\varphi_i)a^W\right] + \frac{n_i^*\lambda_i^*(w_i - \varphi_i c_W - (1-\varphi_i)a^W)}{2(w_i+b)} = 0. \tag{24}$$

I denote by $(P_i^*; f_i^*; w_i^*)$ the candidate equilibrium solution of (17), (18), and (19). Since $f_i + a^P - c_I = n_i^*\lambda_i^*(w_i - \varphi_i c_W - (1-\varphi_i)a^W)/2S(\lambda_i^*)$, by equation (22) and from equation (24), the withdrawal fee is

$$w_i^* = \varphi_i c_W + (1-\varphi_i)a^W.$$

Hence, the cardholding fee is

$$f_i^* = c_I - a^P.$$

From (20), the deposit fee then verifies

$$P_i^* = 2t\gamma_i^* + n_j^*(1-\varphi_j)(a^W - c_W).$$

From Proposition 1, I know that, if $f_i - k < 0$, the consumer pays by card all his transactions. Hence, if $a^P > c_I - k$, the consumer does not use cash. Assume that $a^W \geq c_W$. Then $w_i \geq c_W$. Because of assumption (A2), we have $c_I < k + \overline{\lambda}(v_i + \sqrt{r(w_i+b)/2S(\overline{\lambda})})$. Hence, $f_i + a^P < k + \overline{\lambda}(v_i + \sqrt{r(w_i+b)/2S(\overline{\lambda})})$. Since $a^P \geq 0$, then $f_i < k + \overline{\lambda}(v_i + \sqrt{r(w_i+b)/2S(\overline{\lambda})})$. From Proposition 1, I can conclude that it is never optimal for the consumers to use only cash if banks price the transactions at the perceived marginal cost.

I can now compute the market share of bank i. Since $P_j^* = 2t(1-\gamma_i^*) + n_i^*(1-\varphi_i)(a^W - c_W)$, and $2t\gamma_i^* = t + P_j - P_i + C_j^*(\lambda_j^*) - C_i^*(\lambda_i^*)$,

$$6t\gamma_i^* = 3t + (a^W - c_W)\left[n_i^*(1-\varphi_i) - n_j^*(1-\varphi_j)\right] + C_j^*(\lambda_j^*) - C_i^*(\lambda_i^*).$$

So

$$\gamma_i^* = \frac{1}{2} + \frac{1}{6t}\left\{(a^W - c_W)\left[n_i^*(1-\varphi_i) - n_j^*(1-\varphi_j)\right] + C_j^*(\lambda_j^*) - C_i^*(\lambda_i^*)\right\}$$

Since $A(P_i; f_i; w_i) = 2t\gamma_i$, at the equilibrium, bank i makes profit

$$\pi_i = 2t(\gamma_i^*)^2 + n_j^*(1-\varphi_j)(a^W - c_W).$$

I now check that the second order conditions are verified at $p^* = (P_i^*; f_i^*; w_i^*)$ by computing the coefficients of the Hessian matrix. I start by the first equation (17), which defines the deposit fee. I have

$$\frac{\partial^2 \pi_i}{\partial^2 P_i} = \frac{\partial^2 \gamma_i}{\partial^2 P_i}A + 2\frac{\partial \gamma_i}{\partial P_i}\frac{\partial A}{\partial P_i} + \gamma_i \frac{\partial^2 A}{\partial^2 P_i}.$$

Since $\partial\gamma_i/\partial P_i = -1/2t$, $\partial^2\gamma_i/\partial^2 P_i = 0$. Since $\partial A/\partial P_i = 1$, $\partial^2 A/\partial^2 P_i = 0$. Hence,

$$\left.\frac{\partial^2 \pi_i}{\partial^2 P_i}\right|_{p^*} = -\frac{1}{t}.$$

The derivative of the first equation with respect to f_i yields

$$\frac{\partial^2 \pi_i}{\partial P_i \partial f_i} = \frac{\partial^2 \gamma_i}{\partial P_i \partial f_i}A + 2\frac{\partial \gamma_i}{\partial P_i}\frac{\partial A}{\partial f_i} + \gamma_i \frac{\partial^2 A}{\partial P_i \partial f_i}.$$

As $\partial\gamma_i/\partial P_i = -1/2t$ and $\partial A/\partial P_i = 1$, then $\partial^2\gamma_i/\partial P_i\partial f_i = 0$ and $\partial^2 A/\partial P_i \partial f_i = 0$. At $p^* = (P_i^*; f_i^*; w_i^*)$, from (21), $\left.\frac{\partial A}{\partial f_i}\right|_{p^*} = \left.\frac{\partial C}{\partial f_i}\right|_{p^*}$. Hence,

$$\left.\frac{\partial^2 \pi_i}{\partial P_i \partial f_i}\right|_{p^*} = -\frac{1}{t}\left.\frac{\partial C}{\partial f_i}\right|_{p^*}.$$

From Lemma (2), I have that $\partial C_i/\partial f_i \geq 0$, hence,

$$\left.\frac{\partial^2 \pi_i}{\partial P_i \partial f_i}\right|_{p^*} \leq 0.$$

Similarly,

$$\left.\frac{\partial^2 \pi_i}{\partial P_i \partial w_i}\right|_{p^*} = -\frac{1}{t}\left.\frac{\partial C}{\partial w_i}\right|_{p^*} \leq 0.$$

I now study the second equation (18), which defines the card fee . I have

$$\frac{\partial^2 \pi_i}{\partial^2 f_i} = \frac{\partial^2 \gamma_i}{\partial^2 f_i}A + 2\frac{\partial \gamma_i}{\partial f_i}\frac{\partial A}{\partial f_i} + \gamma_i \frac{\partial^2 A}{\partial^2 f_i}.$$

Since $\frac{\partial \gamma_i}{\partial f_i} = \frac{-1}{2t}\frac{\partial C_i}{\partial f_i}$, $\frac{\partial^2 \gamma_i}{\partial^2 f_i} = -\frac{1}{2t}\frac{\partial^2 C_i}{\partial^2 f_i}$. From (16), I obtain that $\frac{\partial^2 \gamma_i}{\partial^2 f_i} = \frac{1}{2t}\frac{\partial \lambda_i^*}{\partial f_i}\frac{F(\lambda_i^*)}{\lambda_i^*}$. Since

$$\frac{\partial A(P_i; f_i; w_i)}{\partial f_i} = \int_{\lambda_i^*}^{\overline{\lambda}} \frac{F(T)}{T} dT - \frac{\partial \lambda_i^*}{\partial f_i}\frac{F(\lambda_i^*)}{\lambda_i^*}(f_i + a^P - c_I) + \frac{\partial n_i^*}{\partial f_i}(w_i - \varphi_i c_W - (1-\varphi_i)a^W),$$

I can compute the second derivative of A with respect to f_i at p^*. This yields

$$\left.\frac{\partial^2 A(P_i; f_i; w_i)}{\partial^2 f_i}\right|_{p^*} = -\left.\frac{\partial \lambda_i^*}{\partial f_i}\right|_{p^*} \frac{F(\lambda_i^*)}{\lambda_i^*}(1 + \left.\frac{\partial \lambda_i^*}{\partial f_i}\right|_{p^*}).$$

Hence,

$$\left.\frac{\partial^2 \pi_i}{\partial^2 f_i}\right|_{p^*} = \frac{-1}{t}\left(\left.\frac{\partial C_i}{\partial f_i}\right|_{p^*}\right)^2 - \gamma_i \frac{F(\lambda_i^*)}{\lambda_i^*}\left(\left.\frac{\partial \lambda_i^*}{\partial f_i}\right|_{p^*}\right)^2.$$

Consequently,

$$\left.\frac{\partial^2 \pi_i}{\partial^2 f_i}\right|_{p^*} \leq 0.$$

I now compute the cross derivative of π_i with respect to w_i and f_i. This yields

$$\frac{\partial^2 \pi_i}{\partial f_i \partial w_i} = \frac{\partial^2 \gamma_i}{\partial f_i \partial w_i}A + \frac{\partial \gamma_i}{\partial f_i}\frac{\partial A}{\partial w_i} + \frac{\partial \gamma_i}{\partial w_i}\frac{\partial A}{\partial f_i} + \gamma_i \frac{\partial^2 A}{\partial f_i \partial w_i}.$$

The cross derivative of A with respect to f_i and w_i is

$$\left.\frac{\partial^2 A(P_i; f_i; w_i)}{\partial f_i \partial w_i}\right|_{p^*} = \left.\frac{\partial n_i^*}{\partial f_i}\right|_{p^*}.$$

I also have $\frac{\partial^2 \gamma_i}{\partial f_i \partial w_i} = -\frac{1}{2t}\frac{\partial^2 C_i^*}{\partial w_i \partial f_i}$. Since $\frac{\partial C_i^*}{\partial w_i} = n_i^*$, then $\frac{\partial^2 \gamma_i}{\partial f_i \partial w_i} = -\frac{1}{2t}\frac{\partial n_i^*}{\partial f_i}$. Hence, from (20), after some simplifications,

$$\left.\frac{\partial^2 \pi_i}{\partial f_i \partial w_i}\right|_{p^*} = \frac{-1}{t}\left(\left.\frac{\partial C_i}{\partial f_i}\right|_{p^*}\right)\left(\left.\frac{\partial C_i}{\partial w_i}\right|_{p^*}\right).$$

Since the consumer's costs increase with the card fee and the withdrawal fee,

$$\left.\frac{\partial^2 \pi_i}{\partial f_i \partial w_i}\right|_{p^*} \leq 0.$$

Finally, I study the second derivative of π_i with respect to w_i. Using (19), I obtain,

$$\frac{\partial^2 \pi_i}{\partial^2 w_i} = \frac{\partial^2 \gamma_i}{\partial^2 w_i}A + 2\frac{\partial \gamma_i}{\partial w_i}\frac{\partial A}{\partial w_i} + \gamma_i \frac{\partial^2 A}{\partial^2 w_i}.$$

Since

$$\frac{\partial A(P_i;f_i;w_i)}{\partial w_i} = -\frac{\partial \lambda_i^*}{\partial w_i}\frac{F(\lambda_i^*)}{\lambda_i^*}(f_i + a^P - c_I) + \frac{\partial n_i^*}{\partial w_i}(w_i - \varphi_i c_W - (1-\varphi_i)a^W) + n_i^*),$$

I have

$$\left.\frac{\partial^2 A(P_i;f_i;w_i)}{\partial^2 w_i}\right|_{p^*} = 2\left.\frac{\partial n_i^*}{\partial w_i}\right|_{p^*}.$$

Since $\frac{\partial \gamma_i}{\partial w_i} = \frac{-1}{2t}\frac{\partial C_i}{\partial w_i}$, $\frac{\partial^2 \gamma_i}{\partial^2 w_i} = \frac{-1}{2t}\frac{\partial^2 C_i}{\partial^2 w_i}$. From (15), I obtain $\frac{\partial^2 \gamma_i}{\partial^2 w_i} = -\frac{1}{2t}\frac{\partial n_i^*}{\partial w_i}$. Hence,

$$\left.\frac{\partial^2 \pi_i}{\partial^2 w_i}\right|_{p^*} = \gamma_i \left.\frac{\partial n_i^*}{\partial w_i}\right|_{p^*} - \frac{1}{t}\left(\left.\frac{\partial C_i}{\partial w_i}\right|_{p^*}\right)^2.$$

Since $\partial n_i^*/\partial w_i \leq 0$, $\left.\frac{\partial^2 \pi_i}{\partial^2 w_i}\right|_{p^*} \leq 0$.

Denoting the Hessian matrix at $p^* = (P_i^*; f_i^*; w_i^*)$ by $H = \begin{pmatrix} a_1 & b & c \\ b & a_2 & d \\ c & b & a_3 \end{pmatrix}$, we have $a_1 \leq 0$, $a_2 \leq 0$. With our results, it is possible to prove that $a_1a_2 - b^2 \geq 0$, $a_1a_3 - c^2 \geq 0$, $a_3a_2 - d^2 \geq 0$ and that $\det H \leq 0$ (See hereafter). These conditions prove that the Hessian matrix is semi-definite negative at $p^* = (P_i^*; f_i^*; w_i^*)$. Hence, the second order conditions are verified, and the profit of the Issuer is maximal at p^*.

I write here the details of the proof that H is semi-definite negative. I have $a_1 = -1/t \leq 0$, and $a_2 = \partial^2\pi_i/\partial^2 f_i \leq 0$. Hence, the first two conditions are verified. I also have

$$a_1a_2 - b^2 = \frac{\gamma_i F(\lambda_i)}{\lambda_i t}\left(\frac{\partial \lambda_i}{\partial f_i}\right)^2 \geq 0,$$

$$a_1a_3 - c^2 = \frac{-\gamma_i}{t}\left(\frac{\partial n_i}{\partial w_i}\right) \geq 0,$$

and

$$a_3a_2 - d^2 = \underbrace{\frac{-\gamma_i}{t}\frac{\partial n_i}{\partial w_i}\left(\frac{\partial C_i}{\partial f_i}\right)^2}_{X} - \underbrace{\frac{\gamma_i F(\lambda_i)}{\lambda_i t}\left(\frac{\partial \lambda_i}{\partial f_i}\right)^2\left[\gamma_i\left(\frac{\partial n_i}{\partial w_i}\right) - \frac{1}{t}\left(\frac{\partial C_i}{\partial w_i}\right)^2\right]}_{Y}.$$

The terms in the parenthesis of Y are negative, hence Y is positive. Since $\partial n_i/\partial w_i \leq 0$, X is positive. Hence, $a_3a_2 - d^2 \geq 0$. Finally,

$$\det H = (\gamma_i)^2\frac{F(\lambda_i)}{\lambda_i t}\left(\frac{\partial \lambda_i}{\partial f_i}\right)^2\left(\frac{\partial n_i}{\partial w_i}\right).$$

Since $\partial n_i/\partial w_i \leq 0$, I have that $\det H \leq 0$.

Appendix C: Impact of interchange fees on consumers' payment decisions and on the competition for deposits

Appendix C-1: Proof of Lemma 4. From Lemma 2, I know that the threshold λ_i^* above which consumers pay by card, and the number of withdrawals, n_i^*, increase with the card fee and decrease with the withdrawal fee. Since $f_i^* = c_I - a^P$, and $w_i^* = \varphi_i c_W + (1-\varphi_i)a^W$, the threshold λ_i^* and the number of withdrawals n_i^* decrease with the interchange fee on card payments and increase with the interchange fee on withdrawals.

Appendix C-2: Proof of Lemma 5. Since $f_i = c_I - a^P$, and $w_i = \varphi_i c_W + (1-\varphi_i)a^W$, using the envelop's theorem, I find that

$$\frac{\partial C_i^*}{\partial a^P} = -\int_{\lambda_i(a^P,a^W)}^{\overline{\lambda}} \frac{F(T)}{T} dT,$$

and

$$\frac{\partial C_i^*}{\partial a^W} = (1-\varphi_i)n_i^*.$$

Hence, this proves that $\partial C_i^*/\partial a^P \leq 0$, and that $\partial C_i^*/\partial a^W \geq 0$.

Appendix C-3: Proof of Lemma 6. The transactions benefits that a consumer obtains at Stage 4 from opening an account at bank i depend on the difference in the transaction costs, that is $C_j^* - C_i^*$. From Lemma 4, we know that

$$\frac{\partial (C_j^* - C_i^*)}{\partial a^P} = \int_{\lambda_i(a^P,a^W)}^{\lambda_j(a^P,a^W)} \frac{F(T)}{T} dT,$$

and that

$$\frac{\partial (C_j^* - C_i^*)}{\partial a^W} = \left((1-\varphi_j)n_j^* - (1-\varphi_i)n_i^*\right).$$

Therefore, if $\lambda_i^* \leq \lambda_j^*$, we have that $\partial(C_j^* - C_i^*)/\partial a^P \geq 0$. And if $(1-\varphi_i)n_i^* > (1-\varphi_j)n_j^*$, we have that $\partial(C_j^* - C_i^*)/\partial a^W < 0$.

Appendix C-4: Proof of Lemma 7. Since $\left(M_{FC}^i\right)^* = n_j^*(1-\varphi_j)(a^W - c_W)$, then

$$\frac{\partial \left(M_{FC}^i\right)^*}{\partial a^P} = (1-\varphi_j)(a^W - c_W)\frac{dn_j^*}{da^P},$$

and

$$\frac{\partial \left(M_{FC}^{i}\right)^{*}}{\partial a^{W}} = (1-\varphi_j)(a^W - c_W)\frac{dn_j^*}{da^W} + (1-\varphi_j)n_j^*.$$

Since $\partial n_j^*/\partial a^P \leq 0$, then $\partial \left(M_{FC}^{i}\right)^{*}/\partial a^P \leq 0$. Hence, a higher interchange fee on card payments decreases the margin per foreign consumer.

Since $\partial n_j^*/\partial a^W \leq 0$, the first term of $\partial \left(M_{FC}^{i}\right)^{*}/\partial a^W$ is negative, while the second term is positive. A higher interchange fee on withdrawals decreases the number of displaced withdrawals, but increases the margin per displaced withdrawal. The impact of a rise in a^W on M_{FC}^{i} depends on how these two effects compensate each other.

Appendix C-5: Expressions of $\partial\gamma_i^*/\partial a^i$ and $\partial P_i^*/\partial a^i$. I write here the equations that summarise the impact of the interchange fees on the deposit fee and the market share of bank 1. Since $P_i^* = \left(M_{FC}^{i}\right)^{*} + \gamma_i^*$, I have that

$$\frac{\partial P_i^*}{\partial a^P} = \frac{\partial \left(M_{FC}^{i}\right)^{*}}{\partial a^P} + 2t\frac{\partial \gamma_i^*}{\partial a^P}, \tag{25}$$

and

$$\frac{\partial P_i^*}{\partial a^W} = \frac{\partial \left(M_{FC}^{i}\right)^{*}}{\partial a^W} + 2t\frac{d\gamma_i^*}{da^W}. \tag{26}$$

From equation 6 (6), the effect of interchange fees on the market shares can be written as

$$\frac{\partial \gamma_1^*}{\partial a^W} = \frac{1}{6t}\left(a^W - c_W\right)\left[(1-\varphi_1)\frac{dn_1^*}{da^W} - (1-\varphi_2)\frac{dn_2^*}{da^W}\right], \tag{27}$$

and

$$\frac{\partial \gamma_1^*}{\partial a^P} = \frac{1}{6t}\left[\left(a^W - c_W\right)\left((1-\varphi_1)\frac{\partial n_1^*}{\partial a^P} - (1-\varphi_2)\frac{\partial n_2^*}{\partial a^P}\right) + \int_{\lambda_1^*}^{\lambda_2^*}\frac{F(T)}{T}dT\right]. \tag{28}$$

Appendix D: Proof of Proposition 3. From Proposition 2, since $\varphi_1 = \varphi_2 = 0$, and $(M_1^{FC})^* = (M_2^{FC})^* = 0$, the consumers of bank i pay $P_i^* = t + \left[C_j^*(\lambda_j^*) - C_i^*(\lambda_i^*)\right]/3$ for the deposit fee, and the transaction fee for withdrawals is equal to the interchange fee, that is $w_i^* = a^W$. From equation (6), we obtain that for all $i \in \{1,2\}$, that is $\gamma_i^* = 1/2 + \left[C_j^*(\lambda_j^*) - C_i^*(\lambda_i^*)\right]/6t$.

The payment platform chooses the interchange fee on card payment that maximises banks' joint profits, which can be written as

$$\pi = \pi_1 + \pi_2 = \begin{cases} 2t(\gamma_1^*)^2 + 2t(1-\gamma_1^*)^2 & \text{if} \quad a^P \in \left[0, \widehat{a}^P\right) \\ t & \text{if} \quad a^P \geq \widehat{a}^P. \end{cases}$$

Solving for the first order condition yields

$$\frac{\partial \pi}{\partial a^P} = \frac{2}{3t}\left(C_2^* - C_1^*\right)\frac{\partial\left(C_2^* - C_1^*\right)}{\partial a^P}.$$

Since $\frac{\partial\left(C_2^* - C_1^*\right)}{\partial a^P} = \int\limits_{\lambda_1^*}^{\lambda_2^*}\frac{F(T)}{T}dT$, then $\frac{\partial \pi}{\partial a^P} = \frac{2}{3t}\left(C_2^* - C_1^*\right)\int\limits_{\lambda_1^*}^{\lambda_2^*}\frac{F(T)}{T}dT$.

If $v_1 > v_2$, we know from Lemma 3, that $C_2^* - C_1^* > 0$, and from Lemma 2 that $\lambda_2^* - \lambda_1^* > 0$. Hence, we have that $\partial\pi/\partial a^P > 0$. A similar reasoning can be done if $v_2 > v_1$. We conclude that the payment platform chooses the maximum interchange fee on card payments that is compatible with merchants' acceptance of payment cards.

Appendix E: Proof of Proposition 4.

Appendix E-1: the optimal interchange fee on withdrawals is strictly higher than the marginal cost c_W. I show that the interchange fee on cash withdrawals that maximises banks' joint profits is strictly higher than a^W. Replacing for $a^W = c_W$ in (9), since $\gamma_1^*|_{a^W=c_W} = 1/2$, I find that

$$\left.\frac{\partial \pi}{\partial a^W}\right|_{a^W=c_W} = (1-\varphi_1)n_2^* + (1-\varphi_2)n_1^*.$$

Hence, if $(\varphi_1, \varphi_2) \neq (1,1)$, we have $\left.\frac{\partial \pi}{\partial a^W}\right|_{a^W=c_W} > 0$. So, the choice of $a^W = c_W$ cannot be an optimum for the payment platform.

Replacing for $a^P = c_I - k$ in (8), since $\gamma_1^*|_{a^P=c_I-k} = 1/2$, I find that

$$\left.\frac{\partial \pi}{\partial a^P}\right|_{a^P=c_I-k} = \left(a^W - c_W\right)\left[(1-\varphi_1)\frac{\partial n_1^*}{\partial a^P} + (1-\varphi_2)\frac{\partial n_2^*}{\partial a^P}\right].$$

Since $\frac{\partial n_i^*}{\partial a^P} < 0$ for $i \in \{1;2\}$, we have $\left.\frac{\partial \pi}{\partial a^P}\right|_{a^P=c_I-k} \leq 0$. Hence, if $a^W > c_W$ and $(\varphi_1, \varphi_2) \neq (1,1)$, the choice of $a^P = c_I - k$ cannot be an optimum for the payment platform. This analysis enables me to conclude that the joint profit maximising interchange fees verify $a^W > c_W$, and $a^P < c_I - k$.

Appendix E-2: Proof of Proposition 4. I denote by n^* the number of withdrawals made by a consumer in this case, by φ the percentage of "home" withdrawals, and by v the variable benefit of paying by card. I assumed that the second order conditions are verified (See

Appendix I for an example). Since $\gamma_1^* = \gamma_2^* = 1/2$, equations (8) and (9) can be rewritten as

$$\frac{\partial \pi}{\partial a^P} = 2\frac{\partial n^*}{\partial a^P}(1-\varphi)(a^W - c_W),$$

and

$$\frac{\partial \pi}{\partial a^W} = 2(1-\varphi)\left[\frac{\partial n^*}{\partial a^W}(a^W - c_W) + n^*\right].$$

Since $dn^*/da^P \leq 0$, if $a^W > c_W$, then $d\pi/da^P \leq 0$. Hence, the optimal interchange fee on card payments is equal to zero. The interchange fee on cash withdrawals is equal to the monopoly price, that is,

$$\frac{a^W - c_W}{a^W} = -\frac{1}{\nu},$$

where ν denotes the elasticity of the number of withdrawals to the withdrawal interchange fee, a^W.

Appendix F: Proof of Proposition 5. I assumed that the second order conditions are verified (See Appendix I for an example). Combining equations (8) and (9), I obtain that

$$\frac{\partial M_{FC}/\partial a^W}{\partial \gamma_1^*/\partial a^W} = \frac{\partial M_{FC}/\partial a^P}{\partial \gamma_1^*/\partial a^P}.$$

I denote by $\mu_{FC}(a^j)$ the elasticity of M_{FC} to the level of interchange fee a^j, for $j \in \{W; P\}$ and by $\Gamma(a^j)$ the elasticity of the market share of bank 1 to the interchange fee. The simultaneous choice of a^P and a^W depends on $\mu_{FC}(a^W)$ and $\mu_{FC}(a^P)$. Optimal interchange fees are chosen such that:

$$\frac{\mu_{FC}(a^W)}{\Gamma(a^W)} = \frac{\mu_{FC}(a^P)}{\Gamma(a^P)}. \tag{29}$$

Appendix G: Proof of Proposition 6. I now determine the interchange fees that maximise social welfare, $W = \pi + B - \gamma_1^*(P_1^* + C_1^*) - (1-\gamma_1^*)(P_2^* + C_2^*)$.

I denote by $C_T = \gamma_1(P_1^* + C_1^*) + (1-\gamma_1)(P_2^* + C_2^*)$, the total costs born by the consumers.

Using equations (9) and (8), solving for the first order condition yields

$$\frac{\partial W}{\partial a^P} = 4t(2\gamma_1^* - 1)\frac{\partial \gamma_1^*}{\partial a^P} + \frac{\partial M_{FC}}{\partial a^P} - \frac{\partial C_T}{\partial a^P}, \tag{30}$$

and

$$\frac{\partial W}{\partial a^W} = 4t(2\gamma_1^* - 1)\frac{\partial \gamma_1^*}{\partial a^W} + \frac{\partial M_{FC}}{\partial a^W} - \frac{\partial C_T}{\partial a^W}. \tag{31}$$

I start by determining the impact of the a^W on social welfare. From equation (26) and Lemma

4, I have that

$$\frac{\partial(P_i^*+C_i^*)}{\partial a^W} = 2t\frac{\partial\gamma_i^*}{\partial a^W} + (1-\varphi_j)(a^W - c_W)\frac{\partial n_j^*}{\partial a^W} + (1-\varphi_j)n_j^* + (1-\varphi_i)n_i^*.$$

and

$$\begin{aligned}\frac{\partial C_T}{\partial a^W} &= \frac{\partial\gamma_1^*}{\partial a^W}\left(P_1^*+C_1^*-P_2^*-C_2^*\right) \quad (32)\\ &+\gamma_1^*\left(2t\frac{\partial\gamma_1^*}{\partial a^W}+(1-\varphi_2)(a^W-c_W)\frac{\partial n_2^*}{\partial a^W}+(1-\varphi_2)n_2^*+(1-\varphi_1)n_1^*\right) \quad (33)\\ &+(1-\gamma_1^*)\left(-2t\frac{\partial\gamma_1^*}{\partial a^W}+(1-\varphi_1)(a^W-c_W)\frac{\partial n_1^*}{\partial a^W}+(1-\varphi_2)n_2^*+(1-\varphi_1)n_1^*\right).\end{aligned}$$

From (1), we have that $P_1^* + C_1^* - P_2^* - C_2^* = -t(2\gamma_1^* - 1)$. Hence, replacing in equation (31) for $\partial M_{FC}/\partial a^W$ and equation (32), equation (31) can be rewritten as

$$\frac{\partial W}{\partial a^W} = 3t(2\gamma_1^*-1)\frac{\partial\gamma_1^*}{\partial a^W} + (1-\gamma_1^*)(1-\varphi_2)(a^W-c_W)\frac{\partial n_2^*}{\partial a^W} + \gamma_1^*(1-\varphi_1)(a^W-c_W)\frac{\partial n_1^*}{\partial a^W}.$$

From (6) and Lemma 4, we have that

$$\frac{\partial\gamma_1^*}{\partial a^W} = \frac{1}{6t}\left(a^W - c_W\right)\left[(1-\varphi_1)\frac{\partial n_1^*}{\partial a^W} - (1-\varphi_2)\frac{\partial n_2^*}{\partial a^W}\right].$$

Hence, the effect of the interchange fee on withdrawals on social welfare can be written as

$$\frac{\partial W}{\partial a^W} = \frac{1}{2}\left(a^W - c_W\right)\left[\left(4\gamma_1^*-1\right)\left(1-\varphi_1\right)\frac{\partial n_1^*}{\partial a^W} + \left(3-4\gamma_1^*\right)\left(1-\varphi_2\right)\frac{\partial n_2^*}{\partial a^W}\right].$$

We know that $dn_i^*/da^W \leq 0$ for all $i \in \{1;2\}$. If t is sufficiently high, simulations show that the term into brackets is negative, because $\gamma_1^* \in [1/4;3/4]$. Therefore, $\partial W/\partial a^W \leq 0$ for $a^W \geq c_W$ and $\partial W/\partial a^W \geq 0$ otherwise. The choice of $a^W = c_W$ maximises social welfare.

I now determine the impact of the interchange fee on card payments on social welfare. From equation (25) and Lemma 4, I have that

$$\frac{\partial(P_i^*+C_i^*)}{\partial a^P} = 2t\frac{\partial\gamma_i^*}{\partial a^P} + (1-\varphi_j)(a^W-c_W)\frac{\partial n_j^*}{\partial a^P} - \int_{\lambda_i^*}^{\overline{\lambda}}\frac{F(T)}{T}dT,$$

and

$$\frac{\partial C_T}{\partial a^P} = \frac{\partial \gamma_1^*}{\partial a^P}(P_1^* + C_1^* - P_2^* - C_2^*) + \gamma_1^* \left(2t\frac{\partial \gamma_1^*}{\partial a^P} + (1-\varphi_2)(a^W - c_W)\frac{\partial n_2^*}{\partial a^P} - \int_{\lambda_1^*}^{\overline{\lambda}} \frac{F(T)}{T} dT \right) \tag{34}$$
$$+(1-\gamma_1^*)\left(-2t\frac{\partial \gamma_1^*}{\partial a^P} + (1-\varphi_1)(a^W - c_W)\frac{\partial n_1^*}{\partial a^P} - \int_{\lambda_2^*}^{\overline{\lambda}} \frac{F(T)}{T} dT \right).$$

Since $\gamma_1^*|_{a^W=c_W} = 1/2$, and since $\left.\frac{\partial \gamma_1^*}{\partial a^P}\right|_{a^W=c_W} = 0$, I have that $\left.\frac{\partial C_T}{\partial a^P}\right|_{a^W=c_W} = -\frac{1}{2}\left(\int_{\lambda_1^*}^{\overline{\lambda}} \frac{F(T)}{T} dT + \int_{\lambda_2^*}^{\overline{\lambda}} \frac{F(T)}{T} dT \right).$ Therefore, I have that $\left.\frac{\partial C_T}{\partial a^P}\right|_{a^W=c_W} \leq 0$. From equation (8), I have that

$$\left.\frac{\partial \pi}{\partial a^P}\right|_{a^W=c_W} = \left.\frac{\partial M_{FC}}{\partial a^P}\right|_{a^W=c_W} = 0.$$

Hence, I have that

$$\left.\frac{\partial C_T}{\partial a^P}\right|_{a^W=c_W} = \left.\frac{\partial C_T}{\partial a^P}\right|_{a^W=c_W} \leq 0.$$

Consequently, it is socially optimal to choose $a^P = \max(\widehat{a}; \overline{a})$.

Appendix H. Section 4.1, a monopolistic aquirer. The payment system chooses the levels of interchange fees that maximise banks' joint profits, that is

$$\pi = 2t(\gamma_1^*)^2 + 2t(1-\gamma_1^*)^2 + M_{FC}^1 + M_{FC}^2,$$

where

$$M_{FC}^1 = n_2^*(1-\varphi_2)(a^W - c_W) + M_A^1,$$
$$M_A^1 = (\overline{m}(a^P) - c_A - a^P)\int_{\lambda_2^*}^{\overline{\lambda}} \frac{F(T)}{T} dT,$$

and

$$M_{FC}^2 = n_1^*(1-\varphi_1)(a^W - c_W).$$

The derivative of banks' joint profits with respect to a^P and a^W are exactly the same as in (9) and (8), except that M_{FC}^1 now comprises the profits that bank 1 makes on the payment card transactions made by a consumer of bank 2, that is M_A^1.

If $\gamma_1^* \neq 1/2$, the profit maximising interchange fees verify the same ratio as in (29).

I now compute the welfare maximising interchange fees. The same reasonning as in Appendix

G applies, except that the impact of interchange fees on M_A^1 is taken into account. The impact of the interchange fee on withdrawals on social welfare can be written as

$$\frac{\partial W}{\partial a^W} = \frac{1}{6}\left[(8\gamma_1^* - 1)\left(a^W - c_W\right)(1-\varphi_1)\frac{\partial n_1^*}{\partial a^W} + (7 - 8\gamma_1^*)\left\{\left(a^W - c_W\right)(1-\varphi_2)\frac{\partial n_2^*}{\partial a^W} + \frac{\partial M_A^1}{\partial a^W}\right\}\right].$$

Since the second term in the parenthesis may be positive or negative, it is not necessarily optimal for a social planner to set $a^W = c_W$. We have

$$\left.\frac{\partial W}{\partial a^W}\right|_{a^W = c_W} = \frac{1}{6}(7 - 8\gamma_1^*)\left.\frac{\partial M_A^1}{\partial M_A^1}\right|_{a^W = c_W}.$$

Since $\partial M_A^1/\partial a^W \geq 0$, and since $(7 - 8\gamma_1^*) \geq 0$ for a sufficiently high t, the social welfare can be increased by choosing a higher interchange fee on withdrawals than c_W.

Appendix I: An example, with the distribution $F(T) = 2ST$ and second order conditions. Since $S(\lambda_i^*) = S(\lambda_i^*)^2$, from (12) and (13), for all $i \in \{1; 2\}$, the optimal number of withdrawals is given by

$$n_i^* = \lambda_i^* \sqrt{\frac{rS}{2(w_i + b)}},$$

and the threshold λ_i^* is given by

$$\lambda_i^* = \frac{1}{v}\left(f_i - k - \sqrt{\frac{r(w_i + b)}{2S}}\right).$$

From Proposition 2, we know that $f_i = c_I - a^P$ and that $w_i = \varphi_i c_W + (1 - \varphi_i)a^W$. Hence, the optimal number of withdrawals is given by

$$n_i^* = \max\left(\frac{1}{v}\left\{\left(c_I - a^P - k\right)\sqrt{\frac{rS}{2(\varphi_i c_W + (1-\varphi_i)a^W + b)}} - \frac{r}{2}\right\}; 0\right),$$

and the threshold λ_i^* is given by

$$\lambda_i^* = \max\left(\min\left(\frac{1}{v}\left(c_I - a^P - k - \sqrt{\frac{r(\varphi_i c_W + (1-\varphi_i)a^W + b)}{2S}}\right), \overline{\lambda}\right), 0\right).$$

To simplify the notations, I define $h_i(a^W) = \varphi_i c_W + (1 - \varphi_i)a^W + b$, and $\alpha_i(a^W)$ by

$$\alpha_i(a^W) = \frac{1}{v}\sqrt{\frac{rS}{2h_i(a^W)}}.$$

I have that $\partial n_i^*/\partial a^P = -\alpha_i(a^W)$, that $\partial^2 n_i^*/\partial^2 a^P = 0$, and that $\partial^2 n_i^*/\partial a^P \partial a^W = -\alpha_i(a^W)(1-\varphi_i)/2h_i(a^W)$. Also, I have that $\partial n_i^*/\partial a^W = -\alpha_i(a^W)(c_I - a^P - k)(1-\varphi_i)/2h_i(a^W)$ and that $\partial^2 n_i^*/\partial^2 a^W = 3\alpha_i(a^W)(c_I - a^P - k)(1-\varphi_i)^2/4(h_i(a^W))^2$.

Note also that, in this example, a consumer of bank i bears the transaction costs

$$C_i^* = -vS \times (\lambda_i^*)^2 - vS + 2S \times (c_I - a^P)\overline{\lambda}.$$

Second order conditions in the symmetric case. I show that the determinant of the Hessian matrix, H, is negative in the symmetric case, that is if $\varphi_1 = \varphi_2 = \varphi$. This will enable me to show that, with this example for F, banks' joint profits are maximised if the interchange fee on card payments is set to zero, while the interchange fee on withdrawals is set at the monopoly price. I have that

$$\frac{\partial^2 \pi}{\partial^2 a^P} = 2(1-\varphi)(a^W - c_W)\frac{\partial^2 n^*}{\partial^2 a^P}.$$

Since $\partial^2 n^*/\partial^2 a^P = 0$, then $\partial^2 \pi/\partial^2 a^P = 0$. Hence, $\det H = -(\partial^2 \pi/\partial a^P \partial a^W)^2 < 0$. So π admits a maximum at the critical point that we found.

Second order conditions in the asymmetric case. I now show that the determinant of the Hessian matrix is negative in the asymmetric case.

We have that

$$\det H = \left(\partial^2 \pi/\partial^2 a^W\right)\left(\partial^2 \pi/\partial^2 a^P\right) - (\partial^2 \pi/\partial a^P \partial a^W)^2.$$

Since $\partial^2 n_i^*/\partial^2 a^P = 0$, then $\partial^2 \pi/\partial^2 a^P = 4t(2\gamma_1^* - 1)\left(\partial \gamma_1^*/\partial a^P\right)^2 \geq 0$. Hence, to prove that $\det H < 0$, it is sufficient to prove that $\partial^2 \pi/\partial^2 a^W \leq 0$. Simulations suggest that this is the case. But the analytical result cannot be expressed simply.

Simulations with this example also show that W is decreasing with a^W if $a^W \geq c_W$ for a sufficiently high t.

Appendix J: Examples In this Appendix, we give a few examples of market structures in several European countries. In the first column, I give the name of the entity that manages the ATM network. In the second column, I give the name of the largest payment card systems (in terms of transaction volume) that operate in the country. In the last column, I precise whether the payment card systems (PCS) choose multilateral interchange fees for card payments, and whether there are also multilateral or bilateral interchange fees on withdrawals. The letters AV mean that the interchange fee is an Ad Valorem tariff.

Country	**ATM networks**	**PC Systems**	**Interchange fees?**
Denmark	Sumclearing/PBS.	PBS.	ATMs: entry fee.
			PCS: No.
France	System "CB"	System "CB"	ATMs: Yes. PCS: Yes.
			- Bilateral component.
UK	Largest: Link, managed by "Vocalink".	Visa, MasterCard.	Link: Yes. PCS: Yes.
Germany	The "Cash pools"	Ec-Karte. POZ.	PCS: No.
Finland	Managed by "Automatia".	Pankkikortti System.	ATMs: no IF. Entry fee.
	(Owned by the 5 largest banks)		PCS: No IF.
Sweden	ATMs are installed and owned by banks.	Visa	ATMs: bilateral IF.
			PCS: Yes.
Norway	Managed by BankAxept	BankAxept	ATMs: entry fee+ MIF.
Portugal	Multibanco (managed by SIBS)	SIBS	PCS: Yes (AV)
Italy	Bancomat (managed by SIA)	Bancomat (SIA)	PCS: Yes (AV)
Belgium	ATMs managed by the banks.	Banksys	ATMs: bilateral IF.
	(Formerly owned by Banksys).		PCS: Yes.
Spain	ServiRed	ServiRed	PCS: Yes
	Red Euro 6000	Red Euro 6000	ATMs: Yes.
	Telebanco 4B	Telebanco 4B	
Netherlands	Agreement between Postbank & Equens	Equens/Interpay.	PCS: Bilateral IF.

Sources of the table: PSE Consulting, Groupement des Cartes Bancaires, Interim Report on Payment Cards (European Commission).

VI. CONCLUSION

Nous présentons dans notre conclusion une synthèse des résultats obtenus dans notre thèse, ainsi qu'une mise en perspective par rapport au contexte économique présenté en introduction. Nous suggérons aussi quelques pistes de recherche.

VI.1. Synthèse des principaux résultats.

Dans notre thèse, nous étudions les deux problématiques suivantes:

- Le rôle des interchanges dans les stratégies d'investissement des acteurs des systèmes de paiement par carte.
- L'influence des interchanges (paiement et retrait) sur les mécanismes de substitution entre la carte et les espèces.

Le premier chapitre de notre thèse nous permet de constater non seulement la diversité des taux de détention et d'usage des cartes de paiement en Europe, mais aussi la variété de l'organisation des marchés. Nous utilisons l'exemple français pour décrire les interactions économiques entre les acteurs des transactions de paiement par carte, au moyen de l'étude des comportements de paiement des consommateurs et de l'analyse de l'organisation du système « CB ». Nous présentons aussi les principales questions soulevées par la mise en œuvre du SEPA (Single Euro Payments Area).

Nous retenons dans ce chapitre plusieurs observations empiriques importantes, en lien avec nos problématiques. Le mécanisme d'interchange pratiqué par le système « CB » comprend une composante qui tient compte de l'investissement pratiqué par les banques pour améliorer la sécurité du système. La qualité du dispositif, mis en œuvre par les banques, se traduit par la faiblesse du taux de fraude observé en France sur les paiements par carte. Cette observation montre que les systèmes de paiement peuvent choisir d'utiliser un mode de calcul des interchanges qui tienne compte des investissements. Par ailleurs, notre étude empirique révèle que la carte de paiement est l'instrument de paiement le plus utilisé en France pour les transactions de montants moyens. L'étude des comportements de paiement des consommateurs montre que les consommateurs substituent la carte aux espèces pour les transactions de faibles montants, tandis que le chèque est plus utilisé pour les transactions de montants élevés. Cette observation montre que la modélisation des interchanges dans les systèmes de paiement par carte doit tenir compte de l'existence d'une substitution possible pour le consommateur entre la carte de paiement et les autres instruments de paiement.

Dans le second chapitre de notre thèse, nous présentons une revue de la littérature sur les interchanges. La théorie économique nous enseigne que les interchanges constituent un instrument pour développer la demande d'usage des cartes de paiement, en instaurant un mécanisme d'équilibrage entre les coûts supportés par la banque du consommateur, et ceux subis par la banque du commerçant. Sous certaines hypothèses, les interchanges permettent de corriger les externalités d'usage susceptibles d'être exercées par les consommateurs sur les commerçants. Cependant, ce mécanisme a des répercussions imparfaites sur la demande d'usage des consommateurs, d'une part à cause de l'existence d'une concurrence imparfaite sur les marchés de détail bancaires, et d'autre part à cause des interactions stratégiques entre les commerçants. En effet, la nature de la concurrence sur les marchés de détail bancaires influence la façon dont les modifications de coûts se répercutent sur les prix payés par les utilisateurs (porteurs et commerçants). Par exemple, si les banques émettrices ne font pas bénéficier les consommateurs de la baisse de coûts marginaux induite par les interchanges, ce mécanisme ne permet pas de développer l'usage des cartes de paiement. Par ailleurs, la nature des interactions stratégiques entre commerçants détermine la façon dont ces derniers transmettent leurs coûts aux consommateurs. Si les commerçants répercutent sur leurs prix de détail toutes les augmentations de coûts générées par une hausse des interchanges, ils peuvent neutraliser l'effet des interchanges sur la demande des consommateurs. Enfin, la littérature montre que l'existence d'une concurrence entre plates-formes de paiement n'entraîne pas nécessairement une baisse des interchanges. Les interchanges résultant de l'équilibre de la concurrence entre plates-formes de paiement dépendent de plusieurs facteurs parmi lesquels la possibilité pour les consommateurs et les commerçants de se raccorder à une ou plusieurs plates-formes, les asymétries entre consommateurs et commerçants, et la différenciation entre plates-formes.

Dans le troisième chapitre de notre thèse, nous nous interrogeons sur les relations entre les interchanges et les investissements pratiqués par les acteurs des systèmes de paiement.

Dans l'article intitulé *"Interchange Fees and incentives to Invest in Quality of a Payment Card System",* nous étudions la façon dont les interchanges doivent tenir compte de la qualité du service fourni aux consommateurs et aux commerçants, en particulier lorsque la qualité du service est déterminée par les investissements réalisés par les banques. Dans notre modèle, la banque émettrice et la banque acquéreur sont des monopoles, les consommateurs sont hétérogènes et les commerçants sont homogènes.

Si le niveau de qualité de service est exogène, nous étendons le résultat de Baxter (1983) en montrant que l'interchange optimal doit donc être d'autant plus élevé que la qualité du service fourni aux commerçant est élevée. Si les consommateurs et les commerçants sont hétérogènes, nous étendons le résultat de Schmalensee (2002), en montrant que l'interchange optimal permet d'égaliser les coûts marginaux de chacune des banques, ajustés des bénéfices marginaux liés à l'augmentation de la qualité du service.

Nous déterminons ensuite le niveau d'interchange optimal lorsque la qualité du service dépend des investissements réalisés par les banques. Les deux banques exercent des externalités l'une sur l'autre par leur choix de qualité de service. Nous montrons qu'une augmentation de l'interchange peut soit favoriser les investissements en qualité des deux banques (par un effet de complémentarité stratégique), soit faire diminuer les investissements en qualité des banques acquéreurs. Lorsque l'interchange favorise les investissements en qualité, le système de paiement choisit l'interchange maximal compatible avec un profit positif des banques acquéreurs. Cependant, lorsque l'interchange et les investissements en qualité de l'acquéreur sont substituts stratégiques, le système de paiement a intérêt à choisir un interchange plus faible pour favoriser les investissements du côté « acquisition ». Le fait qu'il soit optimal dans certain cas de remplacer l'interchange par des investissements des banques acquéreurs dépend de l'incidence relative des investissements en qualité sur les demandes des consommateurs et des commerçants, et des coûts supportés par les banques pour réaliser leurs investissements.

Nous montrons aussi que les systèmes de paiement doivent réfléchir à la structure la plus adéquate pour les commissions d'interchange. En effet, le choix d'une commission d'interchange qui prenne la structure d'un tarif binôme peut se révéler intéressante en période d'investissement.

Dans l'article intitulé *« Private Cards and the By-Pass of Payment Systems by Merchants »*, nous nous interrogeons sur les incitations des commerçants à investir dans leurs propres infrastructures de paiement, en proposant aux consommateurs des cartes privatives. Nous montrons que si un commerçant émet des cartes privatives, il choisit un prix très agressif pour inciter les consommateurs à l'utiliser. En effet, le commerçant est désormais actif sur le marché des transactions et sur le marché des produits. Il a intérêt à pratiquer un prix faible pour la carte privative d'une part pour concurrencer la banque émettrice sur le marché des transactions de paiement, et d'autre part pour attirer des consommateurs de son concurrent sur le marché des produits en leur proposant un service de paiement à un prix plus avantageux. En outre, lorsque les consommateurs payent par carte privative plutôt que par carte bancaire, le commerçant évite de payer la commission commerçant à la banque acquéreur.

Notre modèle montre que les petits commerçants qui n'ont pas les moyens d'investir dans une infrastructure de paiement risquent d'être défavorisés en cas d'entrée des grands commerçants sur le marché des paiements. Non seulement les grands commerçants détournent une partie de leur clientèle en pratiquant des prix très agressifs sur le marché des transactions de paiement, mais aussi les banques ont intérêt à augmenter leurs prix sur le segment des petits commerçants. La concurrence entre la carte bancaire et la carte privative n'entraîne une baisse des prix que du côté porteur. Les commissions payées par les commerçants ont tendance à augmenter. Selon l'interchange choisi par la plate-forme de paiement, la concurrence avec la carte privative est donc susceptible d'entraîner une distorsion encore plus importante de la structure des prix. Des simulations permettent de montrer que le prix total payé par les consommateurs et les commerçants est plus élevé en cas d'émission de cartes privatives, lorsque l'interchange est suffisamment faible.

Nous montrons que l'impact des interchanges sur les incitations des commerçants à émettre des cartes privatives est donc complexe à analyser et dépend de la façon dont se compensent deux effets :

1. Une augmentation de l'interchange réduit le prix des cartes de paiement bancaires, ce qui renforce la concurrence avec la banque émettrice. Cet effet réduit les incitations du commerçant à émettre sa carte privative.
2. Une augmentation de l'interchange augmente le prix payé par le commerçant qui n'a pas émis de carte privative, ce qui augmente ses coûts. Cet effet renforce les incitations à émettre des cartes privatives.

Dans notre modèle, le système de paiement peut choisir de diminuer l'interchange pour dissuader l'entrée du commerçant. Nous donnons différents exemples d'équilibres, en fonction de la valeur des coûts d'entrée, dans lesquels la plate-forme de paiement choisit soit d'accommoder l'entrée, soit de dissuader l'entrée. Nous montrons aussi que si la plate-forme de paiement choisit de laisser le commerçant entrer sur le marché des transactions, elle fixe un interchange plus faible que dans le cas de référence.

Dans le quatrième chapitre de notre thèse, nous étudions le lien entre les interchanges (paiement et retrait) et les mécanismes de substitution entre la carte de paiement et les espèces.

Dans l'article intitulé *« Optimal Interchange Fees for Card Payments and Cash Wihdrawals »*, nous montrons que la substitution entre la carte et les espèces dépend de la concurrence sur les marchés de détail bancaires. Puisque les banques émettrices se concurrencent sur le marché des dépôts pour proposer des services de paiement et de retrait à leurs consommateurs, elles n'ont pas toujours intérêt à promouvoir l'usage de la carte de paiement de telle sorte que les consommateurs ne payent plus en espèces. En effet, les retraits d'espèces des consommateurs constituent une source de revenus pour les banques. Les banques arbitrent donc entre les revenus obtenus à l'ouverture des comptes de dépôts, les revenus obtenus sur les transactions effectuées par leurs consommateurs, et les revenus obtenus lorsque les consommateurs de leurs concurrents effectuent des retraits déplacés.

Notre travail montre que les banques peuvent avoir intérêt à pratiquer des interchanges plus faibles sur les paiements par carte, pour réaliser plus de profits sur les transactions de retraits déplacés et pour adoucir la concurrence sur le marché des dépôts. Ce résultat suggère que les interchanges « paiement » choisis par une plate-forme de paiement sont parfois trop faibles par rapport à l'optimum social, sous l'hypothèse que la plate-forme de paiement maximise les profits joints des banques. La carte de paiement est donc sous-utilisée par les consommateurs lorsque les banques ont la possibilité de faire des profits sur les opérations de retraits déplacés.

Les intérêts des émetteurs de carte de paiements ne sont pas toujours convergents en matière de choix d'une commission d'interchange. Certains émetteurs peuvent détenir aussi des distributeurs automatiques de billets qui concurrencent indirectement l'usage de la carte en fournissant des espèces aux consommateurs. D'autres sont aussi présents sur le segment de l'acquisition. Les asymétries différenciant les banques émettrices limitent donc leurs possibilités d'augmenter l'interchange sur les paiements par carte.

VI.2. Implications en matière de politique économique.

Nous mettons en perspective les résultats de notre thèse dans le contexte des débats de politique économique actuelle qui concernent les interchanges. Au préalable, notons que la construction d'un cadre réglementaire pour l'industrie des paiements est rendue complexe par :

- L'interdépendance des demandes des consommateurs et des commerçants pour l'acceptation et l'usage des instruments de paiements (marchés biface).
- Le statut particulier des espèces, qui constituent un instrument de paiement universel, dont l'usage est gratuit.

Dans notre thèse, nous montrons que différents paramètres peuvent influencer le niveau des interchanges optimaux (retraits déplacés, investissements, émission de cartes privatives…). Nous suggérons une clarification des objectifs poursuivis par les régulateurs, et, si possible, une hiérarchisation des priorités, pour être en mesure de déterminer si le niveau des interchanges pratiqués par les systèmes de paiement est adéquat.

Si l'objectif est d'améliorer l'efficacité de l'usage des instruments de paiement, et si les études empiriques révèlent que les cartes de paiement sont moins coûteuses que les espèces, nos résultats montrent qu'il est nécessaire d'examiner le niveau des interchanges sur les paiements en tenant compte du niveau des interchanges sur les retraits, ainsi que de la façon dont est organisé l'approvisionnement de l'économie en espèces (notamment la structure de détention des DAB). Il ne faut pas favoriser l'existence d'interchanges trop élevés sur les retraits pour encourager les consommateurs à utiliser leurs cartes de paiement.

Si la priorité des régulateurs est de favoriser l'harmonisation de la qualité des services fournis aux consommateurs et aux commerçants par les systèmes de paiement actuellement actifs en Europe, notre thèse montre que les interchanges « paiement » peuvent être utilisés comme mécanisme d'incitation aux investissements. Cependant, nos résultats montrent aussi qu'il ne semble pas adéquat de choisir un niveau arbitraire unique pour les commissions d'interchange en Europe. Tant que les systèmes de paiement n'ont pas harmonisé leurs règles en matière de sécurité, leurs exigences en matière de collecte et de circulation de l'information sur les transactions, l'utilisation d'un interchange unique ne peut pas être justifiée. Par ailleurs, tant que les systèmes de paiement actifs en Europe fourniront des services de qualités très différentes à leurs utilisateurs, les usages dans les différents pays d'Europe resteront très disparates (sous l'hypothèse que les systèmes de paiement qualifiés de « nationaux » restent présents sur le marché). Par conséquent, les régulateurs doivent réfléchir à offrir une certaine souplesse aux systèmes de paiement, qui leur permette d'adapter la structure de la commission d'interchange aux usages du pays considéré. Dans notre thèse, nous montrons aussi qu'il est important de réfléchir à la structure la plus adéquate pour les commissions d'interchange. En effet, l'utilisation d'un tarif binôme peut se révéler plus profitable pour les systèmes de paiement en période d'investissement.

Enfin, si l'objectif du régulateur est de favoriser l'entrée de nouveaux acteurs sur le marché des transactions de paiement – comme les grands commerçants-, il s'agit de s'assurer que cela ne renforce pas leur pouvoir de marché. Dans le second article de notre troisième chapitre nous montrons que l'existence de commissions d'interchange élevées ne constitue pas systématiquement une barrière à l'entrée pour les commerçants qui souhaiteraient investir pour émettre leurs propres cartes de paiement. Cela dépend en effet de la structure du marché sur le segment de l'acquisition. Par ailleurs, nous montrons que les petits commerçants risquent d'être défavorisés en cas d'entrée des grands commerçants sur le marché des transactions de paiement, tandis que les porteurs de cartes bénéficieront de prix plus faibles. Or, les petits commerçants ne disposent pas d'un volume de transactions suffisant pour amortir les investissements dans leur propre infrastructure de paiement. Les régulateurs pourront donc tenir compte des bénéfices et des coûts sociaux liés à une large acceptation de la carte de paiement chez les petits commerçants, s'ils sont amenés à intervenir dans des litiges entre systèmes de paiement et grands commerçants. Notre modèle montre que, dans un marché biface, l'entrée d'un nouvel acteur sur le marché peut faire augmenter le surplus d'un côté du marché, tout en faisant diminuer le surplus de l'autre côté du marché, ce qui rend complexe l'évaluation des bénéfices et des coûts sociaux liés à une intensification de la concurrence.

VI.3. Perspectives de recherche.

De nombreuses questions de recherches concernant les interchanges méritent d'être approfondies. Nous commençons par mentionner quelques pistes qui pourraient compléter nos travaux. Enfin, nous proposons d'autres thématiques de recherche.

Concernant le lien entre interchanges et qualité de service fourni par la plate-forme de paiement, nous pensons que notre travail mériterait d'être enrichi par des éléments empiriques, si des données sont disponibles. Une étude réalisée aux Pays-Bas[1] montre que les consommateurs sont sensibles à des éléments de qualité de service lorsqu'ils choisissent leurs instruments de paiement (sécurité, maniabilité, etc…). Cependant, il n'existe pas d'étude qui mesure la corrélation entre l'augmentation de l'usage de la carte de paiement et les investissements réalisés par les banques. Par ailleurs, il serait intéressant de mener une étude analogue qui prenne en compte les motifs d'acceptation de la carte par les commerçants. S'il n'est pas possible de mener une telle étude sur la carte de paiement, il serait intéressant de recueillir des données pour le lancement d'un nouvel instrument de paiement, qui nécessite des investissements.

Nous pensons aussi qu'il est nécessaire de poursuivre les recherches débutées dans notre travail sur les cartes privatives, pour mieux comprendre quelles sont les autres formes de coopération pouvant caractériser les relations entre systèmes de paiement et commerçants (accords de cobranding, entrée des commerçants comme membres des systèmes de paiement, construction de plates-formes entre grands commerçants, etc.). Ces travaux permettraient de s'interroger sur la forme optimale de l'accès aux infrastructures de paiement existantes pour les nouveaux entrants, dont font partie les commerçants. Quelles sont les formes d'accès les plus

[1] Jonker (2005), cité dans les références du chapitre V.

efficaces ? Quelles formes d'accords doit-on privilégier ? Est-il économiquement souhaitable que certains acteurs du marché des produits renforcent leur part de marché en proposant des services de paiement ? Ces études permettront de déterminer à quelles conditions l'entrée sur le marché ne génère pas une duplication inefficace des investissements. Enfin, nous poursuivons actuellement nos recherches afin d'évaluer l'impact de l'entrée des commerçants sur le bien-être social. Nous serons alors en mesure de déterminer si l'émission de cartes privatives doit être encouragée.

Enfin, dans notre travail sur les interchanges « paiement et retrait », nous avons montré qu'il était nécessaire de prendre en compte les arbitrages effectués par les banques entre les profits réalisés sur les transactions de paiement par carte, et les transactions de retrait. Nous pensons qu'il serait intéressant de modéliser le fait que les banques émettrices assument plusieurs fonctions, dont celle d'acquéreur et de détenteur de distributeurs automatiques de billets, ce qui implique une concurrence sur plusieurs marchés. Dans notre modèle, les banques émettrices se concurrencent sur le marché des dépôts pour affilier des consommateurs. L'étendue de leur réseau de distributeurs automatiques de billets constitue un facteur de différenciation qui adoucit la concurrence sur le marché des dépôts. Il s'agirait de modéliser aussi le fait que ces mêmes banques émettrices peuvent aussi se concurrencer pour affilier des commerçants, ce qui risque d'influencer leurs intérêts en matière de choix des interchanges. Par ailleurs, le modèle que nous avons construit pourrait être utilisé pour comparer différents modes de calculs d'interchanges. Par exemple, il serait possible d'examiner l'impact d'une commission d'interchange différenciée sur les transactions de faibles montants et sur les transactions de montants plus élevés, afin d'étudier la question de l'efficacité de la substitution entre la carte et les espèces. Ou encore, l'interchange fixe que nous avons modélisé pourrait être remplacé par un tarif binôme. Enfin, en ce qui concerne les consommateurs, nous avons modélisé la décision de substituer la carte de paiement aux espèces en utilisant le modèle de Whitesell. Il serait intéressant d'examiner l'incidence de ce choix sur le résultat obtenu. Par exemple, Bounie et Houy (2007)[2] ont formalisé l'existence d'une autre modélisation possible d'une autre règle de choix pour les consommateurs : le « Cash Holding Model ».

Plus généralement, nous pensons que la recherche sur les interchanges doit être poursuivie dans deux directions.

---

[2] Bounie, D. et Houy, N. (2007): « A model of Demand for Cash and Deposits », Working Paper ESS-07-13, Telecom ParisTech.

Les modèles sur les interchanges doivent être enrichis par des données empiriques, ce qui permettra d'évaluer la validité des hypothèses théoriques formulées. Nous pensons notamment que les mesures des coûts sociaux totaux associés à l'usage des instruments de paiement doivent être poursuivies. Nous préconisons aussi une évaluation des montants investis dans les infrastructures de paiement, ainsi qu'une mesure du coût de leur maintenance.

Par ailleurs, nous suggérons la construction de modèles d'interchanges qui prennent en compte l'existence d'une substitution possible entre les instruments de paiement pour les consommateurs. Ceci permettrait d'approfondir les questions de concurrence entre plates-formes de paiement ainsi que le sujet de la dualité, notamment lorsque les plates-formes fournissent différents instruments de paiement. En effet, des banques identiques peuvent être membres de plates-formes de paiement qui se concurrencent pour proposer différents instruments de paiement aux consommateurs. Lorsque ces plates-formes de paiement choisissent des interchanges, elles influencent indirectement les stratégies d'acceptation des commerçants, et les décisions d'usage des consommateurs. Or les intérêts des banques ne sont pas nécessairement convergents : ils dépendent du profil de leur clientèle, de leur réseau d'agences, et de leurs stratégies de différenciation. Le jeu de la concurrence entre plates-formes, fournissant différents services de paiement, comportant des membres aux objectifs divergents, peut-il donner lieu à un choix d'interchanges qui entraîne une efficacité des choix des consommateurs et des commerçants ? Les travaux de recherche doivent être poursuivis pour formuler des réponses plus précises à ces questions.