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The impact of SEPA in credit transfer payments: Evidence from the euro area

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ABSTRACT

This paper analyses the effect of the implementation process of the Single Euro Payments Area (SEPA) project on credit transfer payments in euro area countries during the period between 2008 and 2013. Using both univariate and multivariate fractional regression models, we found that, when controlling for socio-demographic, economic, technological and institutional factors, the progress in the migration to SEPA formats had a relevant positive impact on the share of payments made with credit transfers. Our results provide for the first time empirical evidence of the direct effect of the implementation of SEPA on payment habits and set the basis for the discussion of some of the possible implications of payments digitalization from both economical and societal perspectives.

1. Introduction

The Single Euro Payments Area (SEPA) project is, undoubtedly, a key milestone for European integration. By establishing a single set of conditions, rights and obligations for euro payments regardless of the location, this project aims to increase harmonization and efficiency in euro payments and, for that reason, contribute to take complete advantage of the Economic and Monetary Union (ECB, 2013).

Understanding the impact of the progress in SEPA migration on the use of credit transfers is of great interest to both payment service providers and policymakers. The implementation process required significant investments by the banking community, for which a financial return is expected in the near future. By supporting the SEPA project, authorities intended to encourage the substitution of less efficient means of payment, since this might reduce the costs supported by society with the use of payments instruments (Schmiedel et al., 2012) and also contribute to economic growth (Hasan et al., 2013). But the relevance of this topic does not extinguish in this positivist approach. The effect of the SEPA project should be explored

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in more than just an economic angle. As a matter of fact, money—an ever-present element in our daily lives—has deep and complex social, economic and political connections as Dodd (2014) underlines. Due to technological developments, the way money is used to make payments has seen significant changes and credit transfer payments form part of a broader phenomenon of payments' digitalization. Identifying and discussing the different implications of this dematerialization is therefore another aim of this paper.

Examining the overall impact of SEPA implementation on credit transfer payments in euro and non area countries will only be feasible in the years following the complete conclusion of the migration (i.e., after 31 October 2016). Note that a considerable period after completing SEPA migration must be guaranteed before a general analysis is performed, since the possible substitution effects with other payment instruments might take some time to occur. Yet, at this stage, it is feasible to evaluate what was the impact of the progress in the migration in euro area countries. In fact, between 2008 and 2013 the migration of credit transfers to SEPA standards has seen considerable progress. In December 2008 only 2% of euro area credit transfers were SEPA compliant, but in December 2013 around 74% of credit transfers were made in accordance with SEPA rules.

In this context, this paper examines the effect of the progress in SEPA migration on credit transfer payments in euro area countries between 2008 and 2013. While a small number of the existing papers have explored the potential benefits of the implementation of SEPA (see an overview in Schmiedel, 2007) and a few cross-country studies identified some of the factors that might influence the use of credit transfers (for example, Humphrey et al. (1996b), Deungoue (2008) and Martikainen et al. (2015)), none of them focuses on the effect of SEPA adoption on credit transfer payments. Thus, this study complements the existing literature in several ways. First, according to our knowledge, it provides the first empirical examination of the effect of SEPA migration on the use of credit transfers, therefore enriching the existing literature which is mainly focused on the theoretical analysis of SEPA or on the computation of potential economic benefits of this project. Second, the analysis of the effect of SEPA migration progress on the use of credit transfers – measured as the proportion of the number of credit transfer payments on the total number of payments made with credit transfers, direct debits, cards and cheques – is performed using estimation techniques that take into account the fractional nature of the dependent variable under estimation. Third, the analysis includes not only the most well known fractional regression models (FRM), which are univariate in the sense that only the share of interest is described, but also FRM that allow for the presence of neglected heterogeneity, recently proposed by Ramalho and Ramalho (2014), and multivariate FRM that describe simultaneously the share of interest and other shares of non-cash payments instruments, controlling for potential substitution effects between them.

From our regression results we conclude that, after taking into consideration the potential impact of socio-demographic, economic, technological and institutional variables, the progression in the migration of credit transfers to SEPA formats had a statistically significant positive effect on the use of this payment instrument. This result suggests that the migration to SEPA impacted credit transfer payments in more than just a technical way. The fact that the pattern of use of this payment instrument was affected by the project can unveil future advantages when full migration is achieved in terms of: (i) the returns obtained by payment service providers with the use of this payment instrument; (ii) the social costs supported with the use of payment instruments; and (iii) the evolution of consumption and trade. Indeed, since the use of this payment instrument is still relatively low in some euro area countries (for example, in Portugal, Spain, France and Malta, the share of payments made through credit transfers in 2013 was less than 20%), the migration to SEPA might contribute to an increase in credit transfers usage, with the potential benefits that might result from it.

The remainder of this paper is structured as follows. Section 2 presents an outline of the use of credit transfers in euro area countries and of the SEPA project, as well as a summary of relevant literature. Section 3 describes the data and illustrates the methodology used. Section 4 reports the empirical results. Section 5 discusses the findings and concludes.

2. Framework

In this section it is presented a summary of the evolution of credit transfer payments in euro area countries between 2008 and 2013, as well as a brief overview of the SEPA project. The relevant literature is also reviewed.

2.1. Credit transfer payments in the euro area

According to Kokkola (2010), credit transfers have been the most commonly used non-cash payment instrument in the euro area. In fact, the share of payments made with credit transfers in the euro area (computed considering the relative importance of the number of credit transfer payments – SEPA compliant or not –, on the total number of payments made with credit transfers, direct debits, cards and cheques) has been stable across the period in analysis, ranging from around 33% in 2008 to about 32% in 2013 (Table 1).

The relative importance of this payment instrument in the euro area is quite substantial when compared to the United States of America (US) or Canada. Still, it is lower than the proportion found in Switzerland (of around 51% in 2013). In fact, the majority of cashless payments in Switzerland are made by credit transfers due to the historical relevance of the Swiss Postal Administration which contributed to a payment culture based on credit transfers (BIS, 2011).

Focusing on the various euro area countries, we can observe considerable differences among them. On the upper bound we have countries such as Slovakia, Finland, Greece, Slovenia and Austria, where the proportion of credit transfer payments

Table 1
Evolution of the share of the number of payments made through credit transfers between 2008 and 2013.

	2008	2013	Variation
Euro area	33.1%	32.2%	−3%
United States of America	6.8%	7.3%	7%
Canada	10.2%	9.6%	−6%
Switzerland	55.3%	51.1%	−8%

Source: European Central Bank Statistical Data Warehouse for data on the European Union and the euro area and Bank for International Settlements for data on the United States of America, Canada and Switzerland.

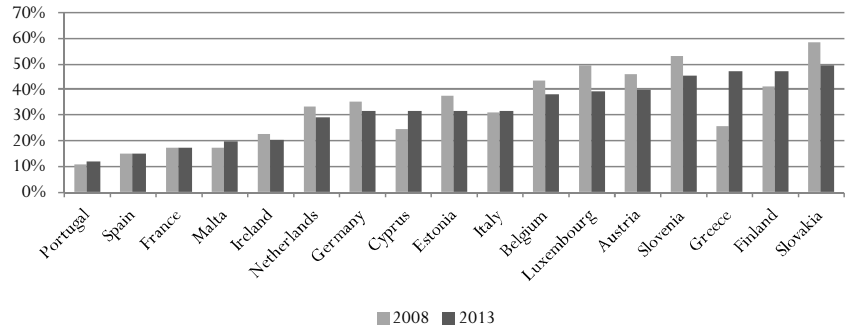

Fig. 1. Evolution of the share of credit transfer payments (in volume) between 2008 and 2013 in euro area countries.
Source: European Central Bank Statistical Data Warehouse.

was above 40% in 2013. Typically, the countries where the relative importance of this payment instrument increased from 2008 to 2013, were those with a lower share of credit transfer payments in the beginning of the period (with the exception of Ireland and Finland). Even so, there are still countries on the lower bound, like Portugal, Spain, France and Malta, where the share of payments made with credit transfers remained below 20% in the period comprised between 2008 and 2013 (Fig. 1).

The differences on the intensity of use of credit transfers in the various euro area countries leave room for further expansions in the usage of this payment instrument in the future, with potential impacts on the economy. Indeed, the empirical evidence suggests that migration to electronic payment instruments, such as credit transfers, might stimulate the real economy. According to Hasan et al. (2013), credit transfer payments revealed the second strongest relation, after card payments, with the evolution of the economy, consumption and trade. In addition, it might generate greater efficiency in terms of the costs supported by society with the use of payments instruments. Schmiedel et al. (2012) concluded that the weighted average unit social cost of credit transfers in a sample of EU countries amounted to €1.92 per transaction, which compares with about €3.55 in cheques.

2.2. Brief overview of the SEPA project

In the last years, one of the key elements that might have impacted the payments landscape, particular in the credit transfer payments in the euro area countries, was the implementation of the Single Euro Payments Area or SEPA project. This area comprises 28 EU Member States, as well as Iceland, Norway, Liechtenstein, Monaco, Switzerland and San Marino. The project results from an initiative to promote payments integration in the European Union (EU) that began around 1999, when the European Central Bank (ECB) highlighted the need to establish a single payments area to improve the service levels of domestic and cross-border retail payments (ECB, 1999). It aims to harmonize retail payments in euro made by consumers, merchants, corporations and other entities between or within national boundaries, as well as to improve transparency and provide more efficient retail payments (ECB, 2013).

The adoption by the European Parliament and the Council of the European Union of Regulation (EC) No 2560/2001 (repealed by Regulation (EC) No 924/2009), that established that the charges for cross-border euro payments within the EU should be equal to domestic euro payments, changed the cost structure and returns of banks. This led to the creation, in 2002, of the European Payments Council (EPC) by the banking community. This coordination and decision-making body of the European banking industry on issues related to payments seeks to support payments integration, in particular the SEPA project. Since the efforts of the European banking community were not enough to ensure the implementation of SEPA, Regulation (EU) No 260/2012 was adopted in March 2012 by the EU Council and the European Parliament. This Regulation established rules for the initiation and processing of credit transfer and direct debit transactions in euro. It also required the use of common standards, such as the International Bank Account Number (IBAN)—an international payment account

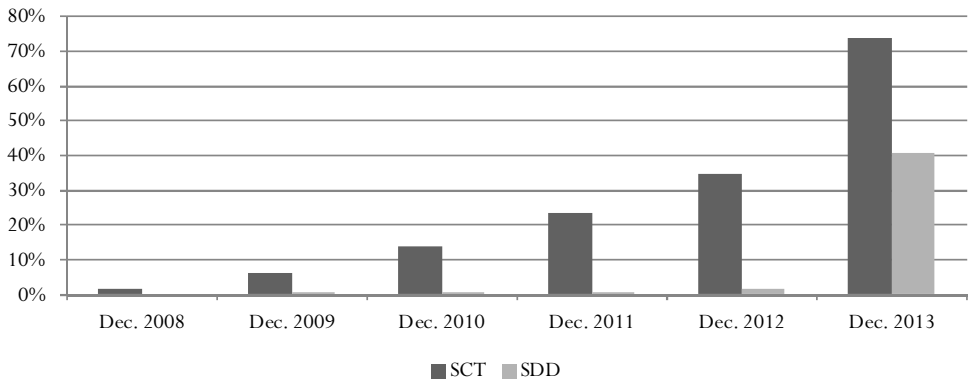

Fig. 2. Evolution of the share of SCT and SDD transactions in the euro area between 2008 and 2013. Source: European Central Bank.

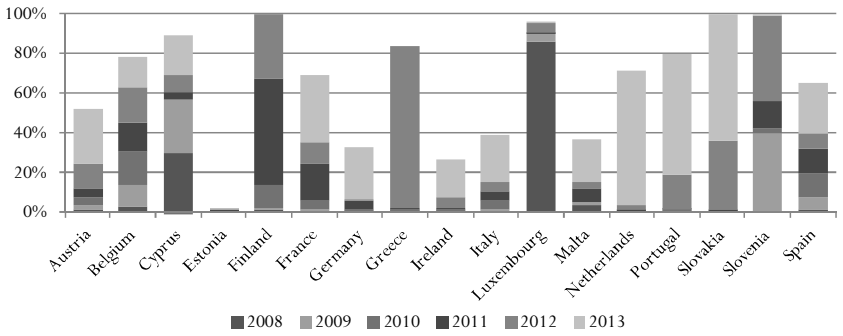

Fig. 3. Evolution of the SEPA adoption process in euro area countries between 2008 and 2013. Source: European Central Bank.

number identifier. Furthermore, the Regulation set 1 February, 2014 as the deadline for replacing national credit transfers and direct debits with their SEPA equivalents in the euro area (hereinafter referred to as SEPA credit transfers or SCT and SEPA direct debits or SDD) and 31 October, 2016 as the deadline for Member States with other currencies. Nonetheless, the Regulation provided the Member States with the possibility to adopt derogations to some of the abovementioned rules and standards. For instance, Member States could provide consumers with conversion services that allow them to continue using the national payment account number identifier (i.e., the Basic Bank Account Number or BBAN) instead of IBAN until 1 February, 2016. Taking into consideration the slow migration level in some Member States, particularly in SDD, the European Commission published on 9 January, 2014 a proposal for a Regulation amending Regulation (EU) No 260/2012 with an additional migration period for the euro area of six months (i.e., until 1 August, 2014). This Regulation (EU) No 248/2014 was adopted on 26 February, 2014.

Fig. 2 displays the evolution of the share of SCT and SDD transactions in the euro area. The migration process to SCT in the euro area was much smoother than the SDD migration. In 2011, around 23.7% of the total number of credit transfer transactions processed corresponded to SCT, while only 0.5% of the total number of direct debit transactions processed was SEPA compliant. The migration to SDD in the euro area only started improving in 2013.

Although the adoption process of SCT was relatively gradual in the euro area, significant differences in the rate of progression existed between countries. For instance, Luxembourg achieved a very high rate of SCT transactions in 2008 (of around 86%) while the Netherlands, Slovakia and Portugal registered a significant acceleration in the compliance with SEPA in 2013. By the end of 2013 only Finland and Slovakia had completed the migration to SCT (Fig. 3).

2.3. Literature review

Credit transfer payments have not been widely explored in the existing literature. According to our understanding this can derive from two factors. First, this type of payment instrument is not commonly used in the US when compared to other countries, as highlighted in Table 1. This results from historical reasons regarding, for example, the geographical size of the country and the concentration of the banking system (Humphrey et al., 1996a). Nonetheless, a significant part of the research made on the use of payment instruments is focused on the US. Second, credit transfers might be mainly used for

bill payments and not payments at the point of sale (such as shops), being this last type of payments more investigated in the existing studies.

The small number of studies that incorporate credit transfer payments in the analysis include the papers of Stavins (2001), Mantel (2001), Hayashi and Klee (2003), Bolt et al. (2008) and Schuh and Stavins (2013). The investigation performed by Stavins (2001) highlighted the importance of socio-demographic factors such as income, age, education level and marital status on consumers' use of cash, cheques, cards and credit/debit ACH transactions (i.e., credit transfers and direct debits). The author obtained evidence of a positive impact of the education level and a negative effect of age characteristics on ACH transactions. Other factors have also been discussed in the literature. Hayashi and Klee (2003) incorporated in the investigation the effect of the adoption of new products (for example, computer and cellular phones) and found a positive impact on bill payments. Schuh and Stavins (2013) extended further the examination of consumers' payment habits by focusing separately on their adoption and use. The authors conclude that the adoption of online banking bill payments (i.e., bill payments made from a bank account and initiated by a consumer using the bank's website) is negatively influenced by age. In some papers, the examination of this payment instrument is made together with other payment instruments. For example, Mantel (2001) focused on the effect of socio-demographic factors, the level of adoption of new products and the perception of the characteristics of electronic payment instruments regarding control, convenience of use and security, on the (aggregate) consumers' usage of electronic payment instruments. Moreover, Bolt et al. (2008) used data from the Netherlands and Norway to assess the relevance of pricing policies.

The abovementioned studies – based on survey data – draw attention to the important role played by consumers' socio-demographic characteristics in explaining the use of payment instruments, namely credit transfers. Nevertheless, those studies do not provide information on the patterns of use of this payment instrument at cross-country level. Humphrey et al. (1996b) estimated a model of payment instrument demand with Ordinary Least Squares (OLS) in fourteen countries for the period 1987–1993 that included electronic giro payments (these payments incorporated direct debits and credit transfers). The analysis provided evidence of a negative effect of the real Gross Domestic Product (GDP) growth, the number of Automated Teller Machines (ATM) and Point-of-Sale (POS) terminals. Deungoue (2008) and Martikainen et al. (2015) focus their investigation on the convergence of payment behaviour in European countries for the periods from 1990 to 2002 and 1995–2001, respectively. Both studies found evidence of convergence in credit transfer payments in Europe.

Some authors tried to anticipate the potential benefits of SEPA implementation. Schmiedel (2007) presents an overview of those studies, as well as the results of an investigation performed in cooperation with the banking industry that identifies the potential economic consequences of SEPA. In a more recent study, Virtanen (2014) examines, from a theoretical perspective, the key characteristics of the SEPA project and discusses some of its expected effects. We can therefore conclude that although the literature identifies some of the factors that might influence the use of credit transfers, the existing papers do not focus on the impact of SEPA adoption on the use of this payment instrument from an empirical point of view. Taking into consideration that the full migration to SCT in the euro area countries was achieved on 1 February, 2016, only in a few years will it be possible to compare the evolution in credit transfer payments before and after the conclusion of the implementation of SEPA. Even so, at this moment it is possible to investigate what was the effect of the progression in the migration to SEPA. As a result, we aim to contribute to the existing literature by answering the question "what was the impact in the use of credit transfers in euro area countries of the progress of adoption of SEPA standards and rules between 2008 and 2013?".

Notwithstanding the above, one should bear in mind that the use of payment instruments (namely credit transfers) changed in the broader context of the evolution of money. From an economists' point of view, money is usually considered in its functional definition as being a unit of account, medium of exchange and store of value—a definition that derives from the one proposed for the first time by Jevons (1876). However, money also plays other relevant social roles. Scholars from areas that range from economics to sociology, philosophy and anthropology paid particular attention to the impact of money in social relations. Karl Marx, a philosopher, economist and sociologist of the nineteen century defended that money plays a central role in the relations between the owners of the means of production and the workers (Hart and Ortiz, 2014). The classical theories of George Simmel, a sociologist and philosopher, and Max Weber, a sociologist, philosopher and economist of the beginning of the twentieth century, provide deeper insights into the social elements of money. Simmel considers money as a social institution that can impact social and moral relations among individuals. He argues that money acts as tool of valuation and comparison among things, generating a detachment from them. As a result, it reduces social relations to quantitative ones (Dodd, 2014), causing individualization and disorder on social relations (Coeckelbergh, 2015) because it makes individuals indifferent towards objects and people. To Weber, money is a mean of exchange as long as people believe that it will be accepted. By using money that provides a specific value to objects, enhanced rationality is introduced into economic life (Carruthers and Ariovich, 2010; Reijers, 2014). Geoffrey Ingham, a sociologist born in 1942, reinforces the social nature of money by arguing that money is basically constituted by the social relations between creditors and debtors (Carruthers and Ariovich, 2010). Moreover, for the anthropologist born in 1943 Keith Hart, money is an instrument of collective memory, intensely connected with the cultural conditions of its production and use (Dodd, 2014).

The search for a clear understanding on money, its role and impacts does not end in the abovementioned authors and approaches. Yet, this short review emphasizes the need to look at money, in general, and payment instruments, in particular, as more than just a mere economic phenomenon. Societal aspects should also be taken into consideration. In fact, there is a growing awareness of the importance of social and ethical elements on economics and finance as highlighted, for example, in the recent articles of Artis (2015), Schinckus (2015) and Revelli (2016). Bearing this in mind, and taking also

Table 2
Descriptive statistics of the dependent and independent variables for euro area countries (period between 2008 and 2013).

Variable	Mean	Std. Dev.	Min.	Max.	No. Obs.
Dependent variables					
propct	0.33	0.12	0.11	0.59	102
propdd	0.18	0.13	0.01	0.50	102
propcard	0.42	0.13	0.14	0.69	102
propcheq	0.07	0.10	0	0.43	102
Independent variables					
SEPA adoption factors ($\boldsymbol{S_{it}}$)					
mig	0.28	0.34	0	1	102
conv	0.35	0.48	0	1	102
Socio-demographic factors ($\boldsymbol{SD_{it}}$)					
edu	0.67	0.14	0.29	0.85	102
age	40.25	2.56	33.40	45.30	102
Economic factor ($\boldsymbol{E_{it}}$)					
gdp	−0.01	0.03	−0.14	0.09	101
Technological factors ($\boldsymbol{T_{it}}$)					
atm	0.85	0.32	0.41	1.66	102
pos	21.08	8.33	6.15	38.12	95
Institutional factors ($\boldsymbol{I_{it}}$)					
ddebits	34.02	32.32	1.10	120.96	102

The table reports the descriptive statistics of the dependent and independent variables in the period between 2008 and 2013 for the 17 euro area countries. "Std. Dev." stands for standard deviation, "Min." for the smallest value of the observations, "Max." for the highest value of the observations and "No. Obs." for the number of observations.

into consideration that the specific topic under analysis has not been widely explored using a critical methodology (Harvey, 1990), we complement our conclusions with a critical analysis of the impact of SEPA project on society.

3. Data and methodology

In this section it is presented a brief descriptive analysis of the data employed in the model and a summary of the methodology adopted in the empirical examination.

3.1. Data and descriptive statistics

For the analysis we used data from the European Central Bank Statistical Data Warehouse (ECB SDW) regarding the share (in volume) of payments made with credit transfers and other cashless payment instruments (i.e., direct debits, cheques and cards) in 17 euro area countries[1] during the period 2008–2013. Through credit transfers the payer can instruct the institution where it holds his account to transfer funds to a beneficiary. According to the methodological notes of the ECB SDW, credit transfers are counted on the payer's side and comprise both payment transactions that take place between two accounts held at different banks and payment transactions that take place between two accounts held at the same bank. SCT are also included in the data.

Regarding the independent variables, we incorporated information on the progress of the migration to SEPA as well as control variables regarding socio-demographic, economic, technological and institutional effects. Detailed information on the variables used in the analysis can be found in Table A1 of the Appendix. To investigate the impact of the progress of SEPA migration on credit transfer payments we included two variables: *mig* and *conv*. The variable *mig* reflects the evolution of the share of SCT transactions as a percentage of the total volume of all credit transfers initiated in a country. The migration of credit transfers to SEPA formats should provide substantial benefits for the various stakeholders according to ECB (2013): consumers will be able to use a single account to make payments in the SEPA area and those payments will be faster and simpler; merchants will benefit from easier remote business payments; companies will be able to receive and send payments in various countries using common technical standards and a single account, what should smooth liquidity management; and payment service providers will be able to process cross-border credit transfers in a more cost efficient way. It is thus expectable that the use of credit transfers is positively influenced by the migration. The variable *conv* reflects whether in a certain country it is allowed to offer consumers with conversion services to IBAN for national transactions until 1 February, 2016. The expected impact of this element is not straightforward. On the one hand, providing conversion services can be more convenient for consumers and impact positively on the use of credit transfers. However, on the other hand, if IBAN is

[1] Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia and Spain. Latvia and Lithuania were not included since they joined the euro area in 2014 and 2015.

not asked to consumers, they might not become aware of the advantages of SEPA. The other possible derogations were not statistically significant so, to ensure a parsimonious specification, they were not included in the final model. Moreover, an interaction term between the variables *mig* and *conv* was also included to allow the effect of the migration to the SEPA to change according to the possibility (or not) of offering conversion services to IBAN.

To take into account the possible effect of socio-demographic factors on credit transfers usage, as identified in studies based on survey information (see, for example, the papers of Stavins, 2001 and Hayashi and Klee, 2003), data on the share of population with upper secondary or tertiary education attainment (*edu*) and the median age of the population (*age*) was added to the model. According to the existing literature, the education level should have a positive impact because it might ease the use of electronic payment instruments. The effect of age is not consensual in the studies based on survey data and in various cases was not statistically significant. Even though the analyses based on survey data do not incorporate information regarding the economic context, this factor might play a role in a cross-country framework. In fact, Humphrey et al. (1996b) found a negative relation between the use of electronic giro and real income per capita due to the economic characteristics of the countries that had higher per capita electronic giro payments. So, in our model we incorporated information on the percentage change in the real Gross Domestic Product (*gdp*). Technological factors were also taken into consideration since the number of ATM and POS terminals per thousand inhabitants might facilitate cash withdrawals or the use of cards. A negative impact of the variables *atm* and *pos* is therefore expectable, as previously obtained by Humphrey et al. (1996b). Finally, to account for potential substitution effects in the univariate analysis we also added a variable that might capture the most relevant substitution effect taking into consideration the nature of credit transfer payments – the per capita number of payments made with direct debits (*ddebits*).

The descriptive statistics for the dependent and independent variables are presented in Table 2. The averages per country can be found in Table A2 of the Appendix. Between 2008 and 2013, around 33% of the payments in the euro area were made with credit transfers. During this period the highest share of payments was made with cards and the lowest with cheques. On average, the share of SCT was 28% in euro area countries between 2008 and 2013. The differences across the sample were quite remarkable, as reflected by the standard deviation. It is also interesting to note that the technological environment revealed the diverse situations that exist in euro area countries.

3.2. Model specification and methodology

In our empirical analysis we investigate the effect of the SEPA project using estimation techniques specifically adapted to the fractional nature of the dependent variable. Moreover, we complement the typical univariate analysis with models that allow for the presence of neglected heterogeneity and multivariate models that, besides the share of card payments, account for alternative shares of payment instruments.

The analysis of the effect on the share of payments made with credit transfers of the migration process to SEPA was performed by estimating the following model:

$$Y_{it} = G\left[\beta_0 + \beta_1 S_{it} + \beta_2 (mig \times conv)_{it} + \beta_3 SD_{it} + \beta_4 E_{it} + \beta_5 T_{it} + \beta_6 I_{it} + \varepsilon_{it}\right] \quad (1)$$

where Y_{it} refers to the share of payments made with credit transfers (in volume) in the univariate analysis or the share of payments made with credit transfers, direct debits, cards and cheques in the multivariate analysis, with i ($i = 1, \ldots N$) representing each country and t ($t = 1, \ldots 6$) denoting the time period; S_{it} refers to migration indicators which comprise the variables *mig* – the share of SCT transactions on the total volume of all credit transfer transactions initiated in a country –, and *conv* – a dummy variable that captures if in a country it is allowed to offer consumers with conversion services to IBAN for national transactions until 1 February, 2016; $(mig \times conv)_{it}$ is an interaction term between the variables *mig* and *conv*; SD_{it} denotes socio-demographic factors (i.e., *edu* and *age*); E_{it} regards to the variable *gdp*; T_{it} represents technological determinants (i.e., *atm* and *pos*); and I_{it} is the institutional factor reflecting the use of direct debits (i.e. *ddebits*)—only included in the univariate case. In addition, $\varepsilon_{it} = \alpha_i + u_{it}$, where α_i refers to the country-specific effects and u_{it} denotes the idiosyncratic error term. Finally, β_j, $j = 1, \ldots 6$, are vectors of parameters associated to each type of explanatory variables. We note that, due to the small dimension of the sample, a parsimonious specification of the model had to be considered.

3.2.1. Univariate analysis

To estimate the model a natural starting point is to consider linear models. Nonetheless, this type of models might not be adequate for the analysis of the share of payments made with credit transfers. In fact, according to Papke and Wooldridge (1996), Ramalho et al. (2011) and Ramalho and Ramalho (2014), linear models do not guarantee that the predicted values lie between zero and one. A more appropriate approach is the assumption of a functional form that defines the required constraints on the conditional mean of the dependent variable. So, for the analysis of the FRM we considered three conditional mean functions—logit $\left(E(Y|X) = \frac{e^{X\beta}}{1+e^{X\beta}}\right)$, complementary loglog $\left(E(Y|X) = 1 - e^{X\beta}\right)$ and probit $\left(E(Y|X) = \phi\left(X\beta\right), [.]\right.$, with φ defined as a standard normal distribution). The models were estimated by pooled Quasi-Maximum Likelihood (QML) using a robust version of the variance of the estimated parameters.

Although we consider a wide variety of explanatory variables in our analysis, it is possible that other factors may influence the share of interest. Therefore, we also consider estimators that take into account this potential neglected heterogeneity (that might generate bias in the standard FRM estimators). Specifically, we employ Generalized Method of Moments (GMM)

estimators recently proposed by Ramalho and Ramalho (2014), designated as GMMx, applied with two link functions, the logit and complementary loglog (note that the probit specification cannot be employed in the framework of this GMM estimator).

In order to ensure the adequacy of the models, we performed a RESET test of the specification and a generalized goodness-of-functional form or GOFF test, as indicated in Ramalho et al. (2014). Average partial effects (APE) were computed to measure the effect of changes in the covariates on the response variable, averaged across the population.

3.2.2. Multivariate analysis

The level of adoption of a payment instrument is frequently connected, at least to a certain extent, with payment instruments choice. In fact, the characteristics and the inherent pros and cons of different payment instruments might play a role on payment habits. In order to capture the relationship between non-cash payment instruments, a multivariate fractional analysis was also considered. This type of analysis allows us to simultaneously investigate the effect of selected independent variables on the share of payments made with credit transfers, as well as on other payment instruments. Hence, it is possible to evaluate if the conclusions obtained in the univariate scenario change when a disaggregation of all non-cash payment instruments (i.e., credit transfers, direct debits, cheques and cards) is made.

Since the share of payments made with cheques assumes the value zero in certain cases, we are not able to use the Dirichlet-Multinomial model – a multivariate extension of the beta-binomial model (see Mullahy, 2011 and Murteira and Ramalho, 2016). So, we considered a Fractional Multinomial Logit (FML) model – an extension of the fractional response model proposed by Papke and Wooldridge (1996) to the multivariate case. The FML model, which is estimated by QML, takes into consideration the bounded nature of the shares and the fact that the proportions must add up to one. Being c_{ij} the share of the number of payments with jth payment instrument made in the ith country, the conditional mean function is $E\left(Y_{ij}|X_i\right) = \frac{e^{x_i\beta_j}}{\sum_{h=1}^{J} e^{x_i\beta_h}}$.

We considered as dependent variables the share of payments made with credit transfers, as well as the share of payments made with direct debits (the reference category), cheques and cards (in volume). Each of the dependent variables ranges between zero and one and they sum up to the unity, reflecting the fact that increases in the proportion of payments made with credit transfers must imply a reduction in the share of payments with the other non-cash payment instruments. To take into account any possible heteroscedasticity, robust standard errors are used. Since the regression coefficients cannot be interpreted directly, APE implemented according to Buis (2008) are analysed instead. These effects reflect how changes in one independent variable affect a dependent variable when all the other variables are kept at the mean (Molowny-Horas et al., 2015).

4. Empirical results

In this section the model selection strategy, as well as the estimation results, are presented for the univariate and multivariate cases (Table 3).

4.1. Model selection

For the univariate examination of the share of credit transfer payments logit, complementary loglog and probit FRM estimated with pooled QML were used. According to the results of the RESET test only two models have a correct specification: the FRM with a logit conditional mean function and the FRM with a probit conditional mean function. However, only the model with a logit conditional mean function revealed an adequate link specification in the GOFF test. The univariate analysis was also performed using the GMMx estimator with two link functions—logit and complementary loglog to take into account potentially neglected heterogeneity. According to the RESET test only the model with a logit link function is correctly specified. Overall, the coefficients retain the statistical significance, the direction of the impact and the magnitude in comparison with the APE of the logit FRM (Table 4). Therefore, neglected heterogeneity appears not to be a problem in our framework, which reinforces the validity of the results of the standard logit FRM. For that reason, our univariate analysis will focus on that model.

To capture the relationships that might exist between the various non-cash payment instruments, a multivariate investigation was performed with a FML estimated by QML. Note that the results of the multivariate analysis reveal that some of the variables are no longer statistically significant (Table 4), suggesting that when a broader set of payment instruments is taken into consideration the relative importance of some factors is reduced.

4.2. The effect of SEPA adoption process

Both the univariate and multivariate results provide evidence that our key interest variable – the progress of SEPA migration in credit transfers – has a statistically significant positive effect in the use of credit transfers. See the results for the remaining shares included in the multivariate analysis in the Appendix (Table A3). The impact measured by the APE is 0.067 in the univariate model and 0.086 in the multivariate analysis, which is relevant taking into consideration that the mean of the share of credit transfer payments in our sample is 0.33. This positive effect is a good indicator to policymakers,

Table 3
Estimation results for the period between 2008 and 2013 in euro area countries.

Variables	Univariate analysis					Multivariate analysis
	FRM (logit)	FRM (cloglog)	FRM (probit)	GMMx (logit)	GMMx (cloglog)	FML
mig	0.3194**	0.2347**	0.2010***	0.3198***	0.2501***	1.0613***
	(0.1272)	(0.1026)	(0.0776)	(0.1197)	(0.0243)	(0.2613)
conv	−0.2221**	−0.2159***	−0.1173**	−0.2122***	−0.1908***	−0.1436
	(0.0892)	(0.0654)	(0.0476)	(0.0824)	(0.0110)	(0.4337)
mig x conv	−0.2896*	−0.2079*	−0.1937**	−0.3612**	−0.2645***	−1.1629***
	(0.1521)	(0.1232)	(0.0918)	(0.1431)	(0.0247)	(0.4219)
edu	2.4235***	1.9892***	1.4601***	2.6228***	2.2190***	0.6644
	(0.2805)	(0.2413)	(0.1651)	(0.2671)	(0.0310)	(1.4880)
age	0.0544***	0.0424***	0.0334***	0.0530***	0.0466***	−0.0584
	(0.0141)	(0.0121)	(0.0084)	(0.0160)	(0.0016)	(0.0703)
gdp	−1.2075	−0.9520	−0.7347	−1.2112	−1.1242***	−0.7043
	(0.8837)	(0.6775)	(0.5498)	(0.8925)	(0.1083)	(0.8748)
atm	−0.3352***	−0.3017***	−0.1871***	−0.3088***	−0.2806***	−1.0618
	(0.0826)	(0.0739)	(0.0471)	(0.0695)	(0.0076)	(0.7452)
pos	−0.0279***	−0.0232***	−0.0166***	−0.0265***	−0.0216***	0.0143
	(0.0042)	(0.0034)	(0.0025)	(0.0037)	(0.0004)	(0.0268)
ddebits	−0.0072***	−0.0059***	−0.0043***	−0.0068***	−0.0056***	–
	(0.0013)	(0.0010)	(0.0008)	(0.0012)	(0.0002)	
RESET test p-value	0.2710	0.0880	0.4510	0.1370	0.0270	–
GOFF test p-value	0.1040	0.0760	0.0800	–	–	–
No. Obs.	95	95	95	95	95	95

The table reports the estimation results of the: (i) univariate analysis of the share of payments made with credit transfers (in volume) considering a FRM with a logit, cloglog and probit distribution functions and the GMMx estimator; and (ii) multivariate analysis of the share of payments made with credit transfers using a FML model. In the multivariate analysis the results for the shares of the other non-cash payment instruments (i.e., direct debits, cheques and cards) are presented only in Table A3 of the Appendix, given the scope of the analysis. Robust standard errors are in parenthesis. Constant term coefficient not reported. The *p*-value of the RESET test for model specification is presented. If the model is correctly specified, the null hypothesis should not be rejected. In addition, the GOFF test *p*-value is reported. The null hypothesis of the test is that the link specification of the model is correct. Variables in value have been adjusted for inflation. Note that: * indicates significance at the 10% level, ** at the 5% level and *** at the 1% level. "No. Obs." stands for the number of observations.

Table 4
APE of selected models.

Variables	Univariate analysis		Multivariate analysis
	FRM (logit)	GMMx(logit)	FML
mig	0.0671**	0.0658***	0.0861**
	(0.0266)	(0.0245)	(0.0357)
conv	−0.0466***	−0.0436**	−0.0635
	(0.0168)	(0.0172)	(0.0662)
mig x conv	−0.0608*	−0.0743**	−0.0751
	(0.0319)	(0.0294)	(0.0552)
edu	0.5088***	0.5396***	0.4216***
	(0.0594)	(0.0553)	(0.1074)
age	0.0114***	0.0109***	0.0043
	(0.0029)	(0.0032)	(0.0085)
gdp	−0.2535	−0.2492	−0.2369
	(0.1853)	(0.1835)	(0.1749)
atm	−0.0704***	−0.0635***	−0.1220**
	(0.0173)	(0.0142)	(0.0588)
pos	−0.0058***	−0.0054***	−0.0043**
	(0.0009)	(0.0008)	(0.0019)
ddebits	−0.0015***	−0.0014***	–
	(0.0003)	(0.0002)	

The table reports the APE computed for the following models: FRM with a logit distribution function, GMMx with a logit distribution function and FML. Robust standard errors are presented in parenthesis. Note that: * indicates significance at the 10% level, ** at the 5% level and *** at the 1% level.

since it can reflect the use of a more efficient mean of payment. In addition, it is also encouraging to payment service providers, given that it might reveal acceleration in the recovery of the costs supported with SEPA implementation through the fees charged to the users of this payment instrument.

The univariate analysis suggests that the fact that in a certain country payment service providers were allowed to offer consumers with conversion services to IBAN until 1 February, 2016 affected negatively credit transfer payments (with an APE of −0.047). Moreover, the interaction between the variable *mig* and *conv* appears to have a negative effect of 0.061, indicating that the positive impact in credit transfer payments of the progress in SEPA migration is reduced in countries that allow conversion services for IBAN. However, in the multivariate analysis both the variable *conv* and the interaction term *mig* x *conv* are not statistically significant. We can therefore conclude that when we take into consideration the relationship between non-cash payment instruments the potential impact of derogations is mitigated and the effect of SEPA migration gains more relevance.

4.3. The effect of socio-demographic, economic, technological and institutional factors

In terms of socio-demographic factors, only the variable *edu* is statistically significant in both models and is associated with an increase in payments made with credit transfers. This conclusion is in line with the findings of Stavins (2001) and Hayashi and Klee (2003) and can derive from the fact that the higher the percentage of population with upper or tertiary education attainment, the larger the proportion of population that should find it easier to use credit transfers. The fact that age characteristics of the population are not statistically significant in the multivariate model is not surprising since the effect of age was also not statistically significant in other papers (see, for example, the analysis of Hayashi and Klee, 2003). Although economic factors did not reveal a statistically significant impact, the number of ATM and POS terminals per thousand inhabitants appear to be negatively related with credit transfer payments, in line with the conclusions previously obtained by Humphrey et al. (1996b). The negative effect is possibly connected with the fact that ATM and POS terminals can ease the use of cash and cards. In the univariate analysis, the substitution effect of direct debits reveals a statistically significant impact, highlighting the importance of the inclusion of other payment instruments in the analysis, and therefore reinforcing the results of the multivariate model.

5. Conclusions

This paper examines the impact of the migration progress to SEPA between 2008 and 2013 on the share of payments made with credit transfers in euro area countries. The key finding is that the evolution in the migration to SEPA formats influenced positively the use of credit transfers. Moreover, we also conclude that socio-demographic and technological elements, as well as substitution effects with other non-cash payment instruments played a role in explaining credit transfers usage. From economists point of view, the positive impact of the migration on credit transfer payments can lead to enhanced efficiency in retail payments (both in terms of cost and time of processing) as well as improved competition and innovation in this market (ECB, 2015a). An increase in the use of this payment instrument might stimulate the economy, consumption and trade, according to Hasan et al. (2013).

On 1 August 2014 euro area countries concluded the migration of credit transfers to SEPA formats, but the full process will only be complete at a later stage. On the one hand, euro area countries which applied derogations to the provisions of Regulation (EU) 260/2012 extended the deadline to comply with some SEPA rules until February 2016. On the other hand, non-euro area SEPA countries were given the limit of 31 October, 2016 to complete migration (ECB, 2015a). Considering the results obtained in our analysis, it is expectable that, in the years following the completion of SEPA implementation in credit transfers, this type of payments might be significantly affected. In fact, the still relatively low share of credit transfer payments in some countries of the euro area leaves room for further increases in the use of this payment instrument.

There is therefore ample room for further investigation in this field. For example, it will be important, with post-2016 data, to explore in which way the pattern of use of non-cash payment instruments was affected by SEPA and measure the contribution of this project to economic growth.

One should, nevertheless, reflect on the possible impacts of SEPA implementation on a societal perspective. The SEPA project brings to light authorities interest in promoting greater dematerialization due to increased efficiency when compared with cash. Dematerialization (in our analysis, with a particular emphasis on credit transfer payments), although, can have other effects. On the one hand, digitalization might generate a loss of anonymity. This can be positive if it contributes to reduce illegal transactions and the shadow economy. But it can pose relevant questions in terms of data protection for all the other users, as every payment becomes traceable regardless of its amount or purpose. On the other hand, dematerialization might generate an amplified detachment of things and people with, as Simmel (Dodd, 2014) points out, potential societal and moral implications. By paying with credit transfers (instead of cash) users might experience greater abstraction from the "sacrifice" connected with payments, with likely implications in the consumption pattern. Moreover, digitalization might promote the exclusion of unbanked population, raising vital issues on the area of financial inclusion. In fact, cash is the only option available to unbanked population and, according to World Bank,[2] in 2014 there were 2 billion adults unbanked in

[2] Information available at http://www.worldbank.org/en/programs/globalfindex.

the world. Being SEPA part of a broader project that aims to increase harmonization and integration in retail payments, it might pose questions regarding the concentration of control and power of decision in a limited number of institutions. With cash, economic agents can be more independent in the way they store and use their money, namely outside the banking system. By replacing cash by electronic payments, economic agents agree to grant entities such as payment service providers and IT providers with the ability to process all the payments made. In addition, economic agents might lose the freedom to determine if they intend to spend or save money if negative interest rates are established in cashless societies, as they would need to pay for leaving their money in the bank. In light of these facts, some people advocate the emergence of virtual currencies as a rival to state currency (Dodd, 2014) and a form of participatory democracy (Ansart and Monvoisin, 2016).

The evolution in payment habits will be also shaped by other elements, as payment innovations will continue evolving at a fast pace. Mobile payments, instant payments (i.e., electronic retail payment solutions available 24/7/365 with immediate or close-to-immediate interbank clearing of the transaction and crediting of the payee's account, according to ECB (2015a,b), virtual currencies[3] and many other solutions will probably develop and grow in the following years. This greater than ever dematerialization of payments can also have relevant impacts in line with those previously discussed. Although nowadays the focus is generally on greater efficiency and security, the possible social, political and moral implications should also be considered, at least to a certain extent, by relevant stakeholders. Public administrations, for example, can play a relevant role through the adoption of payment instruments that take into consideration senior citizens capacity to adapt to new technologies and solutions that do not exclude unbanked population. Regulators, when acting as catalysts of innovation, could also bring those topics to the discussions. Raising collective awareness is vital: consumers and companies should be actively involved in these matters, for example by contributing to public consultations and participating in working groups. The evolution of payment habits and their role in the economies will be determined by a broad range of factors, players and elements. Ensuring a satisfactory progress requires the commitment and involvement of all players, in a truly holistic approach.

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Appendix A.

Table A1
Description of the dependent and independent variables used in the empirical analysis.

Variable	Description	Source
Dependent variables		
propct	Share of the number of payments made with credit transfers computed considering the relative importance of the number of payments made with credit transfers on the total number of payments made with credit transfers, direct debits, cards and cheques.	Authors' calculation based on data from the ECB SDW
propdd	Share of the number of payments made with direct debits computed considering the relative importance of the number of payments made with direct debits on the total number of payments made with credit transfers, direct debits, cards and cheques.	Authors' calculation based on data from the ECB SDW
propcard	Share of the number of payments made with cards computed considering the relative importance of the number of payments made with cards on the total number of payments made with credit transfers, direct debits, cards and cheques.	Authors' calculation based on data from the ECB SDW
propcheq	Share of the number of payments made with cheques computed considering the relative importance of the number of payments made with cheques on the total number of payments made with credit transfers, direct debits, cards and cheques.	Authors' calculation based on data from the ECB SDW

[3] Note that, according to ECB (2015b) virtual currencies are not full forms of money and, even though they can have some advantages in terms of financial innovation and new payment solutions for economic agents, they pose significant risks for its users (such as exchange rate risk, counterparty risk and fraud risk) and for central banks tasks (by affecting monetary policy, financial stability and the regular functioning of payment systems). Be that as it may, due to its small relevance, the Eurosystem will continue monitoring virtual currencies.

Table A1 (*Continued*)

Variable	Description	Source
Independent variables		
SEPA migration factors ($\boldsymbol{S}_{it}$)		
mig	Share of SEPA credit transfers as a percentage of the total volume of credit transfers.	ECB
conv	Dummy variable that equals 1 if in the country payment service providers are allowed to offer consumers with conversion services to IBAN for national transactions until 1 February 2016 and 0 otherwise.	ECB
Socio-demographic factors ($\boldsymbol{SD}_{it}$)		
edu	Percentage of persons with upper secondary or tertiary education attainment.	Eurostat
age	Median age of population.	Eurostat
Economic factor ($\mathbf{E}_{it}$)		
gdp	Real percentage change in the GDP.	Eurostat
Technological factors ($\boldsymbol{T}_{it}$)		
atm	Number, per thousand inhabitants, of ATMs (device that permits authorised cardholders, typically using machine-readable plastic cards, to withdraw cash from their accounts and/or access other services, such as balance enquiries, transfer of funds or acceptance of deposits) at the end of each year.	ECB SDW
pos	Number, per thousand inhabitants, of POS terminals (device allowing the use of payment cards at a physical point-of-sale) in the end of each year.	ECB SDW
Institutional factors ($\mathbf{I}_{it}$)		
ddebits	Number of direct debit transactions per capita.	ECB SDW

Table A2
Number of observations and variables average per country.

Country	No. Obs.	*propct*	*propdd*	*propcard*	*propcheq*	*mig*	*conv*	*mig x conv*	*edu*	*age*	*gdp*	*atm*	*pos*
Austria	78	0.4294	0.3771	0.1926	0.0009	0.1675	0.0000	0.0000	0.7698	41.7833	0.0020	0.9723	13.4546
Belgium	77	0.4141	0.1135	0.4694	0.0029	0.3880	0.0000	0.0000	0.6795	40.9000	−0.0033	1.4137	12.4103
Cyprus	76	0.2839	0.0808	0.4006	0.2346	0.6013	1.0000	0.6013	0.7145	35.7000	−0.0277	0.8026	27.1232
Estonia	78	0.3348	0.0560	0.6092	0.0000	0.0065	1.0000	0.0065	0.8198	40.3167	0.0012	0.6518	20.0028
Finland	78	0.4516	0.0392	0.5090	0.0002	0.4740	0.0000	0.0000	0.7690	41.9833	−0.0122	0.4900	33.6858
France	78	0.1726	0.1978	0.4508	0.1788	0.2275	0.0000	0.0000	0.6895	40.0833	−0.0038	0.8719	21.5161
Germany	78	0.3406	0.4944	0.1623	0.0027	0.0787	0.0000	0.0000	0.7995	44.3333	0.0077	0.9951	8.3231
Greece	77	0.3679	0.0842	0.4346	0.1134	0.2789	0.0000	0.0000	0.6245	41.3667	−0.0436	0.7533	33.2195
Ireland	78	0.2196	0.1558	0.4958	0.1288	0.0636	0.0000	0.0000	0.6998	34.3333	−0.0198	0.7089	25.2812
Italy	78	0.3298	0.1610	0.4244	0.0848	0.1202	0.0000	0.0000	0.5433	43.5167	−0.0192	0.8553	23.8689
Luxembourg	78	0.4450	0.1026	0.4508	0.0016	0.9100	0.0000	0.0000	0.7037	38.9000	−0.0197	0.8631	22.3418
Malta	75	0.1994	0.0448	0.4295	0.3262	0.1152	0.0000	0.0000	0.4032	39.9167	0.0112	0.4634	27.2663
Netherlands	78	0.3082	0.2482	0.4436	0.0000	0.1279	1.0000	0.1279	0.6902	40.8000	−0.0067	0.4794	15.3599
Portugal	78	0.1124	0.1420	0.6751	0.0704	0.1719	1.0000	0.1719	0.3458	41.4667	−0.0093	1.6007	24.3817
Slovakia	78	0.5255	0.1618	0.3126	0.0001	0.2297	1.000	0.2297	0.8403	37.2000	0.0178	0.4423	7.0187
Slovenia	78	0.4940	0.1379	0.3675	0.0006	0.5604	0.0000	0.0000	0.7987	41.5833	−0.0135	0.8744	17.7751
Spain	78	0.1469	0.4240	0.4110	0.0182	0.2766	1.0000	0.2766	0.5227	40.1500	−0.0137	1.2622	29.0327

The table reports the variables average per country for the period comprised between 2008 and 2013. "No. Obs." stands for the number of observations.

Table A3
APE of other payment instruments shares used in the multivariate analysis for the period 2008–2013 in euro area countries.

Variables	APE	
	Share of card payments	Share of cheque payments
mig	0.0977**	−0.0377***
	(0.0403)	(0.0217)
conv	0.1151	−0.0424
	(0.0779)	(0.1116)
mig x conv	−0.1941**	0.0988**
	(0.0851)	(0.0393)

Table A3 (*Continued*)

Variables	APE	
	Share of card payments	Share of cheque payments
edu	−0.3414	−0.1856*
	(0.2332)	(0.0433)
age	−0.0105	−0.0067**
	(0.0068)	(0.0028)
gdp	0.2626**	−0.0264
	(0.1370)	(0.0931)
atm	0.0071	−0.0121
	(0.0830)	(0.0186)
pos	0.0080**	0.0012**
	(0.0032)	(0.0005)
No. Obs.	95	95

The table reports the APE of the remaining shares considered in the multivariate analysis using the FML. Robust standard errors are presented in parenthesis. Note that: * indicates significance at the 10% level, ** at the 5% level and *** at the 1% level.

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