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Fees: Assessing the  
Effectiveness of Antitrust  
Investigations and  
Regulation in Europe**

By *Santiago Carbó-Valverde  
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# **Payment Card Interchange Fees: Assessing the Effectiveness of Antitrust Investigations and Regulation in Europe**

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## **Abstract**

This article provides empirical evidence on the impact of different interventions by public authorities on interchange fees (IFs) and cross-border multilateral interchange fees (MIFs) on both adoption and usage of payment cards in the EU-27. Controlling for social and financial characteristics across countries, we find no statistically significant effects on payment card adoption. However, we find mixed results on payment card usage after specific regulatory events: (i) IFs regulation and investigations seem to have increased the number of transactions per card, (ii) mandatory reductions in IFs seem to have a negative impact on the value of transactions per card, and (iii) antitrust and regulatory scrutiny related to MIFs is found to increase the number of transactions per card but to reduce the value of transactions per POS. Additionally, the results show that specific regulatory and antitrust investigations related to both IFs and MIFs have statistically significant effects on card transactions as a proportion of all transactions made in a specific country.

**JEL codes:** G20, D12, E41.

**Keywords:** payment cards, interchange fees, adoption, usage, merchant, cardholders.

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## **1. Introduction**

During the last decade, payment card markets have been characterized by their rapid growth and widespread usage among consumers and merchants. Transactions which were once exclusively conducted in cash are increasingly made using cards in several countries (Hove, 2004; Deungoue, 2008). According to the statistics on non-cash payments published by European Central Bank (ECB), the number of cards with a payment function in the EU remained relatively stable at 726.7 million compared with 725.2 million in 2009 (European Central Bank, 2011), this represented around 1.45 payment cards per EU inhabitant. The number of card transactions rose by 6.7% to 33.9 billion, with a total value of 1.8 trillion Euros which corresponds to an average value of around 52 Euros per card transaction (European Central Bank, 2011). The greater acceptance and use of payment cards suggests that a growing number of consumers and merchants prefer payment cards to paper-based instruments. This makes sense by considering that some studies have suggested that less frequent cash usage would improve social welfare (Garcia-Swartz et al., 2006; Gerdes et al., 2005; Humphrey, 2004; Klee, 2006). In a similar way, Humphrey et al. (2006) suggest that the complete replacement of paper-based payment instruments by electronic instruments would produce a cost saving of approximately 1% of the total GDP in 12 European countries.

The payment card industry today includes thousands of banks and other financial service providers. As intermediaries, they process payments between millions of merchants and more than a billion cardholders around the globe (Capgemini et al.,

2010). This practice (getting both sides<sup>1</sup> of the market on board) relies on the economic definition of two-sided markets which has already been reviewed in the comprehensive surveys of Rochet (2003), Hunt (2003) and Bolt and Chakravorti (2008). As the card industry has grown and matured, competition law or policy has increasingly been applied in this area. In particular, interchange fees (IFs, hereafter) and cross-border multilateral interchange fees (MIFs, hereafter) have become a controversial issue and the subject of regulatory and antitrust investigations. IFs play an important role in any card system: any card transaction between a merchant and a consumer is enabled by two system member banks, the acquirer (the merchant's bank) and the issuer (the cardholder's bank). When a consumer makes a purchase from a merchant, the issuer bank deducts the IFs from the amount it pays to the acquiring bank that handles a card transaction for a merchant. The acquiring bank then pays the merchant the amount of the transaction minus which is often referred to as a discount fee. This fee covers the acquiring cost, business's margins, a fee paid to the network (Visa or MasterCard) and also the IF (the fee that acquirer banks pay to issuer banks).

Over the last decade, both IFs and MIFs have been a matter of regulatory controversy in the European Union;<sup>2</sup> however, the industry's two-sidedness and other

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<sup>1</sup> Consumers and merchants constitute two different parts – or “sides” – of the card market. Markets enabling interaction between two groups of end users are also referred to as “bilateral markets”.

<sup>2</sup> Regulatory actions have been diverse and include investigations, regulatory scrutiny and mandatory reductions Antitrust authorities, central bank regulators, and laws in various jurisdictions, including the European Union, Australia, Brazil, Colombia, Germany, Honduras, Hungary, Mexico, New Zealand, Norway, Poland, Portugal, Romania, Singapore, South Africa, Spain, Sweden, Switzerland, the United States and the United Kingdom have taken regulatory actions on these fees (European Commission, 2006; Evans, 2011; VISA Inc., 2008; Weiner and

specificities make received traditional antitrust doctrine largely inappropriate in order to design sound policy interventions (Tirole, 2011). In addition, competition authorities and bank regulators have questioned the legality, or propriety, of setting IFs as well as whether merchants are being asked to pay too much. Merchants have also complained about these fees. However, the card schemes, and the banks that ultimately receive these IFs, say they are necessary for operating systems that maximize the value to consumers and merchants and for encouraging investment and innovation (Börestam and Schmiedel, 2011; Bradford and Hayashi, 2008; Tirole, 2011). The ultimate effect of IFs and MIFs regulation and antitrust investigations on the card market are still an open research since ex-post social welfare gains are difficult to determine and is highly sensitive to the specifications of the model employed (Chakravorti and Shah, 2001).

While the theoretical literature on the economics of payment cards is growing (Humphrey, 2010; Verdier, 2011), the empirical literature is yet too limited to provide much guidance to public authorities (Bolt and Chakravorti, 2011). Hence, the lack of empirical studies would explain why competition authorities have been concerned about determining methods to assess the impact of IFs regulations on payment systems. In this way, this paper tries to shed light on the effects of IFs and MIFs regulations on payment systems by considering a detailed compilation of the most important events related to IFs and MIFs (which include both investigations and regulatory scrutiny) during the period 1995–2009. The EU-27 countries are a unique laboratory to undertake the empirical study for two main reasons: *(i)* their wide heterogeneity across adoption and usage levels of payment cards and the subsequent and considerable development of

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Wright, 2005) and have also imposed price caps in certain countries, such as Australia (Chang et al., 2005).

electronic payments during the last years (European Central Bank, 2012), and *(ii)* the intense regulatory developments related to IFs occurred during the last years (Börestam and Schmiedel, 2011). It is worth to point out that our work is closely related to the study by Carbó et al. (2010) (hereafter CCR). This study estimates the effects of IF regulation on consumer and merchant adoption and usage. There are three key differences with our study. First, while CCR focus on government-encouraged fee reductions in the Spanish payment card market during 1997 to 2007, we adopt a cross-country perspective which includes all the EU-27 countries. Second, CCR's sample includes transactions of debit cardholders, credit cardholders and average IFs, while our sample only includes aggregate transactions of cardholders (of both credit and debit cards) and we have not information on IFs (since there is no homogenous public information). Third, unlike CCR, this work observes a wide range of regulatory activity in the EU-27. Consequently, we can capture more complex patterns related to the adoption and usage decisions of payment cards which couldn't be adequately captured in their model. Because of these differences in the data and model specification between our study and CCR, we view that these two studies complement each other.

Controlling for social, economic and financial characteristics across countries and years, our main results are as follows. We find no statistical effects of antitrust investigations and regulatory activity of IFs and MIFs on adoption ratios (number of cards per capita and number of POS per merchant). However, we find mixed results on cards' usage ratios after specific regulatory events have taken place: *(i)* IFs investigations and regulatory scrutiny have a positive impact on the number of card transactions per card, *(ii)* we find that the value of transactions per card has decreased because of a mandatory reduction in IFs and *(iii)* the number of transactions per card

and the value of transactions per POS are positively and negatively related to antitrust and regulatory scrutiny related to MIFs, respectively. Also, we find that mandatory IF reductions have had a positive and statistically significant effect on both the volume and value of card payments as a percentage of the national payments, while the impact of the MIFs regulation on the value of card payments as a percentage of the national payments was also positive.

Following this introduction, Section 2 offers an overview of the payment literature related to antitrust and regulatory issues about IFs. Section 3 discusses the sample used and introduces a set of empirical models to test whether adoption and usage of payment cards have been affected by specific events (investigations and regulation) related to IFs and MIFs, controlling for cross-country variation in financial, economic and social conditions. Section 4 shows the main results. Finally, Section 5 presents our main conclusions.

## **2. The role of IFs in the payment literature**

Since Baxter (1983) some studies have considered IFs as necessary incentives to guarantee participation by all parties (buyers, sellers, and their associated payment service providers) in the payment card market. According to Baxter, IFs are used by payment platforms to correct the market failure caused by usage externalities. IFs equilibrium conditions on each side of the market not only allow payment card schemes to operate flexibly, but are also necessary to induce both parties to participate (Baxter, 1983; Rochet and Tirole, 2002). Frankel and Shampine (2006) list three principal economic arguments offered in support of claims that IFs have important pro-

competition or efficiency-enhancing economic effects. These are: *i*) IFs “balance” a “two-sided” payment system market to correct an indirect “network externality” and solve a “chicken and egg”<sup>3</sup> entry barrier problem; *ii*) IFs solve a “usage externality” in which consumers would not have enough incentives to use cards which are assumed to impose lower costs on merchants; *iii*) IFs are needed to reimburse card issuers for specific services they provide for the benefit of merchants and their banks (e.g. the interest-free grace period, the “payment guarantee,” and “processing”).

IFs seem to be essential to the smooth operation of any payment card system. If the IF is too high, merchants will not accept the cards through POS devices, resulting in low usage and consumer adoption. On the other hand, if the IF is too low, consumers may not have sufficient incentives to participate in payment networks. Since low usage volumes and lack of participation may undermine platform viability and thereby deter innovation in the card market, IFs regulation may have a critical impact on platform size, especially when there is competition between platforms (Harper et al., 2006). During the last decade have had an intense antitrust activity and regulatory scrutiny, with Australia as an emblematic case of mandated reduction of IFs (Gans and King, 2003; Prager et al., 2009). There is a common agreement on why IFs exist but concerns arise with respect to the determination of the socially optimal IF (Börestam and Schmiedel, 2011) and its impact in the whole market.

Today, however, there is little consensus among economists regarding the assessment of current pricing structures and IFs in the industry (Evans, 2011; Evans et

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<sup>3</sup> Merchants are reluctant to devote resources to accepting cards until there is a large volume of cardholders, while consumers are not interested in holding cards until a large volume of merchants accept them (Evans and Schmalensee, 2005).

al., 2011). Although some theoretical models claim that IFs are intended to equitably distribute payment system costs,<sup>4</sup> concerns have been expressed that this is not always the case and that fees may be excessive. Evans and Schmalensee (2005) mention that there is no basis in economics for concluding that the privately set IFs is just right. The challenge to policymakers, on the other hand, is to use the information available to decide whether a network's pricing strategy and rules are likely to encourage or restrict economic efficiency (Hunt, 2003).

The scope of investigations and regulatory scrutiny related to IFs and MIFs in Europe has not been fully studied until recently (Evans, 2011; Evans et al., 2011). Hayashi (2010) studies IFs for credit and debit cards in the United States and 12 other countries (Australia, Belgium, Canada, Denmark, France, Germany, Italy, the Netherlands, Spain, Sweden, Switzerland, and the United Kingdom) and finds that IFs applied to card transactions vary across countries. The "Interim Report I" conducted by the European Commission during the second half of 2005 suggests that merely issuing cards would generate positive profits in 20 out of 25 countries, even without IF income. Moreover, it shows that IFs vary considerably across the EU, which may indicate that the market for card payment services is not working efficiently in some member states (European Commission, 2006). Recent changes and evolution related to IFs have resulted from pressure from regulatory and competition authorities that have investigated payment systems for violations of competition law (Börestam and Schmiedel, 2011; Bradford and Hayashi, 2008; European Commission, 2006; Hayashi and Weiner, 2006). However, it seems that policy interventions in the payment card

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<sup>4</sup> Given that merchants are constrained from setting prices based on payment instruments costs in many jurisdictions, and merchants often do not differentiate prices even in jurisdictions allowing them to do so, the level of the IF affects the adoption and usage of payment cards.

industry may render unintended consequences due to their complex environment (Wang, 2010).

### **3. The data and empirical models**

#### **3.1 The database**

Our database consists of a comprehensive list of events (investigations and regulatory scrutiny) related to IFs and MIFs in the EU-27. The list has been compiled from the academic literature and government reports (see Annex A).<sup>5</sup> The collected information has been classified into three groups: *(i)* investigations and regulatory scrutiny related to IFs in the EU-27, *(ii)* Mandatory reductions of IFs at national level, and *(iii)* investigations and antitrust activities concerned with MIFs. This classification is particularly relevant since the motivation for why public authorities intervene differs across jurisdictions and institutions (Chakravorti, 2010).

Payment card data draws from the statistics of the European Central Bank's Payment and Securities Systems (so called the "Blue Book of Payments"). The full set of payment card statistics can be downloaded from the Statistical Data Warehouse (SDW) on the ECB's website. We also use data from several issues of the "ECB Blue Book Addendums" in order to complete for some of the missing data not included in the SDW during the period 1995 – 1999. Moreover, we include both social and financial indicators as control variables in our regressions. Annual lending rates come from the

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<sup>5</sup> A double check of the main events related to IFs in the EU-27 was carried out through of LexisNexis<sup>®</sup> database. LexisNexis<sup>®</sup> provides access to billions of searchable documents and records from more than 45,000 legal, news and business sources.

International Financial Statistics (IFS) while the Eurostat database was employed to obtaining GDP, crime rates, aggregate consumption per capita and the government's expenditure in education as a percentage of the GDP. We have also included a set of dummy variables in order to capture potential structural changes in both the year when a country become a member of the EU and the years of the implementation phase<sup>6</sup> of the Payment Service Directive in the Single European Payment Area (SEPA, hereafter) framework.<sup>7</sup> All in all, these variables represent a rich set of important factors which could determine both adoption and usage ratios in the European payment card industry.

Table 1 provides descriptive statistics of the main variables employed in our empirical models. The data frequency is annual and the sample period is 1995-2009. In order to make correct cross-country comparisons payment data are given in per capita terms and, where values are involved they are deflated to adjust for inflation and converted to Euros.

Considering adoption ratios, we observe an average of 0.94 cards<sup>8</sup> per capita in our sample with values ranging from 0 to 2.75 cards per capita. Moreover, we find an

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<sup>6</sup> This phase has been particularly important in the payment card market. During this phase, banks created the products they are now offering their customers (European Commission, 2012). Each participating country set up national implementation and migration bodies which prepared the roll-out of the new SEPA instruments, standards and infrastructures.

<sup>7</sup> The SEPA project represents one of the major steps towards the European payment system integration (Deungoue, 2008). it holds a market potential of up to 123 billion in benefits (cumulative over 6 years) with a significant upside for all demand side stakeholders while allowing banks to retain current margins since the payment card market is thus expected to grow because of (Capgemini LLC, 2008; De Meijer, 2010; European Central Bank, 2010).

<sup>8</sup> Note that payment cards include all cards with a payment function: credit cards, debit cards and delayed debit cards. Since we are more concerned about the effect on the entire card market

average of 0.98 POS devices per merchant ranging from 0 to 6.13 devices. Normalizing the data in terms of square kilometres, there is an average of 181.7 cards and 2.02 POS terminals in our sample. Regarding usage indicators, we distinguish two groups. The first one accounts for the volume of transactions per card and POS. Hence, we observe an average of 30.8 transactions per card per year and 2,697 card transactions per POS devices per year. The second group accounts for the value of transactions per card and POS devices which represent approximately 1,571 euros in POS transactions per card and per year and an average of 145,000 euros in card transactions per POS terminal per year. Interestingly, transactions with cards represent around 34% of the total volume of transactions (which include both cash and non-cash payment instruments) in the EU-27. However, card payments only represent 1.25% of the aggregate value of transactions (using both cash and non-cash payment instruments) in our sample.

Regarding control variables, the average GDP per capita in our sample is approximately 19,293 euros, the number of ATMs per square kilometre (as a proxy of the relative ease of withdrawing cash compared to paying at POS devices) is 0.1 but ranging from 0 to 0.57 depending on the country and year. The average lending interest rate is approximately 10.03% while the average number of crimes per kilometre square registered by the police is 8.22.<sup>9</sup> Consumption expenditure per capita account for 11,302

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rather than a particular type of card, we focus our study on the whole payment card market. Also, and more important, disaggregated data by type of card is not available in many countries in our sample which decrease substantially the number of available observations in our empirical estimations.

<sup>9</sup> Crime has been particularly important in the payment literature. Some theoretical models suggest that crime may deter cash usage (He et al., 2005). From an empirical perspective, Humphrey et al. (1996) suggest that crime rate probably explains cross-country differences in payment usage.

euros and the average public expenditure on education represents about 5.18% of the GDP. Annex B1 and B2 include a detail description across countries during our sample period.

### 3.2 The empirical models and estimation procedure

In this Section, we develop a set of empirical models to analyse how investigations and regulatory events related to IFs and MIFs have affected adoption, usage and aggregate transactions in the EU-27 payment industry.

#### 3.2.1 Adoption and usage models

Our empirical specification consists of the estimation of two equations that identify adoption and usage ratios, respectively. Consider the following simultaneous regression equations for both consumers and merchants as follows:

$$\begin{cases} y_{i,t}^c = \alpha^m y_{i,t-1}^m + \gamma^c IF_{i,t} + \beta^{nc} X_{i,t}^c + \eta_i + \varepsilon_{i,t}^c \\ y_{i,t}^m = \alpha^c y_{i,t-1}^c + \gamma^m IF_{i,t} + \beta^{mm} X_{i,t}^m + \eta_i + \varepsilon_{i,t}^m \end{cases} \quad (1)$$

where  $y^c, y^m$  are the dependent variables that represent adoption and usage ratios for consumers and merchants in country  $i$  and year  $t$ , respectively. In terms of adoption,  $y^c$  represents the number of cards per capita while  $y^m$  measures the number of POS per merchant. In order to modelling payment usage, we follow two approaches: (i) we consider payment usage in terms of volume of transactions. Hence,  $y^c$  represents the number of transactions per card and  $y^m$  represents the number of transactions per POS

terminal and (ii) the second approach takes payment usage in terms of the value of transactions. Hence,  $y^c$  corresponds to the value of transactions per card and  $y^m$  is the value of transactions per POS terminal. We also include the one year-lagged value and volume of transactions per card as explanatory variables in each one of the equations in order to minimize likely endogeneity problems in the empirical specification.

Parameters  $\alpha^c$  and  $\alpha^m$  allow us to capture the strength of adoption and usage network effects<sup>10</sup> from consumers towards merchants and merchants towards consumers, respectively. We expect that network effects to keep a positive sign. These variables are particularly relevant since the value of accepting (holding) a card depends on how many consumers (merchants) accept (hold) that card. Also, after consumers decide whether to get a payment card, they must also decide how often they will use it (Özlem and Emilio, 2009; Rochet and Tirole, 2003; Shy, 2011).

$IF_{i,t}$  is a vector of dummy variables that include the three different events related to IFs and MIFs in order to capture the year-effect when any of the different types of antitrust investigations and regulatory interventions were introduced (see Annex A for a detailed list of the events).  $X^c, X^m$  include a set of explanatory variables representing cross-country factors which can affect adoption and usage of payment cards for both consumers and merchants respectively.  $\eta_i$  is an unobserved country-specific effect and  $\varepsilon_{i,t}^c, \varepsilon_{i,t}^m$  are the error terms for the cardholder and merchant equations.

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<sup>10</sup> We have tried to minimize endogeneity problems affecting simultaneous equations estimations by employing one-year lagged variables as covariates.

Since time-invariant country characteristics (fixed effects) may be correlated with the explanatory variables, by transforming the regressors by first differencing the fixed country-specific effect is removed. In this way, our final empirical specification will be as follows:

$$\begin{cases} \Delta y_{i,t}^c = \alpha^m \Delta y_{i,t-1}^m + \gamma^c IF_{i,t} + \beta^{vc} \Delta X_{i,t}^c + \Delta \varepsilon_{i,t}^c \\ \Delta y_{i,t}^m = \alpha^c \Delta y_{i,t-1}^c + \gamma^m IF_{i,t} + \beta^{vm} \Delta X_{i,t}^m + \Delta \varepsilon_{i,t}^m \end{cases} \quad (2)$$

### 3.2.1 Card transactions as a percentage of all transactions in a country

Structural changes related to IFs and MIFs are assumed to have potential effects in the transactions carried out with payment cards with respect to other available payment instruments. In order to test the effect of investigations and regulatory scrutiny of IFs and MIFs, we also consider the volume and value of payment card transactions as a proportion of the aggregate volume and value of transactions (cash and non-cash based) carried out in a particular country and year.<sup>11</sup> We consider an adapted version of equation (2) as follows:

$$\begin{cases} \Delta y_{i,t}^{vol} = \alpha^{val} \Delta y_{i,t-1}^{vol\_card} + \gamma^{vol} IF_{i,t} + \beta^{vol} \Delta X_{i,t}^{vol} + \Delta \varepsilon_{i,t}^{vol} \\ \Delta y_{i,t}^{val} = \alpha^{vol} \Delta y_{i,t-1}^{val\_card} + \gamma^{val} IF_{i,t} + \beta^{val} \Delta X_{i,t}^{val} + \Delta \varepsilon_{i,t}^{val} \end{cases} \quad (3)$$

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<sup>11</sup> These results could have potential regulatory implications since a recent study showed that, on average, each cash-using household transfers \$50 to households that use credit cards and each credit card using household receives a subsidy of \$240 every year in the US (Schuh et al., 2010).

where dependent variables represent both volume ( $y^{vol}$ ) and value ( $y^{val}$ ) of card transactions as a percentage of the aggregate volume and value of transactions in country  $i$  and year  $t$ , respectively. As for the adoption and usage regressions, we also include the one year-lagged value and volume of transactions per card as explanatory variables in each one of the equations and a vector of dummy variables which includes each of the three events related to IFs considered in the previous section along with a set of explanatory variables for the value ( $X^{val}$ ) and volume ( $X^{vol}$ ) equations. Social and financial factors which can affect national levels of card transactions and,  $e$  is the error term.

### **3.2.3 GMM simultaneous estimation methodology**

As is usual in simultaneous estimations, the error terms in equations (2) and (3) could be potentially correlated. This correlation implies that even if a separate equation-by-equation estimation would be consistent, it will not be as efficient a simultaneous equation method. To obtain efficient estimates and address the issue of cross-equation restrictions and endogeneity concerns in simultaneous equations, we estimate equations (2) and (3) jointly using a General Methods of Moments (GMM) routine with fixed effects and time dummies. The GMM estimation is based on the simultaneous estimation of the merchant and consumer equations. It relies on a set of orthogonality conditions which are the products of equations and instruments. The initial conditions for estimation are obtained using three-stage least squares (3SLS), which is a restricted version of the simultaneous equation GMM model. This kind of GMM estimator allows for heteroskedasticity and cross-equation correlation where some variables (in our particular case, the network effects for the adoption and usage equations) may appear as

both exogenous and (lagged) endogenous variables in the different equations (Hansen, 1982). We also cluster standard errors at the country-level and account for cross-sectional correlation by using time dummies, as suggested by Petersen (2009). All variables (except for the regulatory dummy variables) are expressed in logs so that the differences can be interpreted as growth rates.

Endogeneity has been controlled by using up to 3-year lagged values of the full set of explanatory variables as instruments. We run Sargan tests of over identifying restrictions in order to validate the set of instruments under the null hypothesis of correct identifying restrictions. According to the Sargan tests, the null hypothesis cannot be rejected in all our empirical models, which suggests that the chosen instruments were appropriately specified (assuming that the model has been correctly specified).

## **4. Main results**

### **4.1 Adoption**

Table 3 presents the results of the simultaneous estimation of equation 2. As we expected, we find that network effects play a positive and statistically significant role in fostering adoption in both the consumer and merchant equations. This effect seems to be higher for merchants than cardholders, ranging from 0.167 to 0.179 for cardholders and from 1.4 to 1.55 for merchants.

Regarding IFs, we do not find statistically significant results for any of the considered events. Hence, payment card's adoption seems to have been mostly driven

by country-specific variables such as the density of ATMs (as a proxy of the easiness of obtaining cash by customers) along with feedback loop effects. We also find that the number of recorded crimes has a negative impact on the number of cards per capita but we do not find any statistically effect in the merchant side. To some extent, this is due to the fact that the greater number of cards in the consumer's wallet the higher the (monetary and time) costs for users in case of theft. The growth rate of GDP per capita has a positive and statistically significant effect on the adoption of POS devices per merchant in two of our models. However no statistically significant effect is found in the case of cardholders' adoption equation.

Interestingly, growth rates of both the lending interest rate and government expenditure on education have decreased the growth rate of payment card adoption. Since higher interest rates could reduce consumer's consumption, it seems reasonable to assume a negative relationship of interest rates with the number of cards per capita (which could be linked to higher levels of consumption). Also, the negative impact of the government expenditure on education on adoption reflects the fact that higher levels of education can lead to more cautious decisions about adopting financial instruments. We also find that the SEPA implementation phase was effective in order to stimulate the consumer side of the market in terms of adoption. However, the negative effect observed on the merchant side could be explained by higher merchant costs due to standardization<sup>12</sup> practices in the payment infrastructure with SEPA. Finally, both EU membership and technological changes (captured by the time trend) keep statistically and significant effects on the adoption's growth rate. In particular, our results suggest a

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<sup>12</sup> This technical concept refers to the capacity of accepting a wider range of cards from a single POS terminal.

positive effect in the merchant side and a negative effect on the consumer side, respectively.

As a robustness check, we estimate the adoption models taking the dependent variables (number of cards and POS) in terms of square kilometres (see Annex C). The results give support to our previous findings.

## **4.2 Usage patterns: the volume and value of card transactions**

### **4.2.1 Volume of transactions**

Table 4 offer our results for the volume of transactions for both cardholder and merchant. Interestingly, unlike adoption, network effects do not seem to explain the growth rate in the number of payment card transactions. With respect to IFs, our results suggest that investigations and regulatory scrutiny resulted in a positive impact on the number of transactions per card. As for mandatory IF reductions, we do not find statistically significant effects. Nevertheless, the signs of both the cross-border antitrust and regulatory scrutiny suggest that regulation of MIFs impacted positively on the number of transaction per card.

Moving on the control variables, the results show that the higher the density of ATMs the lower the number of transactions per card and POS devices. While the negative result for merchants could be expected (due to a substitution effect between cash and card payments), the effect for cardholders is more complex for interpreting (i.e. consumers could have diversified the number of transactions among more cards

which will lead to a lower number of transactions per card). We also observe that criminality reduced the number of transactions per card but we find a positive effect on the growth rate of card transactions per POS. GDP and consumption per capita along with the government expenditure on education have a positive and statistically significant effect on the number of transactions. Lending interest rates have affected positively the number of transactions per card. Since interest rates are also a source of revenues for banks, issuers could be stimulating consumers indirectly for using more intensively their cards when interest rates are high (i.e. by offering them reward programs).

#### **4.2.2 Value of transactions**

In terms of the value of card transactions (Table 5), we do not observe statistically significant network effects in our regressions. With respect to the IFs, we find mixed results depending on the specific regulatory intervention. We do not find any statistically significant effect for antitrust investigations and regulatory scrutiny events related to IFs. However, after a mandatory reduction of IFs, it would be expected a 23.6% reduction in the growth rate of the value of transactions per cards. Anyway, it should be noted that this result is marginally statistically significant and should be considered with caution. Regulatory scrutiny related to MIFs decreased in 12.1% the growth rate of the value of transactions per POS.

Moving on control variables, both crimes and GDP per capita seem to increase the value of transactions per POS devices; however these results are not statistically significant across all specifications. We also find that both consumption per capita and

lending interest rates are positively related to the value of transactions per card and POS devices. EU membership keeps a statistically and significant effect on the merchant's value of transactions whereas technological changes (captured by the time trend) have a negative effect in the value of transactions per card. Finally, no statistically significant effect was found for the education proxy and SEPA.

### **4.3 Payment card substitution and IFs**

To complement our previous estimations, we study the effect of antitrust and regulatory events related to IF on the percentage of card transactions as a proportion of all transactions (both cash and non-cash based) carried out in a country (Table 6). We find that the one year lagged card's extensive margin (value of transactions per card) seems to explain the growth rate of the proportion of the value of card transactions with respect to the country's aggregate value of transactions; however, the size of the effect seems to be economically insignificant.

No statistically significant effect was found in the case of investigations and regulatory scrutiny related to IFs events. Nevertheless, we find a strong positive and statistically significant effect of IFs mandatory reductions on the growth rate of the volume (14%) and value (3.8%) of card transactions as a percentage of the total transactions in a specific country, even after controlling for the influence of the rest of the explanatory variables. Regulatory actions related to MIFs have led to a 0.17% increase in the value of card payments as a percentage of the total transactions in a country. These results are particularly relevant in the cash-substitution literature since the role played by IFs have not been fully considered (Verdier, 2011).

As for the control variables, we find that the number of ATMs, GDP per capita and crimes per square kilometre have a positive effect on card transactions with respect other payment instrument's transactions (in terms of volume and value). Interestingly, the lending rate seems to increase the volume of card transactions and reduce the value of card transactions as a percentage of the total transactions in a specific country. Finally, the SEPA implementation phase had have a positive and statistically significant effect on the value of card transactions with respect to the aggregate value of transactions.

## **5. Summary and conclusions**

A wide range of antitrust investigations and regulations have affected the development of payment systems during the last years and a lively debate has resulted in whether regulate IFs and MIFs and their potential effects in the payment system. These concerns are now a critical issue in the debate over the integration of payments and banking in the European Union (European Commission, 2012). Despite this policy interest, there have been relatively few empirical analyses that explore the potential policy concerns raised in this area.

We study the impact of the main antitrust and regulatory events related to IFs and MIFs on the EU-27 payment card industry. As for the main findings, we find no statistically significant effect of IF regulatory events on the relative adoption ratios for consumers and merchants. It seems that networks effects along with social and

economic factors weight more in order to stimulate adoption decisions of payment instruments by both consumers and merchants.

As for usage results, our findings are mixed. We find that IF investigations and regulatory scrutiny activities have affected positively the volume of transaction per card. By considering mandatory IF reductions, we find a negative effect on the growth rate of the value of transactions per card. Finally, we find evidence of a positive effect of regulatory events related to MIFs on the volume of transactions per card but a negative effect in the growth rate of value of transactions per POS. In a similar way that the adoption equations, both economic and social factors seem play a potential role in order to explain usage of payment cards in Europe.

We also consider the effect on card transactions as a percentage of the aggregate value and volume of transactions (both cash and non-cash based) in a country. We do not find any statistically significant effect of IFs antitrust investigations and regulations. However, mandatory reductions of IFs have a strong positive and significant effect on both volume and value of card transactions as a percentage of the total transactions per country. We also find that regulatory events related to MIFs have increased the growth rate of the value of card payments as a proportion of the total value of transactions per country.

Finally, it is important to mention two issues which represent the main limitations of our study and that should be considered in future research: *(i)* the lack of homogeneous data for credit and debit cards across EU-27 countries do not allow us to carry out a differentiated study of the implications of IFs regulation in each of these

markets. However, since we are more interested in the global effect for all the market, our results could offer some potential insights for future research in this area and (ii) unfortunately, the lack of public available data on card prices could have generated some bias in our results. The weak identification observed in some of the variables across our empirical specifications and models point out the relevance of more in-depth research in this area and the need of increasing the availability of public information about card prices in order to foster the transparency of the market into the SEPA framework.

**Table 1. Variable definitions**

<b>Code</b>	<b>Variable and definition</b>
<b>Interchange fees</b>	
<b>IF_1</b>	Dummy variable for investigations and regulatory scrutiny into IF setting at national level (it doesn't include IFs mandatory reductions). This variable takes the value 1 in the year and country where the scrutiny took place and zero otherwise.
<b>IF_2</b>	Dummy variable for an IFs mandatory reduction at national level. This variable takes the value 1 in the year and country where IFs were reduced by regulation and zero otherwise.
<b>IF_3</b>	Dummy variable for regulatory scrutiny about MIFs (multilateral IFs for cross-border payment card transactions). This variable takes the value 1 in the year which EC took actions related to MIFs and zero otherwise.
<b>Adoption ratios</b>	
<b>ADOP_1</b>	Number of cards per capita with a cash function
<b>ADOP_3</b>	Number of POS terminals per merchant*
<b>ADOP_2</b>	Number of cards with a cash function per Km <sup>2</sup>
<b>ADOP_4</b>	Number of POS terminals per Km <sup>2</sup>
<b>Usage ratios</b>	
<b>USAGE_1</b>	Number of POS's card transactions per card (units)
<b>USAGE_2</b>	Number of POS's card transactions per POS (thousands units)
<b>USAGE_3</b>	Value of POS's transactions per card (euros)
<b>USAGE_4</b>	Value of transactions per POS (thousands euros)
<b>% of card transactions per country</b>	
<b>CASH_2</b>	Share of card transactions as a percentage of the total volume of transactions per country (%)
<b>CASH_3</b>	Share of card transactions as a percentage of the total value of transactions per country (%)
<b>Financial and Social indicators</b>	
<b>GDP</b>	GDP per capita (thousands euros)
<b>ATM_KM</b>	Number of ATM per Km <sup>2</sup> (as a proxy of the financial coverage of the intermediary sector and the easiness of getting cash)
<b>I_RATE</b>	Annual Lending Rates
<b>CRIME</b>	Crimes per Km <sup>2</sup> recorded by the police per country
<b>CONSUMP</b>	Final consumption expenditure of households (Euros per inhabitant).
<b>EDUC</b>	Public expenditure on education as % of GDP per country.
<b>SEPA2</b>	This variable takes the value 1 in the year of the implementation phase and Payment Service Directive (2006-2007) and zero otherwise.
<b>EU</b>	This variable takes the value 1 in the year when a country become member of the EU and zero otherwise

**Note:** All payment data are in Euros on an annual basis. Monetary magnitudes are expressed in real terms; they also have been deflated by using HICP (base 2005=100) from Eurostat.

\* The number of merchants comprises the following sectors: retail trade (except for motor vehicles, motorcycles; repair of personal and household goods), Hotels and restaurants, Transport, storage and communication.

**Table 2. Summary statistics (1995-2009)**

<b>Variable</b>	<b>Obs.</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
<b>ADOP_1</b>	389	0.94	0.55	0.001	2.76
<b>ADOP_3</b>	314	0.89	0.75	0.0003	6.13
<b>ADOP_2</b>	389	181.69	284.11	0.072	2,028.23
<b>ADOP_4</b>	394	2.02	4.04	0.0002	36.20
<b>USAGE_1</b>	373	30.84	32.32	0.19	146.73
<b>USAGE_2</b>	379	2.70	2.05	0.10	9.19
<b>USAGE_3</b>	334	1,571.89	1,485.92	21.80	7,115.30
<b>USAGE_4</b>	331	145.60	111.57	3.19	751.92
<b>CASH_2</b>	254	34.02	15.86	1.55	67.59
<b>CASH_3</b>	253	1.25	1.43	0.02	6.47
<b>GDP</b>	402	19.29	9.80	4.27	70.49
<b>ATM_KM</b>	402	0.09	0.11	0.00004	0.57
<b>I_RATE</b>	350	10.03	8.81	0.60	72.50
<b>CRIME</b>	343	8.22	11.27	0.42	58.80
<b>CONSUMP</b>	395	11,302.35	6,776.95	1,070.54	35,266.32
<b>EDUCA</b>	333	5.19	1.12	2.60	8.44

**Table 3. Adoption for cardholders and merchants**  
**Simultaneous equations estimation (GMM) with fixed effects**  
(Clustered standard errors by country and z-statistic in parenthesis)

	<i>Model 1</i>		<i>Model 2</i>		<i>Model 3</i>	
	<i>Number of payment cards per capita</i>	<i>Number of POS per merchant</i>	<i>Number of payment cards per capita</i>	<i>Number of POS per merchant</i>	<i>Number of payment cards per capita</i>	<i>Number of POS per merchant</i>
<b>Constant</b>	0.293*** (0.064)	-1.119*** (0.116)	0.277*** (0.051)	-0.963*** (0.123)	0.255*** (0.064)	-0.986*** (0.121)
<b>Network effects</b>						
<b>Number of POS per merchant</b> $t_{-1}$	0.167** (0.069)		0.179** (0.073)		0.168** (0.077)	
<b>Number of payment cards per capita</b> $t_{-1}$		1.561*** (0.082)		1.473*** (0.085)		1.556*** (0.112)
<b>Interchange fees</b>						
<b>Dummy for IFs antitrust investigations and regulatory scrutiny</b>	-0.051 (0.066)	-0.152 (0.100)				
<b>Dummy for IFs mandatory reductions</b>			-0.016 (0.092)	0.011 (0.087)		
<b>Dummy for MIFs regulation</b>					0.017 (0.031)	-0.048 (0.029)
<b>Control variables</b>						
<b>Number of ATM per Km<sup>2</sup></b>	0.515*** (0.075)	0.416** (0.167)	0.526*** (0.107)	0.334** (0.152)	0.474*** (0.103)	0.438*** (0.167)
<b>Crimes recorded by police per km<sup>2</sup></b>	-0.201*** (0.068)	0.081 (0.132)	-0.135** (0.06)	0.135 (0.137)	-0.123 (0.087)	0.131 (0.124)
<b>GDP per capita</b>	-0.562 (0.473)	0.703 (0.555)	-0.013 (0.486)	1.613*** (0.257)	0.03 (0.433)	1.096*** (0.354)
<b>Lending interest rate</b>	-0.116*** (0.033)		-0.122*** (0.034)		-0.092** (0.042)	
<b>Public expenditure on education (%GDP)</b>	-0.113 (0.100)		-0.187** (0.095)		-0.185* (0.111)	
<b>Dummy for the implementation phase of SEPA (SEPA2)</b>	0.240*** (0.071)	-0.483*** (0.080)	0.212*** (0.063)	-0.407*** (0.087)	0.184** (0.072)	-0.435*** (0.092)
<b>EU Dummy</b>	-0.156*** (0.058)	0.479*** (0.050)	-0.136** (0.054)	0.423*** (0.076)	-0.143** (0.064)	0.490*** (0.072)
<b>Trend</b>	-0.018*** (0.006)	0.083*** (0.011)	-0.021*** (0.007)	0.063*** (0.01)	-0.017*** (0.006)	0.064*** (0.011)
<b>Number of observations</b>	164		164		164	
<b>Hansen test of over identifying restrictions (p-value in parenthesis)</b>	29.446 (p = 0.494)		32.707 (p = 0.335)		30.966 (p = 0.417)	

\* p<0.1, \*\* p<0.05, \*\*\* p<0.01

**Note:** 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.

**Table 4. Usage for cardholders and merchants (volume of transactions)**

**Simultaneous equations estimation (GMM) with fixed effects**  
(Clustered standard errors by country and z-statistic in parenthesis)

	<i>Model 1</i>		<i>Model 2</i>		<i>Model 3</i>	
	<i>Number of transactions per card</i>	<i>Number of transactions per POS</i>	<i>Number of transactions per card</i>	<i>Number of transactions per POS</i>	<i>Number of transactions per card</i>	<i>Number of transactions per POS</i>
<b>Constant</b>	0.751*** (0.201)	0.259** (0.114)	0.576*** (0.175)	0.222* (0.119)	0.656*** (0.156)	0.14 (0.189)
<b>Network effects</b>						
<b>Number of transactions per POS</b> <sub>t-1</sub>	0.122 (0.146)		-0.091 (0.105)		0.051 (0.13)	
<b>Number of transactions per card</b> <sub>t-1</sub>		0.106 (0.096)		0.106 (0.11)		0.122 (0.116)
<b>Interchange fees</b>						
<b>Dummy for IFs antitrust investigations and regulatory scrutiny</b>	0.430** (0.201)	0.034 (0.094)				
<b>Dummy for IFs mandatory reductions</b>			-0.054 (0.074)	0.007 (0.158)		
<b>Dummy for MIFs regulation</b>					0.091** (0.039)	-0.009 (0.042)
<b>Control variables</b>						
<b>Number of ATM per Km<sup>2</sup></b>	-0.667*** (0.100)	-0.366*** (0.086)	-0.627*** (0.076)	-0.345*** (0.081)	-0.703*** (0.099)	-0.367*** (0.108)
<b>Crimes recorded by police per km<sup>2</sup></b>	-0.563*** (0.103)	0.148** (0.070)	-0.318*** (0.117)	0.202** (0.09)	-0.463*** (0.138)	0.146* (0.086)
<b>GDP per capita</b>	2.116* (1.092)	-0.175 (0.626)	1.823*** (0.597)	-0.181 (0.415)	1.077 (0.808)	0.377 (0.717)
<b>Consumption per capita</b>	0.930*** (0.238)	1.124*** (0.212)	0.299 (0.232)	1.059*** (0.245)	0.835*** (0.293)	0.769*** (0.275)
<b>Lending interest rate</b>	0.252*** (0.095)		0.142 (0.091)		0.329*** (0.091)	
<b>Public expenditure on education (%GDP)</b>	0.501*** (0.189)		0.454** (0.197)		0.407*** (0.156)	
<b>Dummy for the implementation phase of SEPA (SEPA2)</b>	0.039 (0.145)	-0.048 (0.080)	0.02 (0.062)	-0.075 (0.073)	-0.028 (0.08)	-0.119 (0.105)
<b>EU Dummy</b>	-0.038 (0.080)	-0.078 (0.057)	-0.069 (0.061)	-0.072 (0.048)	-0.147** (0.069)	-0.045 (0.041)
<b>Trend</b>	-0.080*** (0.019)	-0.014 (0.012)	-0.049*** (0.018)	-0.009 (0.013)	-0.052*** (0.014)	-0.003 (0.02)
<b>Number of observations</b>	172		172		172	
<b>Hansen test of over identifying restrictions (p-value in parenthesis)</b>	30.082 (0.3593)		30.399 (0.344)		28.706 (0.427)	

\* p<0.1, \*\* p<0.05, \*\*\* p<0.01

**Note:** 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.

**Table 5. Usage for cardholders and merchants (Value of transactions)**

**Simultaneous equations estimation (GMM) with fixed effects**  
(Clustered standard errors by country and z-statistic in parenthesis)

	<i>Model 1</i>		<i>Model 2</i>		<i>Model 3</i>	
	<i>Value of transactions per card</i>	<i>Value of transactions per POS</i>	<i>Value of transactions per card</i>	<i>Value of transactions per POS</i>	<i>Value of transactions per card</i>	<i>Value of transactions per POS</i>
<b>Constant</b>	0.398** (0.176)	-0.001 (0.235)	0.597 (0.381)	-0.280** (0.134)	0.424*** (0.126)	0.055 (0.168)
<b>Network effects</b>						
<i>Value of transactions per POS</i> <sub>t-1</sub>	-0.075 (0.138)		0.029 (0.343)		-0.148 (0.193)	
<i>Value of transactions per card</i> <sub>t-1</sub>		-0.268* (0.159)		-0.15 (0.205)		-0.226 (0.282)
<b>Interchange fees</b>						
<b>Dummy for IFs antitrust investigations and regulatory scrutiny</b>	0.138 (0.160)	0.015 (0.0.181)				
<b>Dummy for IFs mandatory reductions</b>			-0.236* (0.122)	-0.151 (0.151)		
<b>Dummy for MIFs regulation</b>					-0.035 (0.028)	-0.121*** (0.036)
<b>Control variables</b>						
<b>Number of ATM per Km<sup>2</sup></b>	0.022 (0.115)	0.007 (0.176)	-0.134 (0.164)	-0.066 (0.176)	-0.093 (0.122)	0.124 (0.145)
<b>Crimes recorded by police per km<sup>2</sup></b>	-0.091 (0.150)	0.176 (0.206)	0.028 (0.226)	0.289** (0.147)	0.064 (0.128)	0.262* (0.158)
<b>GDP per capita</b>	0.546 (0.786)	0.629 (0.969)	-0.032 (0.847)	1.461** (0.708)	0.397 (0.687)	0.445 (0.575)
<b>Consumption per capita</b>	1.429** (0.558)	1.593*** (0.614)	1.359 (0.882)	1.157*** (0.331)	1.214** (0.51)	1.722*** (0.472)
<b>Lending interest rate</b>	0.288*** (0.071)		0.367*** (0.133)		0.307*** (0.087)	
<b>Public expenditure on education (%GDP)</b>	0.011 (0.204)		-0.056 (0.189)		0.062 (0.137)	
<b>Dummy for the implementation phase of SEPA (SEPA2)</b>	0.024 (0.092)	-0.097 (0.116)	0.148 (0.192)	-0.178 (0.096)	0.068 (0.088)	-0.063 (0.097)
<b>EU Dummy</b>	-0.044 (0.069)	0.166* (0.098)	-0.102 (0.18)	0.165** (0.066)	-0.071 (0.066)	0.194*** (0.06)
<b>Trend</b>	-0.037** (0.017)	-0.011 (0.023)	-0.051* (0.03)	0.018 (0.014)	-0.034*** (0.011)	-0.017 (0.017)
<b>Number of observations</b>	141		141		141	
<b>Hansen test of over identifying restrictions (p-value in parenthesis)</b>	21.083 (0.822)		19.880 (0.868)		21.907 (0.785)	

\* p<0.1, \*\* p<0.05, \*\*\* p<0.01

**Note:** 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.

**Table 6. Aggregate impact on card usage**  
**Simultaneous equations estimation (GMM) with fixed effects**  
(Clustered standard errors by country and z-statistic in parenthesis)

	<i>Model 1</i>		<i>Model 2</i>		<i>Model 3</i>	
	<i>Volume of card payments as % share in national payments</i>	<i>Value of card payments as % share in national payments</i>	<i>Volume of card payments as % share in national payments</i>	<i>Value of card payments as % share in national payments</i>	<i>Volume of card payments as % share in national payments</i>	<i>Value of card payments as % share in national payments</i>
<b>Constant</b>	14.986*** (3.380)	0.071 (0.226)	9.760*** (2.618)	-1.074*** (0.271)	14.162*** (2.574)	-0.522** (0.241)
<b>Volume of transactions per card</b> $t-1$	0.028 (0.133)		0.157 (0.137)		0.08 (0.093)	
<b>Value of transactions per card</b> $t-1$		0.001*** (0.000)		0.001*** (0.000)		0.001*** (0.000)
<b>Interchange fees</b>						
<b>Dummy for IFs antitrust investigations and regulatory scrutiny</b>	1.264 (2.211)	-0.17 (0.16)				
<b>Dummy for IFs mandatory reductions</b>			14.042** (6.464)	3.863*** (0.654)		
<b>Dummy for MIFs regulation</b>					0.452 (0.559)	0.174*** (0.054)
<b>Control variables</b>						
<b>Number of ATM per Km<sup>2</sup></b>	-3.974 (3.52)	0.119 (0.19)	0.126 (3.163)	0.740* (0.403)	-3.033 (2.751)	0.123 (0.198)
<b>Crimes recorded by police per km<sup>2</sup></b>	0.23 (2.536)	0.518*** (0.181)	2.326 (1.751)	1.043* (0.549)	-0.789 (1.799)	0.602*** (0.157)
<b>GDP per capita</b>	31.148** (14.945)	-1.437* (0.763)	21.657 (24.079)	2.941 (3.007)	23.543** (11.446)	-0.559 (0.671)
<b>Lending interest rate</b>	3.946* (2.353)	-0.516*** (0.167)	1.373 (1.925)	-0.646*** (0.25)	3.645** (1.734)	-0.502*** (0.156)
<b>Public expenditure on education (%GDP)</b>	-2.795 (2.527)	0.019 (0.18)	1 (2.262)	0.181 (0.269)	-2.084 (2.281)	0.113 (0.169)
<b>Dummy for the implementation phase of SEPA (SEPA2)</b>	1.715 (1.201)	0.362*** (0.127)	0.485 (1.787)	-0.371 (0.308)	1.831* (0.995)	0.202* (0.104)
<b>EU Dummy</b>	-0.884 (1.502)	0.002 (0.104)	0.104 (2.548)	0.532* (0.277)	-1.142 (1.176)	-0.02 (0.094)
<b>Trend</b>	-1.394*** (0.387)	-0.013 (0.023)	-0.954*** (0.329)	0.048** (0.023)	-1.297*** (0.283)	0.035 (0.027)
<b>Number of observations</b>	113		113		113	
<b>Hansen test of over identifying restrictions (p-value in parenthesis)</b>	23.965 (0.683)		25.972 (0.574)		22.704 (0.747)	

\* p<0.1, \*\* p<0.05, \*\*\* p<0.01

**Note:** 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.

## **Annex A: Chronological list of the main antitrust investigations and regulatory events related to IFs and MIFs in the EU- 27**

We include a comprehensive list with the key regulatory events related to IFs that took place in Europe during the period 1995-2009. The events are divided in two groups which distinguish between regulation with a national and cross-border scope.

### **A. Antitrust and regulatory questioning of the IF level (national scope):**

#### **- Austria**

- **2003:** The Cartel Court declared that Europay committed an illegal cartel with almost all Austrian banks with respect to a provision in the payment card contract. Europay abused its dominant position (85 - 90% market share) on the market for payment with debit cards at POS-terminals, so that competitors like *Easycash* had to pay high IFs for using Europay's POS-terminals. *Source:* OECD (2006).

#### **- Denmark**

- **2005:** A new regulatory framework established that the merchant service charge (MSC) charged by Dankort was replaced by an annual fee per retailer of between €67 and €363, depending on the size of the merchant. *Source:* Bradford and Hayashi (2008), Tumpel-Gugerell, G. (2005), OECD (2006) and RBR (2005).

#### **- France**

- **2004:** The European Commission issued a Statement of Objections on 8 July 2004, stating that the IFs constituted an agreement among nine of the largest French banks, which were members of the “*Groupement des Cartes Bancaires*”. *Source:* Tumpel-Gugerell, G. (2005).
- **2005:** A second Statement of Objections was addressed to the “*Groupement des Cartes Bancaires*” alone, as the Commission believed that tariffs were set by a decision of the “*Groupement des Cartes Bancaires*” acting as an association of undertakings, and not by an agreement among the banks themselves. The Commission therefore closed the case against the nine banks to which the preceding Statement of Objections was sent in 2004. *Source:* Tumpel-Gugerell, G. (2005).
- **2007:** In October, the European Commission concluded its examination against the “*Groupement des Cartes Bancaires*” under article 81 of the Treaty. The examination concerned some price measures adopted by the Groupement, which hindered the issuing of cards in France at competitive rates by certain member banks. *Source:* Carletti and Vives (2009).

#### **- Germany**

- **2001:** The ZKA (an association of five central associations of German banks) applied for an exemption from article 1 of the German Act against Restraints of Competition, in order to reach a collective agreement among German banks upon the introduction of IFs into the German debit card system. *Source:* OECD (2006).
- **2003:** Payment system rules no longer would have to be notified to and approved by the German Competition Authority due to the coming into force of Regulation 1/2003 EG and the new Act against Restraints of Competition (2005). From then, there are no

automatic examination of rules concerning fees and their compatibility with applicable German competition law. *Source*: OECD (2006).

- **Hungary**

- **2006**: The Competition Authority of Hungary considered intervening in the payment card market. IFs were set too high compared to costs, especially in the case of debit cards. Price discrimination between “on-us” and “foreign” transactions were considered to have adverse effects upon issuer competition. Until that date, there had been no supervisory activity of IFs competition in Hungary. *Source*: Bradford and Hayashi (2008), OECD (2006) and Börestam & Schmiedel (2011).
- **2009**: The Hungarian Competition Authority (GVH) found in September 2009 that the uniform IFs in transactions using payment cards of Visa Europe and MasterCard Europe, set by the Hungarian banks, breached the Competition Act. *Source*: Börestam & Schmiedel (2011).

- **Italy**

- **2006**: The Bank of Italy and the Italian Competition Authority opened during 2006 a number of antitrust proceedings related IFs affecting the Italian card markets. *Source*: OECD (2006).
- **2009**: The Antitrust regulator launched an investigation into the IFs charged by MasterCard in Italy. The IF is charged whenever a consumer pays a retailer using a credit or a debit card. The regulator is concerned that the level of IFs is too high and that the agreement on IFs between MasterCard and Italian banks may infringe competition law. *Source*: Lexology (2009).

- **Netherlands**

- **2004**: In April 2004, the Dutch Competition Authority concluded that Interpay Nederland, which operated the debit card system, infringed competition laws by charging excessive fees for PIN transactions during a certain period. *Source*: Tumpel-Gugerell, G. (2005) and OECD (2006).
- **2005**: A decision by the Competition Authority led to thousands of retailers requesting reimbursement for lost income. Subsequent discussions led to an agreement beginning from January 2005, whereby all retailers accepting PIN-based debit cards were refunded €0.01 per transaction. In December 2005, following the administrative appeal procedure, the Authority confirmed that the eight banks which established the Interpay system had infringed the prohibition on cartels. *Source*: EuroCommerce and OECD (2006).

- **Poland**

- **2001**: The association of Polish retailers filed a complaint against Visa and MasterCard accusing them of, *inter alia*, price-fixing (via IFs) and creating barriers to entry to the payment cards market. *Source*: OECD (2006).

- **Romania**

- **2008**: Visa’s 10-K statement listed 19 countries around the world in which central banks and regulatory authorities are investigating IF issues and acting to resolve them. This list includes both Romania and Hungary. *Source*: VISA Inc. (2008).

- **Spain**

- **2001**: In December 2001, Sistema 4B applied for an individual exemption for a system to set IFs for transactions between banks arising from payments made with cards issued by

its members. Also, in July 2001, the Spanish company Euro 6000 had been granted an exemption for its IF setting. *Source*: Börestam & Schmiedel (2011).

- **2003**: The Spanish National Competition Commission rejected several proposals from the networks for the setting of IFs. *Source*: Carbó *et al.* (2010) and Börestam & Schmiedel (2011).

#### - **Sweden**

- **1995**: The Swedish Competition Authority rejected applications for negative clearance for the Visa (Case No. 1341/93) and Europay (Case No. 1833/93) systems, in December 1994 and June 1995 respectively, because their non-discrimination rules and MIFs were anti-competitive. *Source*: OECD (2006).

#### - **UK**

- **2003**: The Office of Fair Trading (OFT) found that an agreement between MasterCard's UK members on a common fee for credit and charge card transactions made in the UK infringed the Competition Act 1998. *Source*: Tumpel-Gugerell, G. (2005).
- **2005**: In September, the Office of Fair Trading (OFT) found that MasterCard's IF arrangements were illegal. The OFT issued a Statement of Objections regarding the Visa agreement. *Source*: Bradford and Hayashi (2008) and Börestam & Schmiedel (2011).
- **2006**: MasterCard appealed the decision of OFT, and since MasterCard had changed its method of setting IFs, the OFT consented to its decision being set aside by the Competition Appeal Tribunal. *Source*: Bradford and Hayashi (2008) and Börestam & Schmiedel (2011)
- **2007-2008**: The OFT launched a new MasterCard investigation in February 2007. *Source*: Bradford and Hayashi (2008)

### **B. IFs Mandatory reductions (national scope):**

#### - **Austria**

- **2006**: Following the European Commission's Interim Reports on the retail banking industry, Austrian banks agreed to review arrangements for setting IFs and announced that a reduction could be expected in order to foster genuine competition in acquiring between Europay Austria and Visa Austria. *Source*: Bradford and Hayashi (2008).

#### - **Denmark**

- **2003**: The Competition Authority established a positive merchant service fees for Dankort transactions and reduced the merchant service charge fees for using Maestro and Visa Electron from 0.75% to 0.4%, with a maximum of four DKK. *Source*: Bradford and Hayashi (2008).

#### - **Ireland**

- **2006**: Laser payment card network has committed to cut its joining fees, which were by far the highest in the European Union. *Source*: European Commission (2007).

#### - **Poland**

- **2007**: In January 2007, the banks behind Poland's Visa and MasterCard IF scheme were found to be flouting Poland's competition laws. The Polish Office of Competition and Consumer Protection ordered banks to discontinue their MIFs agreements. *Source*: Bradford and Hayashi (2008) and Börestam & Schmiedel (2011).

- **Portugal**
  - **2006:** The European Commission's Interim Reports led Portuguese issuers and acquirers to satisfy some of the Commission's concerns, via a slight reduction of domestic IFs and the elimination of preferential bilateral domestic IFs. *Source:* Bradford and Hayashi (2008).
- **Spain**
  - **1999:** The Spanish Ministry of the Economy ordered a reduction of IFs, from 3.5% in 1999 to 2.75% in July 2002. *Source:* Carbó *et al.* (2010).
  - **2005:** The Spanish National Competition Commission refused to authorise the IF arrangements of domestic card schemes. In December, agreement was reached between Spanish card networks and merchants for IFs to be reduced from a maximum of 2.32% to 1.1% by 2008. *Source:* Carbó *et al.* (2010), Bradford and Hayashi (2008) and Börestam & Schmiedel (2011).

**C. Antitrust and regulatory scrutiny of the MIFs level initiated by the European Commission (cross-border scope):**

- **2002:** The European Commission reached agreement with Visa to reduce its cross-border IFs by December 2007, to meet the objections from EU merchants (and specifically Eurocommerce), who claimed that Visa's MIFs were too high. The agreement reached required Visa's MIFs on credit cards to be gradually reduced over a five-year period, to reach a weighted average MIFs of 0.7% by 2007. *Source:* Bradford and Hayashi (2008) and Börestam & Schmiedel (2011).
- **2003:** The Commission initiated an investigation of MasterCard and issued a preliminary Statement of Objections, challenging the cost of MasterCard's cross-border MIFs for credit card transactions, similar to its investigation of Visa. *Source:* EuroCommerce.
- **2007:** The Commission ruled that MasterCard's MIFs were illegal in December 2007. *Source:* Börestam & Schmiedel (2011).
- **2008:** MasterCard filed an appeal against the decision in March 2008. On March, the Commission decided to open formal antitrust proceedings against Visa Europe Limited in relation to MIFs for cross-border point of sale transactions within the EEA using Visa branded consumer payment cards, and the 'Honour-All-Cards-Rule' as it applies to these transactions. The proceedings will seek to establish whether these practices constitute infringements of Article 81 of the EC Treaty and Article 53 of the EEA Agreement, which forbid restrictive business practices such as price fixing. *Source:* Neven and De La Mano (2009) and Börestam & Schmiedel (2011)
- **2009:** On April, the Commission sent a Statement of Objections to Visa. The Commission's preliminary view is that the MIFs set directly by Visa restrict competition between banks for accepting consumer payment cards without benefiting consumers by contributing to technical and economic progress. *Source:* Bradford and Hayashi (2008), European Commission (2009), Capgemini, RBS and EFMA (2010), Neven and De La Mano (2009), Prager *et al.* (2009) and Börestam & Schmiedel (2011).

**Annex A1: Adoption indicators in the EU- 27 (1995-2009)**  
**Standard errors in parenthesis**

	ADOPTION				USAGE				% OF CARD TRANSACTIONS	
	ADOPI	ADOP3	ADOP2	ADOP4	USAGE_1	USAGE_2	USAGE_3	USAGE_4	CASH_2	CASH_3
<b>Austria</b>	0.99 (0.06)	0.54 (0.1)	95.48 (6.07)	0.71 (0.12)	15.31 (2.41)	2.31 (0.11)	790.89 (108.55)	125.53 (6.18)	14.66 (0.66)	0.69 (0.07)
<b>Belgium</b>	1.41 (0.07)	1.01 (0.15)	478.2 (24.48)	3.6 (0.18)	34.53 (2.65)	4.68 (0.45)	1,903.29 (114.75)	256.59 (20.15)	37.9 (1.29)	1.1 (0.12)
<b>Bulgaria</b>	0.37 (0.1)	0.08 (0.04)	26.03 (7.16)	0.16 (0.06)	1.14 (0.06)	0.41 (0.05)	83.38 (3.26)	29.5 (6.33)	15.79 (2.81)	0.72 (0.13)
<b>Cyprus</b>	0.88 (0.09)	0.62 (0.07)	70.03 (8.77)	1.23 (0.19)	17.85 (1.4)	0.94 (0.06)	1,496.42 (15.76)	76.59 (2.14)	29.92 (1.66)	1.05 (0.11)
<b>Czech Republic</b>	0.52 (0.07)	0.12 (0.03)	67.82 (9.54)	0.41 (0.09)	11.45 (1.66)	1.72 (0.15)	429.98 (53.62)	66.73 (5.38)	6.04 (1.61)	0.1 (0.02)
<b>Denmark</b>	0.78 (0.06)	1.86 (0.15)	97.3 (7.59)	2.12 (0.19)	121.89 (4.46)	6 (0.46)	6,298.89 (178.81)	282.28 (26)	59.4 (1.68)	5.11 (0.29)
<b>Estonia</b>	0.81 (0.1)	0.83 (0.18)	24.44 (3.02)	0.22 (0.05)	36.48 (7.72)	4.03 (0.56)	753.45 (101.82)	81.1 (4.99)	44.46 (3.74)	1.32 (0.13)
<b>Finland</b>	1.15 (0.04)	1.37 (0.13)	17.69 (0.61)	0.27 (0.03)	78.96 (10.28)	5.15 (0.36)	2,853.79 (351.05)	189 (15.4)	47.19 (1.92)	0.64 (0.03)
<b>France</b>	0.89 (0.1)	1.26 (0.06)	100.06 (12.33)	1.76 (0.12)	77.2 (2.59)	4.1 (0.16)	3,868.54 (152.77)	203.35 (5.61)	35.01 (1.63)	0.8 (0.2)
<b>Germany</b>	1.31 (0.05)	0.99 (0.17)	301.04 (12.29)	1.26 (0.13)	13.36 (1.84)	3.16 (0.3)	920.76 (115.32)	222.3 (18.99)	14.2 (0.35)	0.36 (0.03)
<b>Greece</b>	0.61 (0.07)	1.16 (0.14)	51.33 (6.22)	2.56 (0.16)	6 (0.34)	0.14 (0.01)	391.22 (42.92)	10.56 (1.06)	53.8 (1.81)	0.51 (0.07)
<b>Hungary</b>	0.53 (0.07)	0.69 (0.26)	57.48 (7.1)	0.43 (0.05)	10.16 (1.75)	1.52 (0.24)	805.16 (76.03)	139.1 (9.84)	17.42 (1.37)	0.23 (0.03)
<b>Ireland</b>	0.87 (0.07)	0.97 (0.16)	50.12 (4.56)	0.58 (0.09)	32.69 (5.48)	2.56 (0.31)	3,475.68 (297.41)	265.92 (16.98)	40.8 (2.15)	2.74 (0.36)
<b>Italy</b>	0.49 (0.05)	0.62 (0.09)	94.18 (9.28)	2.57 (0.35)	16.21 (1.93)	0.61 (0.05)	1,387.92 (140.66)	53.06 (2.86)	32.27 (1.26)	1.2 (0.06)
<b>Latvia</b>	0.56 (0.11)	0.44 (0.07)	20.11 (3.72)	0.16 (0.03)	18.31 (2.95)	1.89 (0.36)	457.11 (22.69)	53.72 (2.5)	28.01 (3.95)	0.26 (0.05)
<b>Lithuania</b>	0.67 (0.13)	0.37 (0.06)	35.05 (6.89)	0.24 (0.05)	13.83 (1.32)	1.91 (0.26)	252.62 (16.32)	37.3 (4.83)	36.01 (3.28)	0.34 (0.03)
<b>Luxembourg</b>	1.57 (0.08)	1.04 (0.07)	273.43 (18.26)	2.7 (0.2)	30.66 (3.08)	3.09 (0.28)	2,178.21 (180.95)	220.24 (16.5)	44.3 (7.08)	2.96 (0.8)
<b>Malta</b>	1 (0.09)	0.43 (0.01)	1,260.66 (121.44)	19.2 (2.26)	8.9 (0.69)	0.56 (0.04)	558.36 (41.07)	35.13 (1.81)	25.06 (2.45)	1.31 (0.11)
<b>Netherlands</b>	1.66 (0.06)	1.21 (0.13)	642.81 (24.89)	4.7 (0.51)	38.26 (3.85)	5.28 (0.25)	1,836.2 (143.24)	260.91 (12.85)	35.39 (1.16)	1.38 (0.03)
<b>Poland</b>	0.44 (0.07)	0.15 (0.03)	53.47 (8.22)	0.34 (0.07)	9.91 (1.87)	1.44 (0.2)	416.34 (43.8)	54 (7.12)	24.01 (2.54)	0.45 (0.13)
<b>Portugal</b>	1.27 (0.11)	0.44 (0.04)	143.32 (12.67)	1.37 (0.19)	43.09 (2.89)	4.78 (0.21)	1,475.25 (94.23)	163.62 (5.75)	58.96 (1.83)	1.68 (0.11)
<b>Romania</b>	0.28 (0.06)	0.09 (0.04)	25.11 (5.78)	0.12 (0.04)	1.76 (0.54)	0.49 (0.07)	98.63 (19.41)	111.05 (58.4)	15.3 (2.96)	0.16 (0.03)
<b>Slovakia</b>	0.51 (0.08)	2.53 (0.41)	55.96 (8.53)	0.31 (0.06)	5.47 (1.02)	0.99 (0.13)	266.37 (40.21)	44.17 (5.75)	19.61 (1.7)	0.33 (0.05)
<b>Slovenia</b>	1.19 (0.09)	0.87 (0.17)	116.97 (9.48)	1.21 (0.17)	27.82 (1.17)	2.88 (0.23)	965.8 (39.07)	80.21 (3.82)	32.81 (0.44)	1.4 (0.08)
<b>Spain</b>	1.3 (0.08)	0.91 (0.06)	108.72 (8.2)	1.87 (0.16)	16.36 (1.69)	0.95 (0.09)	719.68 (97.61)	42.2 (5.71)	35.51 (1.23)	0.97 (0.14)
<b>Sweden</b>	0.76 (0.07)	0.98 (0.11)	15.26 (1.52)	0.27 (0.03)	78.13 (10.47)	3.91 (0.5)	3,731.33 (334.37)	192.75 (13.98)	50.32 (3.62)	4.88 (0.4)
<b>UK</b>	2.27 (0.13)	1.98 (0.09)	557.06 (33.25)	3.38 (0.23)	30.09 (3.02)	4.94 (0.45)	1,972.57 (225.57)	326.03 (36.88)	45.01 (1.36)	0.37 (0.03)

**Annex A2: Financial and social indicators in the EU- 27(1995-2009)**  
**Standard errors in parenthesis**

	<b>GDP</b>	<b>ATM_KM</b>	<b>I_RATE</b>	<b>CRIME</b>	<b>CONSUMP</b>	<b>EDUCA</b>
<b>Austria</b>	25.71 (0.95)	0.08 (0.01)	5.77 (0.2)	6.58 (0.21)	16,754.3 (631.04)	5.7 (0.06)
<b>Belgium</b>	24.52 (0.89)	0.35 (0.04)	7.73 (0.24)	32.67 (0.19)	15,071.78 (761.88)	6.01 (0.02)
<b>Bulgaria</b>	6.84 (0.58)	0.02 (0)	11.49 (0.68)	1.42 (0.07)	18,60.17 (121.63)	3.87 (0.17)
<b>Cyprus</b>	18.4 (0.96)	0.04 (0)	7.41 (0.2)	0.6 (0.05)	13,691.17 (452.49)	6.05 (0.25)
<b>Czech Republic</b>	15.05 (0.84)	0.03 (0)	8.17 (0.78)	4.78 (0.1)	4,721.16 (465.68)	4.28 (0.07)
<b>Denmark</b>	25.5 (0.89)	0.06 (0)	8.14 (0.36)	11.29 (0.23)	18,865.41 (1145.07)	8.16 (0.07)
<b>Estonia</b>	10.86 (1.05)	0.01 (0)	9.29 (1.1)	1.1 (0.04)	3,853.89 (415.19)	5.53 (0.17)
<b>Finland</b>	22.99 (1.12)	0.01 (0)	5.15 (0.31)	1.08 (0.02)	14,796.99 (1017.24)	6.32 (0.09)
<b>France</b>	22.64 (0.85)	0.07 (0)	6.77 (0.16)	6.79 (0.1)	15,514.37 (800.17)	5.86 (0.05)
<b>Germany</b>	23.89 (0.86)	0.15 (0.01)	9.63 (0.21)	18.09 (0.12)	15,889.16 (577.11)	4.55 (0.02)
<b>Greece</b>	18.01 (0.99)	0.04 (0)	14.63 (2.05)	3.91 (0.83)	13,627.67 (689.76)	3.46 (0.1)
<b>Hungary</b>	12.02 (0.75)	0.03 (0)	14.77 (1.9)	5 (0.16)	45,40.57 (207.57)	5.08 (0.13)
<b>Ireland</b>	26.87 (1.78)	0.03 (0)	4.11 (0.42)	1.35 (0.04)	16,298.52 (1,050.31)	4.61 (0.14)
<b>Italy</b>	22.37 (0.64)	0.12 (0.01)	7.49 (0.68)	8.09 (0.2)	14,641.67 (526.69)	4.61 (0.05)
<b>Latvia</b>	8.79 (0.82)	0.01 (0)	13.36 (2.01)	0.75 (0.04)	31,68.39 (339.62)	5.45 (0.1)
<b>Lithuania</b>	9.61 (0.86)	0.01 (0)	10.83 (1.64)	1.16 (0.03)	32,47.93 (422.11)	5.42 (0.15)
<b>Luxembourg</b>	50.55 (3.29)	0.14 (0.01)	5.7 (0.27)	10.07 (0.2)	27,151.02 (927.26)	3.83 (0.08)
<b>Malta</b>	16.11 (0.58)	0.43 (0.02)	6.55 (0.29)	52.86 (1.3)	8,934.23 (236.85)	5.1 (0.27)
<b>Netherlands</b>	26.39 (1.26)	0.18 (0.01)	4.42 (0.39)	30.85 (0.48)	1,5637 (925.31)	5.15 (0.07)
<b>Poland</b>	10.17 (0.67)	0.02 (0)	14.77 (2.42)	3.9 (0.17)	4,019.95 (283.49)	5.11 (0.08)
<b>Portugal</b>	15.94 (0.7)	0.12 (0.01)	8.77 (1.41)	4.03 (0.1)	9,565.24 (393.16)	5.4 (0.03)
<b>Romania</b>	7.46 (0.74)	0.01 (0)	15.61 (5.26)	1.28 (0.07)	2,881.17 (234.59)	3.44 (0.12)
<b>Slovakia</b>	11.73 (0.93)	0.03 (0)	11.86 (1.44)	2.16 (0.08)	4,147.77 (460.32)	4.24 (0.11)
<b>Slovenia</b>	16.87 (1)	0.05 (0.01)	12.79 (1.53)	3.32 (0.27)	8,915.74 (307.31)	5.77 (0.09)
<b>Spain</b>	20.21 (1.11)	0.09 (0.01)	5.79 (0.71)	3.85 (0.2)	12,162.64 (505.6)	4.36 (0.04)
<b>Sweden</b>	25.03 (1.08)	0.01 (0)	5.61 (0.51)	2.7 (0.03)	15,737.96 (851.3)	7.22 (0.08)
<b>UK</b>	23.99 (1.1)	0.18 (0.02)	4.99 (0.41)	21.98 (0.46)	17,367.48 (855.55)	5.01 (0.1)

**Annex B. Adoption for Cardholders and merchants**  
**Simultaneous equations estimation (GMM) with fixed effects**  
(Clustered standard errors by country and z-statistic in parenthesis)

	<i>Model 1</i>		<i>Model 2</i>		<i>Model 3</i>	
	<i>Number of payment cards per Km<sup>2</sup></i>	<i>Number of POS per Km<sup>2</sup></i>	<i>Number of payment cards per Km<sup>2</sup></i>	<i>Number of POS per Km<sup>2</sup></i>	<i>Number of payment cards per Km<sup>2</sup></i>	<i>Number of POS per Km<sup>2</sup></i>
<b>Constant</b>	0.199*** (0.052)	-0.198 (0.127)	0.223*** (0.055)	-0.218* (0.115)	0.191*** (0.055)	-0.274 (0.175)
<b>Network effects</b>						
<b>Number of POS per Km<sup>2</sup><sub>t-1</sub></b>	0.262*** (0.082)		0.193*** (0.053)		0.253*** (0.079)	
<b>Number of payment cards per Km<sup>2</sup><sub>t-1</sub></b>		1.225*** (0.149)		1.326*** (0.112)		1.293*** (0.147)
<b>Interchange fees</b>						
<b>Dummy for IFs antitrust investigations and regulatory scrutiny</b>	-0.023 (0.069)	0.084 (0.075)				
<b>Dummy for IFs mandatory reductions</b>			-0.047 (0.062)	-0.036 (0.119)		
<b>Dummy for MIFs regulation</b>					-0.001 (0.022)	0.014 (0.025)
<b>Control variables</b>						
<b>Number of ATM per Km<sup>2</sup></b>	0.491*** (0.062)	-0.105 (0.091)	0.506*** (0.051)	-0.187* (0.098)	0.509*** (0.061)	-0.137 (0.085)
<b>Crimes recorded by police per km<sup>2</sup></b>	-0.088* (0.54)	-0.268** (0.135)	-0.101*** (0.032)	-0.28 (0.177)	-0.075 (0.052)	-0.246*** (0.094)
<b>GDP per capita</b>	-0.102 (0.422)	0.357 (0.431)	-0.306 (0.347)	0.299 (0.336)	0.173 (0.53)	0.461 (0.339)
<b>Lending interest rate</b>	-0.021 (0.032)		-0.017 (0.032)		-0.031 (0.027)	
<b>Public expenditure on education (%GDP)</b>	-0.102 (0.062)		-0.062* (0.034)		-0.089 (0.068)	
<b>Dummy for the implementation phase of SEPA (SEPA2)</b>	0.115* (0.065)	0.014 (0.094)	0.156*** (0.044)	-0.012 (0.088)	0.108 (0.066)	-0.028 (0.1)
<b>EU Dummy</b>	-0.095* (0.057)	0.027 (0.117)	-0.136*** (0.043)	0.046 (0.092)	-0.089 (0.072)	0.045 (0.103)
<b>Trend</b>	-0.014** (0.006)	0.017* (0.009)	-0.013** (0.007)	0.019** (0.009)	-0.016** (0.007)	0.024* (0.014)
<b>Number of observations</b>	174		174		174	
<b>Hansen test of over identifying restrictions (p-value in parenthesis)</b>	26.507 (0.649)		27.754 (0.585)		26.946 (0.626)	

\* p<0.1, \*\* p<0.05, \*\*\* p<0.01

## References

- Baxter, W. F. (1983). Bank Interchange of Transactional Paper: Legal Perspectives. *Journal of Law & Economics*, 26(3), 541-588.
- Bolt, W., & Chakravorti, S. (2008). Economics of payment cards: A status report. *Economic Perspectives*, 32(4), 15-27.
- Bolt, W., & Chakravorti, S. (2011). *Pricing in Retail Payment Systems: A Public Policy Perspective on Pricing of Payment Cards*. DNB Working Papers 331, Netherlands Central Bank, Research Department.
- Börestam, A., & Schmiedel, H. (2011). Interchange fees in card payments. *ECB - Occasional paper series*, 131(September).
- Bradford, T., & Hayashi, F. (2008). Developments in interchange fees in the United States and abroad. *Payments System Research Briefing*.
- Capgemini, RBS, & EFMA. (2010). World Payment Report.
- Capgemini LLC. (2008). SEPA: potential benefits at stake *Researching the impact of SEPA on the payments market and its stakeholders*: Capgemini Consulting.
- Carbo-Valverde, S., Chakravorti, S., & Rodriguez-Fernandez, F. (2010). Regulating two-sided markets: an empirical investigation: Federal Reserve Bank of Chicago, Working Paper Series: WP-09-11.
- Carletti, E., & Vives, X. (2009). Regulation and Competition Policy in the Banking Sector *Competition Policy in the EU* (Vol. 1, pp. 260-284): Oxford Scholarship Online Monographs.
- Chakravorti, S. (2010). Externalities in Payment Card Networks: Theory and Evidence. *Review of Network Economics*, 9(2).
- Chakravorti, S., & Shah, A. (2001). *A study of the interrelated bilateral transactions in credit card networks*. FRB Chicago Policy Studies No. EPS-2001-2.
- Chang, H., Evans, D., & Garcia Swartz, D. (2005). The effect of regulatory intervention in two-sided markets: An assessment of interchange-fee capping in Australia. *Review of Network Economics*, 4(4), 5.
- De Meijer, C. R. W. (2010). Towards the end of the SEPA end-date debate? *Journal of Payments Strategy & Systems*, 4(4), 390.
- Deungoue, S. (2008). Will we pay in the same way? *The European Journal of Finance*, 14(1-2), 49-67.
- European Central Bank. (2010). 7th SEPA Progress Report: Beyond Theory into Practice. (October).
- European Central Bank. (2011). 2010 statistics on non-cash payments *Payment statistics*. Frankfurt
- European Central Bank. (2012). Towards an integrated European card payments market. *Monthly Bulletin*, 01, 75-86.
- European Commission. (2006). Interim Report I: Payment cards *Sector Inquiry under Article 17 Regulation 1/2003 on retail banking*. Brussels: Competition DG - Financial Services (Banking and Insurance).
- European Commission. (2007). Introductory Remarks on Final Report of Retail Banking Sector Inquiry Press conference. Retrieved from <http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/07/50&format=HTML&aged=1&language=EN&guiLanguage=en>
- European Commission. (2009). Antitrust: Commission sends Statement of Objections to Visa. Retrieved from <http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/09/151&format=PDF&aged=0&language=EN&guiLanguage=en>
- European Commission. (2012). *Green Paper*: Towards an integrated European market for card, internet and mobile payments. Brussels.

- Evans, D. S. (2011). Payments Innovation and Interchange Fees Regulation: How Inverting the Merchant-Pays Business Model Would Affect the Extent and Direction of Innovation. *SSRN eLibrary*, <http://ssrn.com/abstract=1878825>
- Evans, D. S., Litan, R. E., & Schmalensee, R. (2011). Economic Analysis of the Effects of the Federal Reserve Boards Proposed Debit Card Interchange Fee Regulations on Consumers and Small Businesses. *SSRN eLibrary*, <http://ssrn.com/paper=1769887>
- Evans, D. S., & Schmalensee, R. (2005). The economics of interchange fees and their regulation : an overview. *Proceedings – Payments System Research Conferences*, 73-120.
- Evans, D. S., & Schmalensee, R. (2005). *Paying with plastic: the digital revolution in buying and borrowing*: MIT Press.
- Frankel, A. S., & Shampine, A. L. (2006). The economic effects of interchange fees. *Antitrust Law Journal*, 73(3), 627-673.
- Gans, J. S., & King, S. P. (2003). A Theoretical Analysis of Credit Card Reform in Australia. *Economic Record*, 79(247), 462-472.
- Garcia-Swartz, D. D., Hahn, R. W., & Layne-Farrar, A. (2006). The Move Toward a Cashless Society: A Closer Look at Payment Instrument Economics. *Review of Network Economics*, 5(2), 175-198.
- Gerdes, G. R., Walton II, J. K., Liu, M. X., & Parke, D. W. (2005). Trends in the use of payment instruments in the United States. *Federal Reserve Bulletin*, 180-201.
- Hansen, L. P. (1982). Large Sample Properties of Generalized Method of Moments Estimators. *Econometrica*, 50(4), 1029-1054.
- Harper, I., Simes, R., & Malam, C. (2006). The development of electronic payments systems. In R. Cooper, G. Madden, A. Lloyd & M. Schipp (Eds.), 25-40.
- Hayashi, F. (2010). Payment Card Interchange Fees and Merchant Service Charges – An International Comparison. *Lydian payments Journal*, 1(3).
- Hayashi, F., & Weiner, S. E. (2006). Interchange Fees in Australia, the UK, and the United States: Matching Theory and Practice. *Economic Review*, 91(3), 75-112.
- He, P., Huang, L., & Wright, R. (2005). Money and banking in search equilibrium. *International Economic Review*, 46(2), 637-670.
- Hove, L. V. (2004). Cost-based pricing of payment instruments: The state of the debate. *Economist*, 152(1), 79-100.
- Humphrey, D. (2004). Replacement of cash by cards in US consumer payments. *Journal of economics and business*, 56(3), 211-225.
- Humphrey, D. (2010). Retail payments: New contributions, empirical results, and unanswered questions. *Journal of Banking & Finance*, 34(8), 1729-1737.
- Humphrey, D., Pulley, L. B., & Vesala, J. M. (1996). Cash, Paper, and Electronic Payments: A Cross-Country Analysis. *Journal of Money, Credit and Banking*, 28(4), 914-939.
- Humphrey, D., Willeson, M., Bergendahl, G., & Lindblom, T. (2006). Benefits from a changing payment technology in European banking. *Journal of Banking & Finance*, 30(6), 1631-1652.
- Hunt, R. M. (2003). An Introduction to the Economics of Payment Card Networks. *Review of Network Economics*, 2(2).
- Klee, E. (2006). *Families' use of payment instruments during a decade of change in the U.S. payment system*. Finance and Economics Discussion Series. Board of Governors of the Federal Reserve System (U.S.).
- Lexology. (2009). Investigation of Mastercard's interchange fees, from <http://www.lexology.com/library/detail.aspx?g=8df56fd5-254d-461e-8779-a251bd0a526b>
- Neven, D., & De La Mano, M. (2009). Economics at DG competition, 2008-2009. *Review of Industrial Organization*, 35(4), 317-347.
- OECD. (2006). Competition and Efficient Usage of Payment Cards *Policy Round Tables*.

- Özlem, B.-D., & Emilio, C. (2009). *Pricing payment cards*. European Central Bank - Working Paper Series. European Central Bank.
- Petersen, M. A. (2009). Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches. *Review of Financial Studies*, 22(1), 435-480.
- Prager, R. A., Manuszak, M. D., Kiser, E. K., & Borzekowski, R. (2009). *Interchange Fees and Payment Card Networks: Economics, Industry Developments, and Policy Issues*. Working Papers -- U.S. Federal Reserve Board's Finance & Economic Discussion Series, 1-85.
- RBR. (2005). Study on the impact of regulation 2560/2001 on bank charges for national payments. London: Retail Banking Research.
- Rochet, J. C., & Tirole, J. (2002). Cooperation among Competitors: Some Economics of Payment Card Associations. *The RAND Journal of Economics*, 33(4), 549-570.
- Rochet, J. C., & Tirole, J. (2003). Platform competition in two-sided markets. *Journal of the European Economic Association*, 1(4), 990-1029.
- Schuh, S., Shy, O., & Stavins, J. (2010). *Who gains and who loses from credit card payments?: theory and calibrations*. FRB of Boston Public Policy Discussion Paper No. 10-3.
- Shy, O. (2011). A Short Survey of Network Economics. *Review of Industrial Organization*, 38(2), 119-149.
- Tirole, J. (2011). Payment Card Regulation and the Use of Economic Analysis in Antitrust. *CPI Journal*, 7(1).
- Tumpel-Gugerell, G. (2005). Interchange in a changing market: Observations from the euro area perspective. Speech for conference organised by the Federal Reserve Bank of Kansas City. Santa Fe.
- Verdier, M. (2011). Interchange Fees in Payment Card Systems: A Survey of the Literature. *Journal of Economic Surveys*, 25(2), 273-297.
- VISA Inc. (2008). Form 10 K U.S. Securities and Exchange Commission.
- Wang, Z. (2010). Market structure and payment card pricing: What drives the interchange? *International Journal of Industrial Organization*, 28(1), 86-98.
- Weiner, S. E., & Wright, J. (2005). Interchange Fees in Various Countries: Developments and Determinants. *Review of Network Economics*, 4(4), 290-323.



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