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Regulating Two-Sided Markets: An Empirical Investigation

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April 12, 2010

Abstract

Two-sided market theory predicts that platforms may subsidize the participation of one type of agent by extracting surplus from another type to internalize indirect network externalities. However, few empirical studies exist to evaluate the impact of government intervention in these markets. We use confidential bank-level data to study the impact of government-encouraged fee reductions for payment card services when merchant acceptance is not complete. We find that consumer and merchant welfare improved when the interchange fees, transfers among banks, were reduced. Furthermore, bank revenues increased because the increase in the number of transactions offset the decrease in the per-transaction revenue.

Key words: payment choice, merchant adoption, network competition

JEL Codes: L11, G21, D53

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1. Introduction

The economics of how platforms set prices for two or more types of agents is receiving increasing attention by economists and policymakers. This literature, commonly referred to as two-sided markets or platforms, blends together the network economic literature with the multiproduct firm literature.[1] Rochet and Tirole (2003) define a two-sided market when the price structure, or the share that each type of agent pays the platform, affects the total volume of transactions. Furthermore, one set of agents is unable to negotiate transfers with the other set of agents. Examples of two-sided platforms include media portals (eyeballs and advertisers), heterosexual dating clubs (men and women), and payment networks (consumers and merchants).

The simultaneous adoption of services such as dating or payment services provided by a platform to two sets of agents often involves indirect network externalities. In other words, one type of agent benefits when the other type of agent participates. Often platforms will subsidize the participation of one set of agents by extracting surplus from the other set of agents to internalize this externality. For example, online news providers may not charge eyeballs that view their sites but earn all of their revenue from advertisers.

In this article, we empirically test whether government intervention to change the market-determined platform fees is socially efficient. We ask the following questions. First, do more agents adopt when their fee is reduced? Second, does the other type of agents reduce their adoption and usage because of higher fees? Third, what is the impact on the platform revenues from government-encouraged fee reductions?

We focus on government-encouraged fee reductions in the payment card market. Specifically, we study the effects of several regulatory interventions in Spain during 1997 to

[1] For a broader description of this market, see Armstrong (2006), Caillaud and Jullien (2003), Jullien (2001), Rochet and Tirole (2006), Rysman (2009), and Weyl (2010).

2007. We ask whether reductions in interchange fees can improve social welfare when the network adoption externality has not been completely internalized. To our knowledge, we are the first to use bank-level data to study multiple government-induced reductions in interchange fees. Interchange fees are paid by the merchant's bank to the cardholder's bank. We use a simultaneous equations approach to test the impact of lower interchange fees on adoption and usage decisions of consumers and merchants. Furthermore, we also study the impact of lower interchange fees on issuer and acquirer revenues.

Our main results are as follows. First, we find strong evidence suggesting that merchant acceptance has increased because of a reduction in interchange fees. Second, consumer adoption of debit cards did not significantly decrease over the period because of lower interchange fee revenue for issuers but credit card adoption increased dramatically during the period of interchange fee reductions. Third, bank payment revenues from debit and credit card services are positively related to increased transactions resulting from lower interchange fees.

The structure of fees in two-sided markets has been addressed in the theoretical literature but empirical testing of fees structures in these markets has been limited. Our results suggest that even platforms may benefit from changing the price structure especially in markets where adoption by the side that pays a greater share of the fee is reduced. Furthermore, the price structure may not be constant during emerging and mature stages of an industry's development. Finally, we remain agnostic on the sharing of surplus when the adoption and usage externality have been internalized.

Our article is organized in the following way. In the next section, we discuss several theoretical economic models. In section 3, we discuss the market for payment services in Spain along with the regulatory actions taken by the public authorities. We discuss our empirical

strategy in section 4. We describe our dataset in section 5. In section 6, we present our results. We discuss robustness tests in section 7. Finally, we offer some concluding remarks in section 8.

2. Relevant Literature

There are many industries that can be characterized as a two-sided market. The key aspect of these markets is the presence of an indirect network externality and how fee structures internalize this externality. Whether the fees are per-transaction, fixed, or a combination of both differs across industries.[2] Not surprisingly, the type of fee affects the adoption and usage along with the optimal price structures.

In this article, we focus on the payment card industry. Payment networks are comprised of consumers, their financial institutions (known as issuers), merchants, their financial institutions (known as acquirers) and a network operator or platform. A consumer makes a purchase from a merchant. Generally, the merchant charges the same price regardless of the type of payment instrument used to make the purchase. Consumers often pay annual membership fees to their financial institutions for credit cards and may pay service charges for a bundle of services associated with transactions accounts. Merchants pay fees known as merchant discounts. Acquirers pay interchange fees to issuers.

The lower bound of the merchant discount is the interchange fee and is set by the platform. Generally, decreases or increases in interchange fees are passed onto merchants in the form of lower or higher fees, respectively. Hence, merchants have protested against increases in interchange fees and continue to challenge the setting of these fees. On the other hand, a reduction in the interchange fee will likely result in higher fees for cardholders.

[2] See Armstrong (2006), Rochet and Tirole (2003), and Rysman (2009).

Payment card networks continue to face antitrust scrutiny by public authorities regarding the pricing of payment services (Bradford and Hayashi, 2008). Public authorities are concerned about the collective setting of interchange fees by banks to extract rents from merchants. If these rents are used to attract consumers to use cards, society may be better off if such a shift is socially optimal.

Most of the economic literature on payment card networks to date has been theoretical. Baxter (1983) observed that payment cards should be adopted if the aggregate benefits to consumers and merchants are greater or equal to the aggregate costs to serve them. Furthermore, consumers would adopt payment cards if their benefit is greater than their fee and merchants would adopt if their benefits were greater than their fee. This condition does not necessarily imply that costs be split evenly between consumers and merchants. This literature generally argues that the interchange fee is a balancing mechanism that is necessary to bring both sides on board (Baxter, 1983 and Rochet and Tirole, 2002).

A key assumption made in this literature is that consumers and merchants are unable to negotiate prices based on the type of payment instrument. If merchants are able to pass on payment costs, the level of interchange fees will not affect the usage of payment cards assuming that the proportion of merchants accepting cards is constant.[3] Given that merchants may be contractually unable to set prices based on payment instrument used in many jurisdictions or merchants often do not differentiate prices in jurisdictions where they can, the level of the interchange fee affects the adoption and usage of payment cards.

Some theoretical two-sided models predict that competition may actually worsen social welfare. Rochet and Tirole (2004) and Guthrie and Wright (2007) find that network competition

[3] See Gans and King (2003) for a more general treatment of when interchange fees are neutral. Katz (2005) questions this result based on the level of pass-through between issuers and acquirers to consumers and merchants, respectively. Bolt and Chakravorti (2008a) consider different levels of pass-through in a theoretical model.

may yield a price structure that has a lower social welfare than when there is only one network. If competition is too strong on the consumer side, the network may extract too much from merchants resulting in higher than socially optimal interchange fees. Merchants generally accept cards from multiple networks and consumers choose their preferred issuer and network. Therefore, competition on the consumer side may be more intense especially intra network competition when merchants cannot discriminate card acceptance by issuer (Katz, 2005). In addition, intense competition from issuers may result in lower costs and in some cases rewards to consumers that may be subsidized by merchants or those consumers that avail long-term credit.

Empirical research on the impact of changes in interchange fees on usage is almost non-existent. Hayes (2007) uses structural break analysis to study the impact of interchange fee regulation in Australia. He uses aggregate level monthly data on the changes in share of credit card purchases. Given the maturity of the Australian market, he finds no evidence of structural breaks resulting from an almost 50 percent mandated decrease in interchange fees.

However, there are some empirical investigations of other two-sided markets (Argentesi and Filistucchi, 2007; Dubois, Hernandez-Perez, and Ivaldi, 2007; Kaiser and Wright, 2006; and Rysman, 2004). Our approach is similar to Rysman (2004) who uses a simultaneous equation estimation technique study the tradeoffs between consumers and advertisers in the market for yellow pages. He estimates the consumer demand for yellow page usage as a function of advertising and the inverse demand for advertising as a function of consumer usage. He is able to identify the positive network effect. He also studies welfare tradeoffs between competition and monopoly providers of yellow pages.

2. Spanish Regulatory Developments

Spain represents a unique laboratory to study the effects of encouraged or mandated interchange fee ceilings on consumer and merchant payment card adoption and usage. Spanish residents rely heavily on cash to make purchases. Carbó Valverde *et al.* (2003) report that residents of Spain have traditionally been more cash intensive than residents of countries of similar size and geography. For 2000, they report that Spain had a currency to GDP ratio of 8.9 percent compared to 6.2 percent for Germany, 4.7 percent for Portugal, and 3.2 percent for France. Similarly, Spain had far fewer non-cash transactions per capita per year at 56 than Germany (177), Portugal (94), and France (196). Comparatively, Spain's acceptance of debit cards by merchants was extremely low resulting in low card usage. [4]

The antitrust authorities argued that the low level of adoption of cards in Spain and other European countries is directly related to the collective setting of interchange fees. European antitrust authorities have tried to reduce surplus extraction by issuers in recent years by encouraging the reduction in interchange fees via domestic antitrust and government resolutions. Since the late 1990s, there have been four important events that significantly affected the setting of interchange fees in the Spanish payment card industry.

All government-initiated events are summarized in Table 1. These agreements were sponsored by the Spanish Ministry of the Economy or the Ministry of Industry, Tourism and Trade. In motivating this decision, the TDC stated "interchange fees will be reduced permitting an adequate adoption by merchants and, ultimately, by cardholders" (TDC Decision of 26 April 2000, No. A 264/99). In May 1999, the Spanish government promoted an agreement between the three payment networks and the main merchant associations to reduce maximum multilateral

[4] As noted by the Bank of Spain (2007), the Secretary of State for Commerce and Tourism created a Special Commission to study the usage of payment instruments in Spain and the transition from cash to card payments.

interchange fees to 2.75 percent in July 2002. This agreement was accepted by Spain's Antitrust Authority (TDC) in 2000 (TDC Decision of 26 April 2000, No. A 264/99). Maximum interchange fees varied significantly across merchant categories. For example, in 2002, the average interchange fee was 2.79% in casinos and 0.63% in gas stations.

To some extent the evolution of Spain's interchange fee regulation was affected by a European Commission (EC) decision regarding European Union (EU)-wide cross-border interchange fees in 2002.[5] In 2002, the main government intervention was triggered by the European Commission (EC) Decision 2002/914/EC of 24 July, regarding Case No. COMP/29.373 – Visa International – Multilateral Interchange Fee.[6] Following these investigations of the EC, the TDC followed suit and requested the Spanish payment card networks to provide information on Visa's methodology for determining interchange fee for Visa.

In May 2003, the Spanish Congress requested the TDC to investigate the setting of interchange fees and to follow the basic principles that the European Commission adopted for EU-wide cross-border interchange fees. The TDC issued a report on competition in commercial activities and related payments (TDC, 2003) and refused several proposals of the networks on their setting of interchange fees. In December 2003, the TDC announced that the 'special authorization' for the setting of interchange fees of the three payment card networks were going to be revoked although this decision was not formally undertaken until 2005.

[5] In July 2002, the EC cleared Visa's European cross-border interchange fees and offered some insights on the position of EU competition authorities with regard to the setting of interchange fees. The EC found that there were upward pressures on the level of interchange fees. More recently, MasterCard and the European Commission have agreed on a substantially lower multilateral interchange fees for cross-border European transactions. In addition, the European Commission has opened new discussions with Visa about these fees.

[6] For a summary of these decisions, see Arruñada (2005).

The third important event occurred from 2003 until 2005, when the networks tried to maintain their 'special authorization' for collective determination of interchange fees from the TDC. Several attempts from the industry to maintain their 'special authorization' for the setting of interchange fees were refused during these two years and the networks were requested to set levels of interchange fees that only reflect operating and fraud costs.

The most important regulatory action for the Spanish payment card industry took place in December 2005. The debate started in April 2005, when the TDC refused the proposals of the networks regarding how interchange fees were set and asked them to use a cost-based approach. The network operators were also requested to make a distinction between debit and credit card interchange fees. Some TDC resolutions required the card networks to only include two costs when setting domestic multilateral interchange fees (MIFs): a fixed cost for processing each transaction and a variable ad valorem cost for the risk of fraud (TDC Decisions of 11 April 2005, No. A 314/02, No. A 318/2002and No. A 287/00). As a consequence of this resolution, the Spanish government promoted an agreement between payment networks and merchant associations to establish a timetable to progressively reduce interchange and merchant fees from 2005 to 2009.

From January 2006 to December 2008, the highest interchange fee levels were reduced in a stepwise manner. Furthermore, a distinction was made between debit and credit interchange fees, with the former being a fixed amount per transaction and the latter being a percentage amount per transaction.[7] For merchants with an annual value of point of sale card payment receipts less than €100 million, the credit card interchange fee decreased from 1.40% per transaction in 2006 to 0.35% in 2009 while for debit card fees were reduced from €0.53 per transaction to €0.35 per transaction regardless of the purchase amount. From 2009 onwards, each

[7] See Shy and Wang (2010) for more discussion of proportional and fixed transaction fees.

of the card networks would audit their operations and provide a cost-based analysis for debit and credit cards.[8]

Adoption and usage: main figures

During 1997-2007, debit card transactions increased from 156 million to 863 million and credit card transactions increased from 138 million to 1.037 billion. The reduction in interchange fees increased the acceptance and usage of payment cards. As shown in Table 2, from 1997 to 2007, the number of debit cards has increased by 40.9% while the number of credit cards has increased by 207.1%. During the same period, the number of transactions increased substantially with debit card transactions being five times larger in 2007 than in 1997 while credit card transactions increased by seven times. Furthermore, the average number of POS transactions per card per year has increased from 7.1 to 27.8 during the same period.

Consumer preferences for debit and credit cards differ. Adoption for debit cards by consumers may have reached a saturation point earlier than credit cards because they were adopted for their ATM functionality more than a decade before. In particular, the number of debit cards reached its peak in 2003 (33.1 million) and it has decreased since then to 31.5 million in 2007. However, the number of credit cards increased monotonically during the period, reaching 43 million in 2007. Spanish consumers increased their holdings of credit cards even when annual fees increased suggesting that the market for credit cards had not reached its

[8] Unfortunately, we are not able to test the effects of the new regulatory framework because our sample period ends in 2007. Additionally, it is unclear to what extent the cost-based model will be finally used in the EU and, in particular since MasterCard –in order to avoid conflict with EU antitrust authorities- applied reduced cross-border interchange fee averages in March 2009 using a methodology along the lines of what Rochet and Tirole (2008) have called the "tourist test" interchange fee level. The "tourist test" or "avoided cost test" caps interchange fees at the level of transactional benefits of card payments for merchants (direct cost savings of card payments relative to non-card payments). It therefore aims at internalizing usage externalities between the two sides by setting these fees at the level where merchants are on average indifferent between card and cash payments.

saturation point and consumers are willing to pay higher fees in exchange for greater merchant acceptance.

Table 2 also shows that the average value of debit card transactions have increased significantly from 38.5 to 46 euros/transaction (in real terms) between 1997 and 2007. The increase in average real debit card per transaction value can be explained by the greater usage of these cards for payments of larger-value purchases at the POS. On the other hand, the average credit card transaction value decreased from 58.5 to 54.3 euros (in real terms). The lower average real credit card per transaction value may result from the greater usage of these cards among consumers for lower-value purchases. The increase in credit card usage took place when credit card annual fees have been rising following the reduction of interchange fees. For example, according to the Bank of Spain, average credit card annual fees have increased from 21.35 euros in January 2005 to 28.43 euros in December 2007.

4. The Empirical Model

Our objective is to empirically test whether the market-determined interchange fees prior to government intervention were socially optimal. For a set of interchange fees to be socially optimal, the sum of consumer and merchant utility along with bank profits must be equal or lower under a different set of interchange fees. Two-sided market theory suggests that a lower interchange fee is associated with a lower merchant fee and a higher cardholder fee. If merchants increase adoption of payment cards because of lower fees, we assume that they prefer to accept payment cards for at least certain types of transactions. Similarly, an increase or a relatively stable number of cards outstanding with higher fees suggests that consumers are willing to pay more to be able to use their cards at more merchants or that they are inelastic to price

movements. We will refer to the level of merchant and consumer adoption resulting from changes in the interchange fee as the merchant and consumer extensive margin, respectively. In addition to the extensive margin, we are able to study the impact of interchange fee reductions on usage or intensive margin of payment cards.

We are able to study merchant and consumer extensive and intensive margins separately for debit and credit cards. There are some key differences in how banks charge consumers for their debit and credit cards. Consumers do not generally pay a fixed or per-transaction fee for their debit cards. The pricing for debit card services is often bundled with other banking services such as access to ATMs. Thus, to isolate a fee for debit card services separately is not possible. For our regression analysis, we use the density of rival ATMs as a proxy for the benefit of using debit cards. Given that ATM owners impose surcharges for cards issued by competitor banks, as the likelihood of using one of these ATMs increases, the benefit to having a debit card increases. In addition, there is the indirect network effect, namely as the number of merchants increase the value of the debit card increases. Thus, we would expect an increase in debit card issuance as the proportion of merchants that accept debit cards to increase.

The merchant extensive margin for debit cards is affected by the merchant fee to accept debit cards. We would expect greater merchant adoption as the acceptance fee decreases. In addition, there is the indirect network effect of greater number of cards in the network. We would expect a positive relationship between merchant adoption and number of cards in the network.

Credit cards allow consumers to access lines of credit at their financial institutions when making payment. Unlike debit cards, consumers can use credit cards to make purchases even if they do not have funds in their bank accounts. Credit card services are stand alone products that

usually have explicit fees. Reductions in credit card interchange fee revenue should result in higher annual fee cardholders to offset lost issuer interchange revenue. If consumers do not give up their credit cards, we can conclude that either consumers are inelastic to changes in credit card fees or are willing to pay higher fees if they can use their cards at more merchant locations.

Similar to debit cards, merchant adoption would be affected by the fee that they are charged and the number of credit cards in the network. We would expect as fees decrease and card adoption increases that merchant adoption would increase.

Simultaneous equation setting, identification and exclusion restrictions

Given the two-sided nature of payment card markets, in our empirical specification, we simultaneously estimate the equations that identify the extensive (adoption) margins for merchants and consumers:

$$\textit{Consumer extensive margin} = f(X_{cem}, C, R) \qquad (2)$$

$$\textit{Merchant extensive margin} = f(X_{mem}, C, R) \qquad (3)$$

where X_{cem} and X_{mem} are the exclusion restrictions that identify the consumer extensive margin and the merchant extensive margin equations, respectively. Specifically, debit card exclusion restrictions for consumers are rival ATM density and merchant acceptance. For credit cards, the consumer exclusion restrictions are credit card annual fees and merchant acceptance. The merchant exclusion restrictions are similar for debit and credit cards. They are the respective merchant fees and the number of that type of card in the network. C and R are the vectors of control factors and regulatory dummies that are common to all the equations, respectively.

Our control variables are bank size, the crime rate, and a time trend. Given that payment processing is a scale business, we take bank size (in terms of the number of debit/credit

transactions over total transactions in the network where the bank operates) to control for any increase in bank size during the sample period. We use crime statistics to capture the effect of crime on the decisions of merchants and consumers to accept payment cards.[9] We would expect that as crime increases the adoption of payment cards to increase because payment cards are more secure than cash in the event they are stolen or misplaced. In order to control the (mainly upward) trend in the data for merchant acceptance, number of cards and number of transactions, we use a linear time trend.

We also include four regulatory dummies to measure the impact of the different regulations and or agreements between the Spanish government and market participants on interchange fees. These regulatory dummies represent the year when the regulatory intervention was introduced or the implementation of agreements between market participants. The summary statistics for the variables that we use for our empirical model are shown in Table 4.

Merchant acceptance appears as the dependent variable in the merchant extensive margin equation and it enters the cardholder extensive margin as a lagged explanatory factor. The logic behind this specification is that merchant acceptance and fees may be contemporaneously related while transactions, issuance and usage may be determined by observed previous acceptance.

However, consumers and merchants are not better off unless total card transactions increase. Many new payment technologies failed because one side adopted but the other side either did not adopt or failed to use these payment forms. We will refer to the change in usage from lower interchange fees as the intensive margin. We will also simultaneously estimate the equations that identify the intensive (usage) margins for consumers and merchants:

$$\textit{Consumer intensive margin} = f(X_{cim}, C, R) \qquad (4)$$

[9] Some theoretical money models suggest that crime may be a reason to move away from cash (He, Huang, and Wright, 2005).

$$Merchant\ \ intensive\ margin = f(X_{mim}, C, R) \qquad (5)$$

where X_{cim} and X_{mim} are the exclusion restrictions that identify the consumer intensive margin and the merchant intensive margin equations, respectively. The simultaneous estimation is undertaken for debit and credit cards separately.

For the merchant intensive margin, we use an acquirer's quarterly transactions per POS terminal as our dependent variable. The exclusion restriction that identifies the merchant intensive margin is an interaction term of merchant acceptance by acquirer and the total number of cards in that network. The probability of a card transaction increases when the product of merchant acceptance by an acquirer and the number of total network cards increases.

In the cardholder intensive margin regression, we analyze what factors affect greater usage of payment cards by consumers. The dependent variable is the number of transactions per issuer per card. The key explanatory variable is an interaction term of the merchant acceptance in the network and the number of cards issued by the bank. We include the same control and regulatory dummies as in the other regressions.

Instrumental Variables Approach

Since our model specification allows adoption variables to interact with variables related to number of transactions this may create non-linear cross-equation restrictions on the specified parameters. In order to deal with these restrictions, the simultaneous equations are estimated using a General Method of Moments (GMM) routine with bank (acquirer and issuer specific) fixed effects. All variables (except for the regulatory dummies) are expressed as difference between the logarithms of current period and the period before so that these differences can be interpreted as growth rates. The GMM estimation relies on a set of orthogonality conditions

which are the products of equations and instruments. Initial conditions for estimation are obtained using three-stage least squares (3SLS), which is a restricted version of the simultaneous equation GMM model. Unlike the standard 3SLS, the GMM estimator allows for heteroskedasticity in addition to cross-equation correlation where some variables (as merchant acceptance in our case) may appear both as exogenous and (lagged) endogenous variables in the different equations (Hansen, 1982; Wooldrige, 2002).

Our regression analysis may be subject to some endogeneity and autocorrelation issues. In order to control for endogeneity, lagged values of the explanatory variables in the different equations are employed as instruments. Focusing on the estimation of the set of equations, this treatment eliminates the most obvious source of endogeneity. The primary concern, however, is that some immeasurable aspect of the environment in which banks operate is associated with the acceptance, issuance or usage of cards. Therefore, we also use a simple time trend, up to two lags of GDP and population growth to control for those otherwise immeasurable aspects of the change in markets over time. A summary of the exclusions restrictions, instruments and control factors in each one of the estimated equations is shown in Table 5. The Sargan or J test of overidentifying restrictions is also computed in order to examine the identification of the model with the selected set of instruments under the null hypothesis of correct identifying restrictions. As for potential autocorrelation problems, we also include AR(1) and AR(2) tests of first- and second-order autocorrelation of residuals, respectively, which are asymptotically distributed as a standard normal N(0,1) under the null of no serial correlation.

Identifying issuer and acquirer revenues

Unfortunately, we are unable to measure bank profits directly, but we are able to study the impact on bank revenue. If costs remain constant or grow slower than revenues, bank profits would be increasing with increasing revenue. Given large economies of scale and scope, one might expect that costs would not grow as fast as revenues.

We separate banks into issuers and acquirers for debit and credit cards. Our dependent variables are issuer and acquirer payment card revenue by type of card. For issuers, this would be the product of the average interchange fees and the number of transactions and total annual fees collected (only for credit cards). For acquirers, this would be the difference between the merchant discount charged and the interchange fee paid multiplied by the number of transactions. Similar to consumer and merchant intensive margin, our explanatory variable for acquirers is one-quarter lag of the interaction of merchant acceptance of a specific acquirer and the total number of cards in the network. Our explanatory variable for the issuers is the number of cards issued by each issuer the quarter before times the proportion of merchants accepting in the whole network. We also include a linear time trend, the crime rate, the rivals' ATM density and bank size as control variables. In addition, we have our regulatory dummies.

5. Our Dataset

Unlike consumer and merchant survey data, we use bank-level administrative data that is less likely to be associated with measurement error. For consumers, we rely on issuer transactional and card adoption data to analyze changes in explanatory variables. For merchants, we rely on acquirer adoption and transactional data to analyze changes in explanatory variables.

We use quarterly payment card data from 45 Spanish banks from 1997:1 to 2007:4. These data are adjusted to reflect mergers over the period to create a balanced panel by backward

aggregating all premerger data on merging banks prior to their merger. In total, there are 1,980 panel observations.[10] The database contains quarterly bank-level information on payment cards, ATMs, POS terminals and related transactions volumes and values as well as prices for debit (interchange and merchant fees) and credit card transactions (interchange fees, merchant fees and annual credit card fees). It also contains time-series data on merchant acceptance for debit and credit cards.

Since most of the banks in the sample operate in different regions, the variable for merchant acceptance by acquirer has been computed as an (branch weighted) average of merchant acceptance in the different regions where the (acquirer) bank operates. Similarly, the variable for merchant acceptance at the network level has been computed as a branch-weighted average of the percentage of merchants accepting cards for purchase transactions in the regions where the bank or any other banks belonging to the same network operate over the total number of merchants in those regions.

Additionally, although the maximum and minimum thresholds of interchange fees for different merchant activities is set at the network level, the average bank-level merchant fee varies depending on the actual fee charged and the proportion of the bank's POS debit and credit transactions by merchant sector. Therefore, the merchant discount fee charged by a bank is computed as a transaction weighted-average of merchant discount fees charged by the bank in the different merchant sectors accepting the bank's POS machines.

We also incorporate the availability of cash infrastructure such as ATMs into our analysis. Our data also includes information on ATM density and allows us to compute a rival ATM density variable as a proxy of the relative costs of withdrawing cash at rivals' ATMs.

[10] Our sample banks represented 56.7% of total card payment transactions in 1997 and 64.8% in 2007 when compared to the aggregate date provided by the Bank of Spain.

Some other variables are considered in the database as region-specific control variables that may have an influence on card transactions such as the crime rate. We also control for the four main regulatory changes shown in Table 2 including dummies for those regulatory changes. Table 3 provides the main definitions of the posited explanatory variables.

Our crime data is region specific and measures robberies and assaults per 1,000 residents in a given region. If the bank operates in more than one region, we use a weighted average by the number of bank branches in the region.

6. Main Results

In tables 6-10, we report our regression results. Generally, we find that consumers and merchants benefit from lower in interchange fees during our sample period because an increase in merchant card acceptance results in greater adoption and usage of payment cards. Furthermore, we find that issuer and acquirer revenues increased because lower interchange fees resulted in more transactions. The revenue from increased transactions offsets the decrease in per-transaction revenue for issuers during our sample period. For acquirers, the percentage difference between the merchant discount and the interchange fee remained steady for a significant part of our sample. We will first discuss debit card extensive and intensive margins and then discuss our credit card results.

Debit Card Adoption and Usage

Our empirical analysis strongly suggests that government mandated or encouraged reductions in interchange fees resulted in lower merchant debit card fees and greater merchant debit card acceptance (see table 6). Specifically, a 10 percent reduction in the rate of decline in

the average merchant discount fee by an acquirer resulted in a .43 percent rate of increase in merchant acceptance. Neither bank size nor crime is statistically significant.

The signs of all the regulatory dummies except for 1999 suggest that lower interchange fees strongly impacted the rate of merchant acceptance. However, the impact of each intervention was different suggesting that not all interventions were equal in convincing merchants to adopt debit cards. Furthermore, the consistent positive sign on the last three regulatory dummies suggests that merchant acceptance increased with further reductions in interchange fees. Note that in 2005, there was a change in the way debit card interchange fee was imposed from a transaction percentage to a fixed per-transaction fee.

While we are unable to isolate a price effect for consumer adoption debit card services, we find strong evidence to support our hypothesis that consumers value greater merchant acceptance and react to increases in the price of the main alternative payment instrument—cash. Specifically, a 10 percent increase in the rate of merchant adoption resulted in a .36 percent increase in adoption rate of debit cards by consumers. As the rival ATM density increases, consumer adoption of debit cards increases suggesting that increases in cash acquisition costs impacts positively on debit card adoption. Specifically, a 10 percent increase in the rate of growth of rival ATM density resulted in a 1.64 percent increase in the growth rate of debit card adoption.

Now, we turn to the intensive margin for debit cards (see table 7). First, let's consider the impact of interchange fee regulation on merchant transactional volume from looking at acquirer transactional volume per POS terminal as the dependent variable (table 6, column2). The interaction of merchant acceptance at an acquirer and the total number of cards is significant and positive suggesting that the rate of growth of debit card transactions has increased because there

are more merchants and consumers on board because of lower interchange fees. Specifically, a 10 percent increase in the growth rate of merchant adoption resulted in a debit card transaction growth of .36 percent.

All the regulatory dummies are positive and significant suggesting that regulatory intervention increased overall usage at merchant locations. The rate of transaction growth is highest for the period after 2005 suggesting that the later regulatory interventions had more impact on transactional volume at acquirers.

The increase in issuer transactions proxies for the increase in consumer usage albeit imperfectly. The key explanatory variable is the interaction of merchant acceptance and cards issued by a bank. The interaction term is significant and positive suggesting that an increase in consumer and merchant adoption growth rates increases the rate of growth for consumer transactions (table 7, column 3). Specifically, a 10 percent increase in the rate of the interaction of network merchant acceptance and debit cards issued by an issuer resulted in a .46 percent increase in an issuer's debit card transactions per card. Furthermore, a 10 percent increase in the growth of rival ATM density resulted in a .63 percent increase in the rate of issuer debit card transactions per card. In other words, in a cash-intensive country such as Spain, an increase in cash acquisition costs strongly encourages adoption of debit cards.

All the regulatory dummies are positive and significant suggesting that decreases in debit card interchange fees increased debit card transactions for issuers. As before, the later regulatory actions impact issuer transaction volume growth more. Specifically, the issuer transactional growth rate for 1999 dummy is .096 percent whereas the growth rate for the 2005 dummy is .233 percent.

Both the extensive and intensive debit card margin regressions suggest that consumer and merchant welfare improved when interchange fees were reduced. Not only are transactions occurring at more merchant locations, but each cardholder is using her card more frequently.

Credit Card Adoption and Usage

The underlying dynamics of credit card adoption is significantly different from debit card adoption where consumers had them in their wallets before they started to use them because debit cards also functioned as ATM cards. Reductions in credit card merchant discount fees increased merchant acceptance of credit cards (see table 8). Specifically, a 10 percent increase in the rate of decline of the average merchant discount of an acquirer increased the growth rate of merchant acceptance by 1.59 percent. A 10 percent growth in credit card adoption resulted in a 1.63 percent growth in the acceptance of credit cards by merchants. Note that only the last two regulatory dummies are significant suggesting that the initial regulatory interventions were not as effective in increasing merchant acceptance as the last two.

As our priors suggested, the number of cards issued by an issuer is positively impacted by the number of merchants that accept credit cards (table 8, column 3). Specifically, a 10 percent increase in the growth rate in merchant acceptance increases the growth of credit card issuance by 3.0 percent.

A key result is that growth in the number of cards issued is not affected by the annual fee suggesting that the interchange fee was not previously socially optimal. We are unable to disentangle two potential reasons for this insignificance. First, consumers may be fairly inelastic to increases to credit card annual fees. Second, they are willing to pay higher fees if more merchants accept credit cards. Regardless of why consumers do not respond to prices, there may

be benefits to increasing merchants that accept credit cards by imposing higher costs on consumers. These benefits stem from the network externality of merchant acceptance.

We report credit card merchant and consumer intensive margins in table 9. A 10 percent increase in the growth of the interaction term of acceptance by merchants using the same acquirer and total credit cards in the network results in a 2.44 percent increase in the growth of acquirer transactions at the point of sale (table 9, column2). Interestingly, the crime rate is also positive and statistically significant. One cautious interpretation would be that credit cards unlike debit cards are used for large purchases and merchants are more willing to accept them because carrying large amounts of cash is undesirable in high crime areas. The regulatory dummies when significant have positive signs.

We report the consumer intensive margin in table 9, column 3. We find that a 10 percent increase in the growth rate of the interaction term of merchant acceptance in the network and credit cards issued by an issuer results in a 1.93 percent increase in issuer transaction volume. The coefficient on the crime rate also is significant and positive suggesting that higher crime rates induce shift from cash to credit cards, which are generally used for higher-value purchases. Similarly, all the regulatory dummies are significant and positive.

Mandatory reductions in credit card interchange fees have improved consumer and merchant welfare as evidenced by greater adoption and usage. We analyze the impact of interchange fee regulation on bank revenues in the next section.

Bank revenues

In table 10, we report our results for bank revenues. In the second and third columns, we report debit card acquiring revenue and debit card issuing revenue regression results,

respectively. In the fourth and fifth columns, we report credit card acquiring and credit card issuing revenue regression results, respectively. In both sets of regressions, the increase in the number of transactions is positively correlated with bank revenues suggesting that while per-transaction revenue may have decreased, overall revenues increased because the revenue from increased transactions volume offset the decrease in per-transaction revenue for the time period of our sample.

However, the impact of regulatory dummies is more significant on the issuing side than the acquiring side as also evidenced by the goodness of fit. This result is consistent with the fact that the acquiring side of the business may be more competitive and any reductions in interchange fees would result in an equal magnitude decrease in the merchant discount. We reported earlier that the correlation between the movements in merchant discounts and the interchange fees are close to one. On the issuing side, the reduction in interchange fees is positively and significantly related to bank revenues suggesting that competition may have been too intense on the issuing side resulting in "too high" merchant discount and interchange fees. In turn, fewer card transactions took place at this socially inferior interchange fee.

We present our bank revenue results somewhat cautiously because we are unable to consider additional costs that may have been incurred putting downward pressure on profits. Bolt and Chakravorti (2008a) develop a model that finds lower bounds for merchant fees and implicitly interchange fees based on underlying cost structures. A more complete analysis would consider bank payment card profits instead of revenues. Unfortunately, our dataset does not allow such analysis.

7. Robustness tests

In this section, we conduct several robustness tests to consider alternate explanations for increased adoption and usage of payment cards.

Other Simultaneous Equation Specifications

We have tried other specifications for the simultaneous equations estimations. In particular, we estimated the system using two-stage-least squares, three-stage least squares and seemingly-unrelated regressions. Although the results were overall qualitatively similar, the goodness of fit of these estimations was far poorer than our GMM estimations.

In the GMM baseline results, autocorrelation tests are included to examine the possibility that lagged values of the dependent variables might affect, at least partially, the current values of these variables. In this case, a "dynamic" specification with lagged dependent variables as regressors could address these feedback effects. However, the values of these tests in all our regressions suggest that the null hypothesis of no serial correlation cannot be rejected and, therefore, do not warrant using dynamic specification. In any event, regressions using dynamic panel techniques were also undertaken and the coefficients of the lagged dependent variables were not found to be significant in any of the equations.

Variations in regulatory dummy specification

As for our stepwise dummies showing the effects of changes in interchange fee regulation, various alternatives were considered. The dummies were introduced one by one in the equations and the results were very similar to those obtained when they are included altogether.

Additionally, to identify the regulatory changes, a potential disadvantage of the dummies is that they are a stepwise and discontinuous approximation of the regulatory effect across time. Linear splines give a more precise approximation of the effect of interchange fee regulations as a set of continuous linear functions. Therefore, as a robustness check, we reran our regressions with splines instead of dummies. We approximate the splines as the difference in the number of quarters between four subintervals (the regulatory events). The end points of the linearly approximated subintervals are known as "knots" and the specification of the spline is

$f(x) = \alpha_i[(x_{i+1} - x)/(x_{i+1} - x_i)] + \alpha_{i+1}[(x - x_i)/(x_{i+1} - x_i)]$ when $x \in (x_i, x_{i+1})$ and 0 otherwise,

where x is the quarter considered, and x_i are the "knots." The use of splines did not change our results with all the coefficients for the regulatory events maintaining their signs and no statistically significant differences with the estimated values of the coefficients from the dummies in our baseline results.

Estimations for different sub-periods and related regulatory effects

A simpler (although less informative) approach to likely changes in merchants and consumers' intensive and extensive margins is estimating our main equations for four different time periods (1997-1998, 1999-2001, 2002-2004 and 2005-2007). Table 11 (panels A to D) show the results for this alternative specification. As for merchant adoption of debit and credit cards (Table 11, panels A and B), the effects of changes in debit merchant discount fees on merchant adoption and of merchant acceptance in the network on the number of debit cards are from 1 to 3 times higher in the 1999-2001 and 2005-2007 periods than in the other two periods. These differences are statistically significant according to Wald tests of differences in the estimated coefficients and suggest that the dynamics of prices and adoption and usage particularly

increased in the periods where interchange fees were reduced to a larger extent due to mandated or encouraged government intervention. In the case of credit cards, related differences in the magnitude of the coefficients for the abovementioned sub-periods are a bit lower (from 1 to 1.5 times higher) although also statistically significant according to Wald tests (not shown for simplicity).

Alternative control variables

The results also seemed robust to alternative specifications of the control variables and, in particular, the time trend. A potential weakness of the proposed specification is that the trend is not appropriately capturing over time changes that may overlap with the identified impact of regulatory dummies. In particular, factor such as non linear trends, business cycle influences or technological changes may affect our results. In order to control for these potential influences we have also tried other types of variables to pick them up such as a quadratic time trend, GDP growth and Internet penetration. It may also be the case that the dynamics of intensive and extensive margins may be different in territories with different levels of card usage due to idiosyncratic features such as differences in the presence of tourists that may make adoption and usage potentially heterogeneous across regions, thereby affecting to a larger extent those banks, merchants and consumers in more touristic regions. We have considered these influences by estimating our main equations for two sub-samples separating regions over the median value of tourism revenues over GDP and below that median value. The results for all these alternative specifications are shown in Table 12 (panels A to D) and suggest that none of these alternative specifications significantly change our baseline results and conclusions since our main variables exhibit the same signs and similar coefficient magnitudes.

8. Conclusion

The structure of fees in two-sided markets has been addressed in the theoretical literature but there has been little empirical analysis regarding the impact of changes to fee structures. Theory predicts that platforms in two-sided markets may subsidize the participation of one set of agents by extracting surplus from another set of agents to internalize indirect network externalities. We find evidence that reducing interchange fees have a positive effect on consumer and merchant adoption and usage when merchant adoption is far from complete.

While we are unable to study the impact of interchange fee regulation on bank profits, we find that bank revenues increased because the increase in the number of transactions offset the decrease in the per-transaction revenue. However, there is most likely a critical interchange fee below which revenues no longer increase. Unfortunately, given our data limitations, we are unable to quantify the critical interchange fee.

Interestingly, other market-based solutions may result in maximizing social welfare such as price discrimination based on the benefits received by each merchant and each consumer. For example, in other countries such as the United States, interchange fees for new entrants such as grocery stores in the 1990s were reduced significantly by payment card networks to encourage merchant acceptance of payment cards without government encouragement. Such market-based strategies also internalize the merchant adoption externality. Thus, our results should not be viewed as a blanket endorsement for government-encouraged interchange fee reductions.

Once merchant and consumer adoption is complete, interchange fee regulation may only result in redistribution of surplus among participants, most notably between banks and merchants. In other words, interchange fee regulation would not necessarily improve social

welfare. In this case, we are agnostic about the distribution of surplus among payment card market participants.

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Table 1: Regulatory Actions Affecting the Setting of Interchange Fees

Year	Regulatory action	Regulatory body	Main implications for interchange fees
1999	REDUCTION OF INTERCHANGE FEES	THE SPANISH MINISTRY OF THE ECONOMY	Interchange fees were gradually reduced from around 3.5% in 1999 to 2.75% in July 2002.
2002	INVESTIGATION ON THE SETTING OF INTERCHANGE FEES (MORAL SUASION)	SPAIN'S ANTITRUST AUTHORITY	Following the investigations of the European Commission on cross-border interchange fees, the Spain's Antitrust Authority (the TDC) requested the Spanish payment card networks to provide information on their method of determining interchange fee.
2003	PROPOSALS FROM THE NETWORKS ON THE SETTING OF INTERCHANGE FEES ARE REFUSED (MORAL SUASION)	SPAIN'S ANTITRUST AUTHORITY	The TDC refused several proposals of the networks on their setting of interchange fees.
2005	A REDUCTION OF INTERCHANGE FEES AND A FINAL DATE FOR THE ADOPTION OF A COST-BASED MODEL	THE SPANISH MINISTRY OF INDUSTRY, TOURISM AND TRADE	From January 2006 until December 2008, the maximum level for an interchange fee would be progressively reduced. From 2009 onwards each of the card networks would audit their operations and provide a cost-based analysis for debit and credit cards.

Source: Summary of regulatory developments mainly based on the following resolutions: Spanish Antitrust Authority (Tribunal de Defensa de la Competencia, TDC) resolution on the reduction of interchange fees (24 September 1999), Resolution of the European Commission (DG Competition COMP/29373) on the setting of cross-border interchange fees by Visa International (July 24, 2002), TDC inquiries on the setting of interchange fees by the card networks SISTEMA 4B (inquiry A 314/2002) and SERVIRED (inquiry 318/2002). TDC resolution denying the special authorizations on the setting of interchange fees to all Spanish card networks and requiring them to reduce these fees and to adopt a cost-based model (April 11, 2005).

Table 2: Recent Trends in Card Payments in Spain (1997-2007)

All the monetary magnitudes are expressed in real terms

	1997	**2007**
Total Number of Debit Cards (millions)	22	31
Total Number of Credit Cards (millions)	14	43
Total Number of Debit Card Transactions (millions)	156	863
Total Number of Credit Card Transactions (millions)	138	1037
Average number of POS transactions (per card and year)	7.1	27.8
Average number of ATM withdrawals (per card and year)	23.9	32.6
Average Value of Debt Card Transaction (€)	38.5	46.0
Average Value of Credit Card Transaction (€)	58.5	54.3
Average POS density (POS/km^2)	1.28	2.89
Average ATM density (ATMs/km^2)	0.07	0.12
Average Interchange Fee $^{(*)}$ (%)	1.71$^{(a)}$	0.90
Average Debit Card Interchange Fee$^{(**)}$ (€/transaction)	-	0.40
Average Credit Card Interchange Fee$^{(**)}$ (%)	-	0.93

(a) Data for 2002, the earliest public data available for the average interchange fees for the entire Spanish market.
(*) Average percentage value of total debit and credit, on-us and intersystem interchange fees.
(**) As a consequence of the intervention of the Spanish Ministry of Industry, Tourism and Trade in 2005, a distinction is made between the applicable debit card interchange fees and credit card interchange fees, with debit card transactions becoming a fixed amount per transaction and credit card transactions continuing to be a percentage amount per transaction.

Source: Bank of Spain and authors' own calculations

Table 3: Variable Definitions

Debit card merchant acceptance by acquirer ($MACCD_{it}$)	Computed as (branch-weighted) average of the percentage of merchants accepting debit cards for purchase transactions in the regions where the bank operates over the total number of merchants in those regions.
Credit card merchant acceptance by acquirer ($MACCC_{it}$)	Computed as (branch-weighted) average of the percentage of merchants accepting credit cards for purchase transactions in the regions where the bank operates over the total number of merchants in those regions.
Debit card merchant acceptance in the network ($MACCDN_t$)	The percentage of merchants accepting debit cards where the network operates.
Credit card merchant acceptance in the network ($MACCCN_t$)	The percentage of merchants accepting credit cards where the network operates.
Merchant debit card discount fee ($MFEED_{it}$)	Average (transaction-weighted) debit card merchant discount fee charged by the bank computed as the (transaction-weighted) average discount fee charged to the merchants accepting the bank POS device.
Merchant credit card discount fee ($MFEEC_{it}$)	Average (transaction-weighted) credit card merchant discount fee charged by the bank computed as the (transaction-weighted) average discount fee charged to the merchants accepting the bank POS device.
Number of debit cards by issuer ($DCARDS_{it}$)	Total number of debit cards issued by a bank.
Number of credit cards by issuer ($CCARDS_{it}$)	Total number of credit cards issued by a bank.
Number of debit cards in the network ($DCARDSN_t$)	Total number of debit cards issued by the network.
Number of credit cards in the network ($CCARDSN_t$)	Total number of credit cards issued by the network.
Debit card transactions at the POS ($DEBPOSTR_{it}$)	Debit card transactions per POS terminal by an acquirer.
Credit card transactions at the POS ($CREDPOSTR_{it}$)	Credit card transactions per POS terminal by an acquirer.
Debit card transactions (issuer perspective) ($DEBISS_{it}$)	Debit card transactions per card by issuer.
Credit card transactions (issuer perspective) ($CREDISS_{it}$)	Credit card transactions (month-end/no interest) per card by issuer.
Rival ATM density ($RATMD_{it}$)	Number of an issuer's rival bank ATMs per km^2 in the regions where the bank operates.
Annual credit card fee ($AFEECRED_{it}$)	Average (asset-weighted) annual credit card fee changed by the bank.
Bank size (in the card network) ($BSIZE_{it}$)	Number of bank card transactions over the total number of card transactions in the network in which the bank operates.
Crime rate ($CRIME_{it}$)	The (asset-weighted) ratio of robbery & assaults per 1000 inhabitants in the regions where the acquirer or issuer operates.
Bank (debit card) acquiring revenues (BANKDACR)	Acquirer income from debit card merchant discount fees
Bank (debit card) issuing revenues (BANKDISR)	Issuer income from debit card interchange fees
Bank (credit card) acquiring revenues (BANKCACR)	Acquirer income from credit card merchant discount fees
Bank (credit card) issuing revenues (BANKCISR)	Issuer income from credit card interchange fees and credit card annual fees
Regulation dummy 1999 (*REG99*)	This variable takes the value 1 during the time that the level of interchange fees were reduced by regulation from 1999 to 2002 and zero otherwise.
Regulation dummy 2002 (*REG02*)	This variable takes the value 1 from 2002 to 2003 and zero otherwise and controls for changes related to the moral suasion pressures following the investigation by the Spanish antitrust authority on the collective setting of interchange fees.
Regulation dummy 2003 (*REG03*)	This variable takes the value 1 from 2003 to 2005 and zero otherwise and controls for the increasing pressures and moral suasion on the setting or interchange and the refusal of the proposals for special authorization of collective determination of these fees by the card networks.
Regulation dummy 2005 (*REG05*)	This variable takes the value 1 from 2005 onwards and zero otherwise and controls for changes related to a regulatory initiative on the reduction of interchange fees and the requirement of adoption of a cost-based model for interchange fee setting.
GDP growth	Computed as (branch-weighted) average of the growth of regional domestic product in the regions where each bank operates.
Internet penetration rate	Computed as (branch-weighted) average yearly increase of Internet users in the Spanish regions according to the Survey on Household Technology Adoption elaborated by INE.

SOURCES: All variables related to card payments have been provided by a payment network of 45 Spanish banks. The crime rate variables have been obtained from the Spain's Statistical Office (INE).

EXPLANATORY NOTES:

- All monetary magnitudes are expressed in real terms.
- All variables (except for regulatory dummies are in logarithms)

Table 4: Summary Statistics

	Mean	Std. dev.	Min	Max
Debit card merchant acceptance by acquirer in regions where it has branches ($MACCD_{it}$) (%)	55.36	2.16	51.15	59.36
Credit card merchant acceptance by acquirer in regions where it has branches ($MACCC_{it}$) (%)	57.23	1.97	52.12	61.06
Debit card merchant acceptance in the network ($MACCDN_t$) (%)	58.02	2.02	53.60	61.94
Credit card merchant acceptance in the network ($MACCCN_t$) (%)	59.37	1.92	53.51	62.49
Merchant debit card discount fee by acquirer ($MFEED_{it}$) (%)	1.36	1.18	0.36	3.18
Merchant credit card discount fee by acquirer ($MFEEC_{it}$) (%)	2.03	1.93	1.06	3.56
Number of debit cards by issuer ($DCARDS_{it}$) (millions)	0.48	0.72	0.02	4.2
Number of credit cards by issuer ($CCARDS_{it}$) (millions)	0.55	0.94	0.01	4.9
Number of debit cards in the network ($DCARDSN_t$) (millions)	16	5.8	12	21
Number of credit cards in the network ($CCARDSN_t$) (millions)	20	6.3	10	32
Debit card transactions at the POS by acquirer ($DEBPOSTR_{it}$) (millions)	11.14	34.18	0.11	88.1
Credit card transactions at the POS by acquirer ($CREDPOSTR_{it}$) (millions)	12.28	56.26	0.09	94.7
Debit card transactions by issuer ($DEBISS_{it}$) (%)	1.21	4.16	0.04	10.27
Credit card transactions by issuer ($CREDISS_{it}$) (%)	1.60	5.21	0.02	12.56
Rival ATM density by issuer ($RATMD_{it}$) (ATMs/km^2)	0.9	0.4	0.3	1.5
Annual credit card fee by issuer ($AFEECRED_{it}$) (euros)	15	10	3	35
Bank size (in the card network) ($BSIZE_{it}$) (%)	1.16	4.02	0.01	11.28
Crime rate ($CRIME_{it}$)	0.37	0.21	0.10	0.68
Bank (debit card) acquiring revenues *(BANKDACR)* (€ millions)	4.31	2.19	0.08	45.23
Bank (debit card) issuing revenues *(BANKDISR)* (€ millions)	25.43	13.84	0.32	114.15
Bank (credit card) acquiring revenues *(BANKCACR)* (€ millions)	6.17	3.12	0.11	54.89
Bank (credit card) issuing revenues *(BANKCISR)* (€ millions)	28.06	14.16	0.23	131.12

Table 5: Identification of the equations: exclusion restrictions, instruments and control factors

Equation	Exclusion restrictions	Instruments	Control factors
Consumer extensive margin (debit cards)	- Rival ATM density - Merchant acceptance	- Lagged rival ATM density - Lagged merchant acceptance - Lagged (GDP) - Lagged (population growth)	- Bank size - Crime rate -Time trend
Consumer extensive margin (credit cards)	- Annual fees - Merchant acceptance	- Lagged annual fees - Lagged merchant acceptance - Lagged (GDP) - Lagged (population growth)	
Merchant extensive margin (debit cards)	- Debit card merchant fees - Number of debit cards in the network	- Lagged (debit cards merchant fees) - Lagged (number of debit cards in the network) - Lagged (GDP) - Lagged (population growth)	
Merchant extensive margin (credit cards)	- Credit card merchant fees - Number of credit cards in the network	- Lagged (credit card merchant fees) - Lagged (number of credit cards in the network) - Lagged (GDP) - Lagged (population growth)	
Consumer intensive margin (debit cards)	- (Merchant acceptance of debit cards by acquirer) x (total number of debit cards in that network)	- Lagged (merchant acceptance of debit cards by acquirer) x (total number of debit cards in that network) - Lagged (GDP) - Lagged (population growth)	
Merchant intensive margin (debit cards)	- (Merchant acceptance of debit cards in the network) x (number of debit cards issued by the bank)	- Lagged (merchant acceptance of debit cards in the network) x (number of debit cards issued by the bank) - Lagged (GDP) - Lagged (population growth)	
Consumer intensive margin (credit cards)	- (Merchant acceptance of credit cards by acquirer) x (total number of credit cards in that network)	- Lagged (merchant acceptance of credit cards by acquirer) x (total number of credit cards in that network) - Lagged (GDP) - Lagged (population growth)	
Merchant intensive margin (credit cards)	- (Merchant acceptance of credit cards in the network) x (number of credit cards issued by the bank)	- Lagged (merchant acceptance of credit cards in the network) x (number of credit cards issued by the bank) - Lagged (GDP) - Lagged (population growth)	
Acquirer revenues	- (Merchant acceptance of the acquirer) x (total number of cards in the network)	- Lagged (merchant acceptance of the acquirer) x (total number of cards in the network) - Lagged (GDP) - Lagged (population growth)	
Issuer revenues	- (Number of cards issued by each issuer) x (proportion of merchants accepting in the network)	- Lagged (number of cards issued by each issuer) x (proportion of merchants accepting in the network) - Lagged (GDP) - Lagged (population growth)	

Table 6: Debit Card Extensive Margins for Consumers and Merchants
Simultaneous Equation estimation (GMM with fixed effects)
(Clustered standard errors by bank in parentheses)

	Merchant extensive margin (debit cards)	***Consumer extensive margin (debit cards)***
	Merchant acceptance by acquirer($MACCD_{it}$)	*Number of debit cards by issuer ($DCARDS_{it}$)*
Constant	0.24E-11 (0.001)	0.21E-12 (0.001)
Merchant acceptance in the network ($MACCDN_{t-1}$)	-	0.0363** (0.012)
Merchant debit card discount fee ($MFEED_{it}$)	-0.0429** (0.005)	-
Number of debit cards in the network ($DCARDSN_t$)	0.0015** (0.002)	-
Rival ATM density ($RATMD_{it}$)	-	.1637** (0.014)
Bank size (in the card network) ($BSIZE_{it}$)	0.0122 (0.021)	0.0443** (0.018)
Crime rate ($CRIME_{it}$)	-0.0268 (0.161)	-0.0123 (0.852)
Linear time trend	0.0193** (0.005)	0.1951** (0.018)
Regulation dummy 1999 (REG99)	-0.0234* (0.013)	0.0926** (0.011)
Regulation dummy 2002 (REG02)	0.0116** (0.008)	-0.1425* (0.016)
Regulation dummy 2003 (REG03)	0.0155** (0.007)	-0.1007 (0.023)
Regulation dummy 2005 (REG05)	0.0126** (0.005)	-0.1852** (0.035)
Adjusted R^2	0.82	0.71
Sargan test of overidentifying restrictions (p-value in parentheses)	68.58 (0.005)	
AR(1) (p-value in parentheses)	-0.1009 (0.920)	
AR(2) (p-value in parentheses)	−1.237 (0.216)	
** Statistically significant at 5% level* *** Statistically significant at 1% level*		

Table 7: Debit Card Intensive Margins for Consumers and Merchants
Simultaneous Equation Estimation (GMM with fixed effects)
(Clustered standard errors by bank in parentheses)

	Merchant intensive margin (debit cards)	***Consumer intensive margin (debit cards)***
	Debit card transactions per POS terminal ($DEBPOSTR_{it}$)	*Debit card transactions per card (issuer perspective) ($DEBISS_{it}$)*
Constant	0.04E-13 (0.001)	-0.03E-10 (0.001)
Merchant acceptance by acquirer ($MACCD_{it-1}$)X Number of debit cards in the network ($DCARDSN_{t-1}$)	0.0359** (0.004)	-
Merchant acceptance in the network ($MACCDN_{t-1}$)X Number of debit cards by issuer ($DCARDS_{it-1}$)	-	0.0458** (0.009)
Rival ATM density ($RATMD_{it}$)	-	0.0630* (0.018)
Bank size (in the card network) ($BSIZE_{it}$)	0.0441* (0.004)	0.0112 (0.013)
Crime rate ($CRIME_{it}$)	0.1503 (0.323)	0.1130 (0.692)
Linear time trend	0.1853** (0.001)	0.1138** (0.002)
Regulation dummy 1999 (REG99)	0.0226* (0.004)	0.0963** (0.004)
Regulation dummy 2002 (REG02)	0.1308** (0.008)	0.0635* (0.008)
Regulation dummy 2003 (REG03)	0.0921* (0.005)	0.1002* (0.019)
Regulation dummy 2005 (REG05)	0.2528** (0.011)	0.2331** (0.011)
Adjusted R^2	0.89	0.71
Sargan test of overidentifying restrictions (p-value in parentheses)	154.29 (0.001)	
AR(1) (p-value in parentheses)	−1.528 (0.129)	
AR(2) (p-value in parentheses)	−1.416 (0.136)	

** Statistically significant at 5% level*
*** Statistically significant at 1% level*

Table 8: Credit Card Extensive Margins for Consumers and Merchants
Simultaneous Equation Estimation (GMM with fixed effects)
(Clustered standard errors by bank in parentheses)

	Merchant extensive margin (credit cards)	*Consumer extensive margin (credit cards)*
	Merchant acceptance by acquirer ($MACCC_{it}$)	*Number of credit cards by issuer ($CCARDS_{it}$)*
Constant	-0.30E-06 (0.001)	0.53E-06 (0.001)
Merchant acceptance in the network ($MACCCN_{t-1}$)	-	0.2985** (0.007)
Merchant credit card discount fee ($MFEEC_{it}$)	-0.1585** (0.023)	-
Number of credit cards in the network ($CCARDSN_t$)	0.1630** (0.018)	-
Annual credit card fee ($AFEECRED_{it}$)	-	0.6023 (0.730)
Bank size (in the card network) ($BSIZE_{it}$)	0.0045* (0.001)	-0.0013 (0.019)
Crime rate ($CRIME_{it}$)	0.0696* (0.012)	0.0651** (0.018)
Linear time trend	0.1694** (0.001)	0.1388** (0.042)
Regulation dummy 1999 (REG99)	-0.0950 (0.011)	0.0372** (0.004)
Regulation dummy 2002 (REG02)	0.0633 (0.071)	-0.0231 (0.032)
Regulation dummy 2003 (REG03)	0.1124** (0.055)	0.2651** (0.018)
Regulation dummy 2005 (REG05)	0.2023** (0.018)	0.2955** (0.009)
Adjusted R^2	0.87	0.93
Sargan test of overidentifying restrictions (p-value in parentheses)	152.28 (0.001)	
AR(1) (p-value in parentheses)	-1.198 (0.231)	
AR(2) (p-value in parentheses)	−1.677 (0.094)	

** Statistically significant at 5% level*
*** Statistically significant at 1% level*

Table 9: Credit Card Intensive Margins for Consumers and Merchants
Simultaneous Equation Estimation (GMM with fixed effects)
(Clustered standard errors by bank in parentheses)

	Merchant intensive margin (credit cards)	*Consumer intensive margin (credit cards)*
	Credit card transactions per POS terminal ($CREDPOSTR_{it}$)	*Credit card transactions per card (issuer perspective) ($CREDISS_{it}$)*
Constant	0.10E-07 (0.001)	-0.13E-05 (0.001)
Merchant acceptance by acquirer($MACCC_{it-1}$)X Number of credit cards in the network ($CCARDSTN_{t-1}$)	0.2243* (0.005)	-
Merchant acceptance in the network ($MACCCN_{t-1}$)X Number of credit cards by issuer ($CCARDS_{it-1}$)	-	0.1931** (0.002)
Bank size (in the card network) ($BSIZE_{it}$)	-0.1814 (0.226)	0.0108** (0.003)
Crime rate ($CRIME_{it}$)	0.0995* (0.008)	0.0550* (0.016)
Linear time trend	0.2201** (0.006)	0.1864** (0.002)
Regulation dummy 1999 (REG99)	0.0428 (0.063)	0.0792* (0.008)
Regulation dummy 2002 (REG02)	0.2633** (0.004)	0.2131** (0.002)
Regulation dummy 2003 (REG03)	0.1491* (0.003)	0.1016* (0.004)
Regulation dummy 2005 (REG05)	0.2950** (0.009)	0.3056** (0.004)
Adjusted R^2	0.68	0.95
Sargan test of overidentifying restrictions (p-value in parentheses)	66.34 (0.02)	
AR(1) (p-value in parentheses)	−0.6453 (0.421)	
AR(2) (p-value in parentheses)	−1.176 (0.192)	
** Statistically significant at 5% level* *** Statistically significant at 1% level*		

Table 10: Impact on Bank Issuing and Acquiring Revenues
Simultaneous Equations Estimation (GMM with fixed effects)
(Clustered standard errors by bank in parentheses)

	Bank (debit card) acquiring revenues (BANKDACR)	*Bank (debit card) issuing revenues (BANKDISR)*	*Bank (credit card) acquiring revenues (BANKCACR)*	*Bank (credit card) issuing revenues (BANKCISR)*
Constant	0.11E-07* (0.001)	0.09E-10* (0.001)	0.04E-09* (0.001)	0.09E-10 (0.001)
Merchant acceptance by acquirer ($MACCD_{it-1}$) X Number of debit cards in the network ($DCARDSN_{t-1}$)	0.0362* (0.014)	-	-	-
Number of debit cards by issuer ($DCARDS_{it-1}$) X Merchant acceptance in the network ($MACCDN_{t-1}$)	-	0.1432** (0.008)	-	-
Merchant acceptance by acquirer ($MACCC_{it-1}$) X Number of credit cards in the network ($DCARDSN_{t-1}$)	-	-	0.0838** (0.008)	-
Number of credit cards by issuer ($DCARDS_{it-1}$) X Merchant acceptance in the network ($MACCDN_{t-1}$)	-	-	-	0.1743** (0.005)
Rival ATM density ($RATMD_{it}$)	0.0020 (0.004)	0.00672 (0.005)	-	
Bank size (in the card network) ($BSIZE_{it}$)	0.0837** (0.009)	0.1284** (0.0010)	0.1924** (0.005)	0.0754** (0.004)
Crime rate ($CRIME_{it}$)	0.0346 (0.047)	0.0182 (0.019)	0.0305 (0.034)	0.0310 (0.040)
Liner time trend	0.6684** (0.003)	0.6577** (0.004)	0.5938** (0.006)	0.8036** (0.006)
Regulation dummy 1999 (REG99)	0.0110 (0.011)	0.0439 (0.082)	0.01432 (0.033)	0.0320 (0.077)
Regulation dummy 2002 (REG02)	0.0189 (0.019)	0.0916** (0.003)	0.0316 (0.031)	0.0671** (0.005)
Regulation dummy 2003 (REG03)	0.04461* (0.009)	0.1432** (0.004)	0.0925* (0.010)	0.1946** (0.006)
Regulation dummy 2005 (REG05)	0.031 (0.027)	0.1673** (0.001)	0.1063 (0.012)	0.2838** (0.003)
Adjusted R^2	0.42	0.88	0.44	0.89
Sargan test of overidentifying restrictions (p-value in parentheses)	215.36 (0.001)		184.12 (0.001)	
AR(1) (p-value in parentheses)	−0.6533 (0.510)		−0.7142 (0.493)	
AR(2) (p-value in parentheses)	−0.7760 (0.516)		−0.8471 (0.398)	

** Statistically significant at 5% level*
*** Statistically significant at 1% level*

Table 11 (Panel A): Estimations for different sub-periods: Debit Card Extensive Margins for Consumers and Merchants Simultaneous Equation estimation (GMM with fixed effects)

(Clustered standard errors by bank in parentheses)

	1997-1998		***1999-2001***		***2002-2004***		***2005-2007***	
	Merchant extensive margin (debit cards)	***Consumer extensive margin (debit cards)***	***Merchant extensive margin (debit cards)***	***Consumer extensive margin (debit cards)***	***Merchant extensive margin (debit cards)***	***Consumer extensive margin (debit cards)***	***Merchant extensive margin (debit cards)***	***Consumer extensive margin (debit cards)***
	Merchant acceptance by acquirer ($MACCD_{it}$)	*Number of debit cards by issuer ($DCARDS_{it}$)*	*Merchant acceptance by acquirer ($MACCD_{it}$)*	*Number of debit cards by issuer ($DCARDS_{it}$)*	*Merchant acceptance by acquirer ($MACCD_{it}$)*	*Number of debit cards by issuer ($DCARDS_{it}$)*	*Merchant acceptance by acquirer ($MACCD_{it}$)*	*Number of debit cards by issuer ($DCARDS_{it}$)*
Merchant acceptance in the network ($MACCDN_{t-1}$)	-	0.0227** (0.010)	-	0.0305** (0.012)	-	0.0188** (0.011)	-	0.0429** (0.011)
Merchant debit card discount fee ($MFEED_{it}$)	-0.0053** (0.004)	-	-0.0388** (0.005)	-	-0.0114** (0.005)	-	-0.0558** (0.004)	-
Number of debit cards in the network ($DCARDSN_t$)	0.0010** (0.001)	-	0.0016** (0.002)	-	0.0012** (0.002)	-	0.0017** (0.002)	-
Adjusted R^2	0.62	0.59	0.67	0.62	0.61	0.66	0.64	0.69

Note: Only the main variables representing the exclusion restrictions are shown for simplicity.

** Statistically significant at 5% level*
*** Statistically significant at 1% level*

Table 11 (Panel B): Estimations for different sub-periods: Debit Card Intensive Margins for Consumers and Merchants
Simultaneous Equation Estimation (GMM with fixed effects)
(Clustered standard errors by bank in parentheses)

	1997-1998		***1999-2001***		***2002-2004***		***2005-2007***	
	Merchant intensive margin (debit cards)	***Consumer intensive margin (debit cards)***	***Merchant intensive margin (debit cards)***	***Consumer intensive margin (debit cards)***	***Merchant intensive margin (debit cards)***	***Consumer intensive margin (debit cards)***	***Merchant intensive margin (debit cards)***	***Consumer intensive margin (debit cards)***
	Debit card transactions per POS terminal ($DEBPOSTR_{it}$)	*Debit card transactions per card (issuer perspective) ($DEBISS_{it}$)*	*Debit card transactions per POS terminal ($DEBPOSTR_{it}$)*	*Debit card transactions per card (issuer perspective) ($DEBISS_{it}$)*	*Debit card transactions per POS terminal ($DEBPOSTR_{it}$)*	*Debit card transactions per card (issuer perspective) ($DEBISS_{it}$)*	*Debit card transactions per POS terminal ($DEBPOSTR_{it}$)*	*Debit card transactions per card (issuer perspective) ($DEBISS_{it}$)*
Merchant acceptance by acquirer ($MACCD_{it-1}$)X Number of debit cards in the network ($DCARDSN_{t-1}$)	0.0208** (0.003)	-	0.0448** (0.004)	-	0.0286** (0.003)	-	0.0468** (0.004)	-
Merchant acceptance in the network ($MACCDN_{t-1}$)X Number of debit cards by issuer ($DCARDS_{it-1}$)	-	0.0377** (0.010)	-	0.0518** (0.009)	-	0.0402** (0.011)	-	0.0530** (0.009)
Adjusted R^2	0.72	0.65	0.75	0.66	0.71	0.62	0.76	0.67

Note: Only the main variables representing the exclusion restrictions are shown for simplicity.

** Statistically significant at 5% level*
*** Statistically significant at 1% level*

Table 11 (Panel C): Estimations for different sub-periods: Credit Card Extensive Margins for Consumers and Merchants
Simultaneous Equation Estimation (GMM with fixed effects)
(Clustered standard errors by bank in parentheses)

	1997-1998		***1999-2001***		***2002-2004***		***2005-2007***	
	Merchant extensive margin (credit cards)	*Consumer extensive margin (credit cards)*	*Merchant extensive margin (credit cards)*	*Consumer extensive margin (credit cards)*	*Merchant extensive margin (credit cards)*	*Consumer extensive margin (credit cards)*	*Merchant extensive margin (credit cards)*	*Consumer extensive margin (credit cards)*
	Merchant acceptance by acquirer ($MACCC_{it}$)	*Number of credit cards by issuer ($CCARDS_{it}$)*	*Merchant acceptance by acquirer ($MACCC_{it}$)*	*Number of credit cards by issuer ($CCARDS_{it}$)*	*Merchant acceptance by acquirer ($MACCC_{it}$)*	*Number of credit cards by issuer ($CCARDS_{it}$)*	*Merchant acceptance by acquirer ($MACCC_{it}$)*	*Number of credit cards by issuer ($CCARDS_{it}$)*
Merchant acceptance in the network ($MACCCN_{t-1}$)	-	0.2018** (0.008)	-	0.3362** (0.007)	-	0.2612** (0.006)	-	0.3656** (0.007)
Merchant credit card discount fee ($MFEEC_{it}$)	-0.1322** (0.025)	-	-0.1708** (0.022)	-	-0.1208** (0.025)	-	-0.1874** (0.021)	-
Number of credit cards in the network ($CCARDSN_t$)	0.1286** (0.016)	-	0.1804** (0.017)	-	0.1386** (0.019)	-	0.1907** (0.018)	-
Adjusted R^2	0.75	0.84	0.76	0.80	0.79	0.83	0.78	0.82

Note: Only the main variables representing the exclusion restrictions are shown.

** Statistically significant at 5% level*
*** Statistically significant at 1% level*

Table 11 (Panel D): Estimations for different sub-periods: Credit Card Intensive Margins for Consumers and Merchants
Simultaneous Equation Estimation (GMM with fixed effects)
(Clustered standard errors by bank in parentheses)

	1997-1998		***1999-2001***		***2002-2004***		***2005-2007***	
	Merchant intensive margin (credit cards)	*Consumer intensive margin (credit cards)*	*Merchant intensive margin (credit cards)*	*Consumer intensive margin (credit cards)*	*Merchant intensive margin (credit cards)*	*Consumer intensive margin (credit cards)*	*Merchant intensive margin (credit cards)*	*Consumer intensive margin (credit cards)*
	Credit card transactions per POS terminal ($CREDPOSTR_{it}$)	*Credit card transactions per card (issuer perspective) ($CREDISS_{it}$)*	*Credit card transactions per POS terminal ($CREDPOSTR_{it}$)*	*Credit card transactions per card (issuer perspective) ($CREDISS_{it}$)*	*Credit card transactions per POS terminal ($CREDPOSTR_{it}$)*	*Credit card transactions per card (issuer perspective) ($CREDISS_{it}$)*	*Credit card transactions per POS terminal ($CREDPOSTR_{it}$)*	*Credit card transactions per card (issuer perspective) ($CREDISS_{it}$)*
Merchant acceptance by acquirer ($MACCC_{it-1}$)X Number of credit cards in the network ($CCARDSTN_{t-1}$)	0.1963* (0.006)	-	0.2486* (0.004)	-	0.2013* (0.006)	-	0.2963* (0.005)	-
Merchant acceptance in the network ($MACCCN_{t-1}$)X Number of credit cards by issuer ($CCARDS_{it-1}$)	-	0.1626** (0.002)	-	0.2270** (0.002)	-	0.1755** (0.003)	-	0.2107** (0.002)
Adjusted R^2	0.54	0.83	0.60	0.88	0.59	0.84	0.61	0.87

Note: Only the main variables representing the exclusion restrictions are shown for simplicity.

** Statistically significant at 5% level*
*** Statistically significant at 1% level*

Table 12 (Panel A): Alternative control variables and sub-samples: Debit Card Extensive Margins for Consumers and Merchants

Simultaneous Equation estimation (GMM with fixed effects)

(Clustered standard errors by bank in parentheses)

	Merchant extensive margin (debit cards)	***Consumer extensive margin (debit cards)***	***Merchant extensive margin (debit cards)***	***Consumer extensive margin (debit cards)***	***Merchant extensive margin (debit cards)***	***Consumer extensive margin (debit cards)***	***Merchant extensive margin (debit cards)***	***Consumer extensive margin (debit cards)***
	Merchant acceptance by acquirer ($MACCD_{it}$)	*Number of debit cards by issuer ($DCARDS_{it}$)*	*Merchant acceptance by acquirer ($MACCD_{it}$)*	*Number of debit cards by issuer ($DCARDS_{it}$)*	*Merchant acceptance by acquirer ($MACCD_{it}$)*	*Number of debit cards by issuer ($DCARDS_{it}$)*	*Merchant acceptance by acquirer ($MACCD_{it}$)*	*Number of debit cards by issuer ($DCARDS_{it}$)*
Merchant acceptance in the network ($MACCDN_{t-1}$)	-	0.0363** (0.012)	-	0.0320** (0.011)	-	0.0385** (0.010)	-	0.0329** (0.009)
Merchant debit card discount fee ($MFEED_{it}$)	-0.0423** (0.005)	-	-0.0402** (0.005)	-	-0.0438** (0.004)	-	-0.0433** (0.005)	-
Number of debit cards in the network ($DCARDSN_t$)	0.0016** (0.002)	-	0.0012** (0.002)	-	0.0017** (0.002)	-	0.0013** (0.002)	-
Quadratic time trend	0.0971** (0.002)	0.0863** (0.002)	-	-	-	-	-	-
GDP growth	-	-	0.0003* (0.001)	0.0002** (0.001)	-	-	-	-
Internet penetration rate	-	-	-	-	0.0632* (0.003)	0.0533* (0.003)	-	-
Adjusted R^2	0.82	0.70	0.80	0.69	0.81	0.73	0.82	0.74
Subsample of banks operating in most touristic areas			***Subsample of banks operating in less touristic areas***					
Merchant acceptance by acquirer ($MACCD_{it-1}$)X Number of debit cards in the network ($DCARDSN_{t-1}$)	-	0.0316** (0.009)	*Merchant acceptance by acquirer ($MACCD_{it-1}$)X Number of debit cards in the network ($DCARDSN_{t-1}$)*		-		0.0335** (0.009)	
Merchant acceptance by acquirer ($MACCD_{it-1}$)X Number of debit cards in the network ($DCARDSN_{t-1}$)	-0.0411** (0.004)	-	*Merchant acceptance by acquirer ($MACCD_{it-1}$)X Number of debit cards in the network ($DCARDSN_{t-1}$)*		-0.0438** (0.004)		-	
Number of debit cards in the network ($DCARDSN_t$)	0.0014** (0.002)	-	*Number of debit cards in the network ($DCARDSN_t$)*		0.0011** (0.002)		-	
Adjusted R^2	0.80	0.71	Adjusted R^2		0.85		0.76	

Note: Only the main variables representing the exclusion restrictions are shown for simplicity.

** Statistically significant at 5% level*
*** Statistically significant at 1% level*

Table 12 (Panel B): Alternative control variables and sub-samples: Debit Card Intensive Margins for Consumers and Merchants
Simultaneous Equation Estimation (GMM with fixed effects)
(Clustered standard errors by bank in parentheses)

	Merchant intensive margin (debit cards)	***Consumer intensive margin (debit cards)***	***Merchant intensive margin (debit cards)***	***Consumer intensive margin (debit cards)***	***Merchant intensive margin (debit cards)***	***Consumer intensive margin (debit cards)***	***Merchant intensive margin (debit cards)***	***Consumer intensive margin (debit cards)***
	Debit card transactions per POS terminal ($DEBPOSTR_{it}$)	*Debit card transactions per card (issuer perspective) ($DEBISS_{it}$)*	*Debit card transactions per POS terminal ($DEBPOSTR_{it}$)*	*Debit card transactions per card (issuer perspective) ($DEBISS_{it}$)*	*Debit card transactions per POS terminal ($DEBPOSTR_{it}$)*	*Debit card transactions per card (issuer perspective) ($DEBISS_{it}$)*	*Debit card transactions per POS terminal ($DEBPOSTR_{it}$)*	*Debit card transactions per card (issuer perspective) ($DEBISS_{it}$)*
Merchant acceptance by acquirer ($MACCD_{it-1}$)X Number of debit cards in the network ($DCARDSN_{t-1}$)	0.0335** (0.003)	-	0.0363** (0.004)	-	0.0350** (0.004)	-	0.0335** (0.004)	-
Merchant acceptance in the network ($MACCDN_{t-1}$)X Number of debit cards by issuer ($DCARDS_{it-1}$)	-	0.0444** (0.009)	-	0.0453** (0.009)	-	0.0455** (0.009)	-	0.0421** (0.009)
Quadratic Time trend	0.0412** (0.003)	0.0325** (0.002)	-	-	-	-	-	-
GDP growth	-	-	0.0004* (0.001)	0.0005** (0.001)	-	-	-	-
Internet penetration rate	-	-	-	-	0.0696* (0.003)	0.0528** (0.002)	-	-
Adjusted R^2	0.87	0.71	0.89	0.72	0.87	0.70	0.84	0.63
Subsample of banks operating in most touristic areas			***Subsample of banks operating in less touristic areas***					
Merchant acceptance by acquirer ($MACCD_{it-1}$)X Number of debit cards in the network ($DCARDSN_{t-1}$)	0.0343** (0.004)	-	*Merchant acceptance by acquirer ($MACCD_{it-1}$)X Number of debit cards in the network ($DCARDSN_{t-1}$)*		0.0330** (0.004)	-		
Merchant acceptance in the network ($MACCDN_{t-1}$)X Number of debit cards by issuer ($DCARDS_{it-1}$)	-	0.0429** (0.009)	*Merchant acceptance in the network ($MACCDN_{t-1}$)X Number of debit cards by issuer ($DCARDS_{it-1}$)*		-	0.0420** (0.009)		
Adjusted R^2	0.79	0.61	Adjusted R^2		0.81	0.63		

Note: Only the main variables representing the exclusion restrictions are shown for simplicity.

** Statistically significant at 5% level*
*** Statistically significant at 1% level*

Table 12 (Panel C): Alternative control variables and sub-samples: Credit Card Extensive Margins for Consumers and Merchants
Simultaneous Equation Estimation (GMM with fixed effects)
(Clustered standard errors by bank in parentheses)

	Merchant extensive margin (credit cards)	*Consumer extensive margin (credit cards)*	*Merchant extensive margin (credit cards)*	*Consumer extensive margin (credit cards)*	*Merchant extensive margin (credit cards)*	*Consumer extensive margin (credit cards)*	*Merchant extensive margin (credit cards)*	*Consumer extensive margin (credit cards)*
	Merchant acceptance by acquirer ($MACCC_{it}$)	*Number of credit cards by issuer ($CCARDS_{it}$)*	*Merchant acceptance by acquirer ($MACCC_{it}$)*	*Number of credit cards by issuer ($CCARDS_{it}$)*	*Merchant acceptance by acquirer ($MACCC_{it}$)*	*Number of credit cards by issuer ($CCARDS_{it}$)*	*Merchant extensive margin (credit cards)*	*Consumer extensive margin (credit cards)*
Constant	-0.28E-06 (0.001)	0.44E-06 (0.001)	-0.32E-06 (0.001)	0.59E-06 (0.001)	-0.36E-06 (0.001)	0.57E-06 (0.001)	-0.26E-06 (0.001)	0.35E-06 (0.001)
Merchant acceptance in the network ($MACCCN_{t-1}$)	-	0.2752** (0.007)	-	0.2823** (0.006)	-	0.3237** (0.007)	-	0.2248** (0.006)
Merchant credit card discount fee ($MFEEC_{it}$)	-0.1458** (0.021)	-	-0.1603** (0.025)	-	-0.1723** (0.023)	-	-0.1112** (0.019)	-
Number of credit cards in the network ($CCARDSN_t$)	0.1613** (0.015)	-	0.1508** (0.019)	-	0.1412** (0.017)	-	0.1423** (0.017)	-
Annual credit card fee ($AFEECRED_{it}$)	-	0.6123 (0.652)	-	0.5826 (0.704)	-	0.6123 (0.523)	-	0.5583 (0.547)
Quadratic time trend	0.0632** (0.002)	0.0327** (0.002)	-	-	-	-	-	-
GDP growth	-	-	0.0006* (0.001)	0.0007** (0.001)	-	-	-	-
Internet penetration rate	-	-	-	-	0.0796* (0.004)	0.0788** (0.004)	-	-
Adjusted R^2	0.85	0.92	0.85	0.90	0.85	0.92	0.80	0.84
Subsample of banks operating in most touristic areas				***Subsample of banks operating in less touristic areas***				
Merchant acceptance in the network ($MACCCN_{t-1}$)		-	0.2431** (0.007)	*Merchant acceptance in the network ($MACCCN_{t-1}$)*			-	0.2789** (0.007)
Merchant credit card discount fee ($MFEEC_{it}$)		-0.1465** (0.022)	-	*Merchant credit card discount fee ($MFEEC_{it}$)*			-0.1453** (0.025)	-
Number of credit cards in the network ($CCARDSN_t$)		0.1619** (0.017)	-	*Number of credit cards in the network ($CCARDSN_t$)*			0.1638** (0.014)	-
Annual credit card fee ($AFEECRED_{it}$)		-	0.5683 (0.659)	*Annual credit card fee ($AFEECRED_{it}$)*			-	0.6215 (0.659)
Adjusted R^2		0.83	0.89	Adjusted R^2			0.85	0.93

Note: Only the main variables representing the exclusion restrictions are shown for simplicity.

** Statistically significant at 5% level*
*** Statistically significant at 1% level*

Table 12 (Panel D): Credit Card Intensive Margins for Consumers and Merchants
Simultaneous Equation Estimation (GMM with fixed effects)
(Clustered standard errors by bank in parentheses)

	Merchant intensive margin (credit cards)	*Consumer intensive margin (credit cards)*	*Merchant intensive margin (credit cards)*	*Consumer intensive margin (credit cards)*	*Merchant intensive margin (credit cards)*	*Consumer intensive margin (credit cards)*	*Merchant intensive margin (credit cards)*	*Consumer intensive margin (credit cards)*
	Credit card transactions per POS terminal ($CREDPOSTR_{it}$)	*Credit card transactions per card (issuer perspective) ($CREDISS_{it}$)*	*Credit card transactions per POS terminal ($CREDPOSTR_{it}$)*	*Credit card transactions per card (issuer perspective) ($CREDISS_{it}$)*	*Credit card transactions per POS terminal ($CREDPOSTR_{it}$)*	*Credit card transactions per card (issuer perspective) ($CREDISS_{it}$)*	*Credit card transactions per POS terminal ($CREDPOSTR_{it}$)*	*Credit card transactions per card (issuer perspective) ($CREDISS_{it}$)*
Merchant acceptance by acquirer ($MACCC_{it-1}$)X Number of credit cards in the network ($CCARDSTN_{t-1}$)	0.2019* (0.005)	-	0.2365* (0.005)	-	0.2450* (0.004)	-	0.2196* (0.005)	-
Merchant acceptance in the network ($MACCCN_{t-1}$)X Number of credit cards by issuer ($CCARDS_{it-1}$)	-	0.1715** (0.002)	-	0.2108** (0.001)	-	0.1902** (0.002)	-	0.2033** (0.002)
Quadratic time trend	0.0598** (0.002)	0.0258** (0.002)	-	-	-	-	-	-
GDP growth	-	-	0.0003** (0.001)	0.0004** (0.001)	-	-	-	-
Internet penetration rate	-	-	-	-	0.0544* (0.004)	0.0452** (0.004)	-	-
Tourism (subsample of banks operating in most touristic areas)	-	-	-	-	-	-	-	
Adjusted R^2	0.67	0.94	0.67	0.95	0.66	0.93	0.66	0.92
Subsample of banks operating in most touristic areas				***Subsample of banks operating in less touristic areas***				
Merchant acceptance by acquirer ($MACCC_{it-1}$)X Number of credit cards in the network ($CCARDSTN_{t-1}$)		0.2159** (0.005)	-	*Merchant acceptance by acquirer ($MACCC_{it-1}$)X Number of credit cards in the network ($CCARDSTN_{t-1}$)*			0.2001* (0.005)	-
Merchant acceptance in the network ($MACCCN_{t-1}$)X Number of credit cards by issuer ($CCARDS_{it-1}$)		-	0.1802** (0.002)	*Merchant acceptance in the network ($MACCCN_{t-1}$)X Number of credit cards by issuer ($CCARDS_{it-1}$)*			-	0.1698** (0.002)
Adjusted R^2		0.65	0.96	Adjusted R^2			0.66	0.91

Note: Only the main variables representing the exclusion restrictions are shown for simplicity.

** Statistically significant at 5% level*
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