

European payment systems and monetary union

Francisco J. Callado Muñoz
Assistant Professor, University of Girona

Natalia Utrero González
Visiting Professor,
Universitat Autònoma de Barcelona

Abstract

We make a comparative study of payment systems for E.U. -fifteen countries for the 1996-2002 period. Special attention is paid to the introduction of the new European single currency. The overall trend in payments is for a move from cash to non-cash payment instruments, although electronic instruments are not widely used yet. We find a significant impact from the introduction of the new banknotes and coins on card use.

European payment systems and monetary union

In a world of economic globalization and IT development the ways in which payments are made are clearly evolving. Cash is no longer the unique possibility of making a payment and it shares the stage with credit and debit cards, direct debits, and electronic means.

Bankers and other professionals¹ are very interested in knowing how customers are paying for their daily transactions and monitoring what changes are taking place. They are not alone, financial authorities are also interested in this type of information, since one of their responsibilities is the promotion of efficiency and security of both payment systems and instruments in order to safeguard the monetary policy transmission mechanism and to contribute to the maintenance of systemic stability and public confidence in the currency [ECB (2002)].

	Cash % of narrow money			Cash % of GDP		
	1996	2001	2002	1996	2001	2002
Belgium	27.5	11.8	-	5.1	2.8	-
Denmark	10.2	9.2	8.7	3	2.9	2.9
Germany	27.6	11.3	-	6.9	3.3	-
Greece	44.1	30.9	-	6.5	5.5	-
Spain	25	12	-	10.3	6.6	-
France	14	7.4	-	3.3	2	-
Ireland	34	16.5	-	4.7	3.3	-
Italy	16.1	11.3	-	5.3	4.7	-
Luxembourg	14.6	0.8	-	2.9	1.9	-
Netherlands	18	5.7	-	5.3	2.1	-
Austria	22.9	13.9	-	5.8	3.9	-
Portugal	15.3	8.7	-	4.9	3.6	-
Finland	6.6	6.1	-	2.2	1.9	-
Sweden	-	-	-	4.1	4.5	4.1
U.K.	4.9	5	4.8	3	3.3	3.3
E.U.	13.8	8.6	11.5	5.3	3.5	3.5
Euro-zone	18.1	10.3	14.1	5.8	3.5	4.8

Figure 1

The purpose of this paper is to study the main trends in payment systems across the E.U.-15 countries for the period 1996-2002. The data used in our analysis are derived from the European Central bank (data on payments) and the European commission (economic data). This analysis is interesting not only to have a portrait of the evolution of payment instru-

ments usage in a general setting² but also to analyze the impact of the introduction of the new currency, both among the first 11 countries in 1999³ and the full introduction of Euro notes and coins in 2002 across E.U.-15, on these systems.

Cash use

To analyze the importance of cash payments we use two of the typical proxies used by the BIS studies: cash in circulation as a percentage of GDP and cash in circulation as a percentage of narrow money⁴. Figure 1 offers these two measures for the countries included in the sample. As can be seen, there is a decline in cash use for both indicators and for almost every country. The only exception is the U.K., where there is a slight increase in cash usage for the period 1996-2001 in the proportion of narrow money and around 10% for 1996-2002 in the proportion of the GDP. With respect to the distinction between euro and non-euro countries a point has to be made. The euro-zone shows a decrease for the period 1996-2001 and 1996-2002, but it presents an increase in cash use with the introduction of euro coins and notes in 2002, that is around 35%. Non-euro countries, on the contrary, decrease their use of cash and the figures for 2002 are quite similar to 2001.

It can, therefore, be concluded that the usage of cash declined during the period of study, with the exception of the physical introduction of the euro in 2002 that made the euro area more dependent on cash. The 'dual circulation period'⁵ of the new euro notes and coins and the former national currencies together with the flourishing of money from the unofficial economy could explain this break in the tendency of cash use reduction of the previous years.

Retail payments

Another way of looking at payments systems would be to analyze the competition among instruments at retail level. On the one hand, ATM networks allow customers to have access to cash closer to the point of sale. On the other, EFTPOS instruments, such as debit cards, provide consumers with non-cash means of payment right at the point of sale. Figures 2 to 5 help understanding their evolution in the last years.

1 Companies different from banks (namely retail stores, insurance, petrol stations etc.) are now offering payment services to their clients mainly through credit and debit cards.

2 Markose and Loke (2000) made a first attempt to analyze payment usage for the period 1990-1998 and served as a starting point for this work.

3 The introduction of the single currency in Greece took place in 2001.

4 Usually related to M1, although the correspondence is not always exact.

5 The speed of the changeover was not the same in all countries. The dual circulation period lasted between four weeks and two months.

European payment systems and monetary union

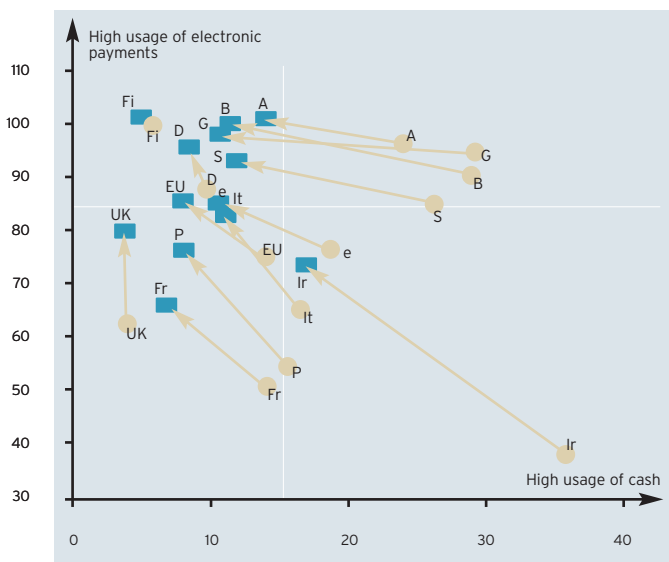


Figure 2: Cash use and non-cash electronic payments

When looking at the relative network densities of EFTPOS to ATM terminals we find that there is no regular pattern across all countries. Greece, Italy, Austria, Sweden, and Portugal seem to have an increase in this period although the rate of growth differs across the countries. Germany, Ireland, and Spain grow at the beginning of the period and then decrease in the later years, while France, Finland, and Luxembourg are relatively unchanged. Denmark, Belgium, and the U.K. do not show a clear tendency. With respect to the Euro and E.U. countries, both groups increase at a similar rate although, again, with the introduction of the notes and coins (2002) the euro-zone suffers a slight decrease. This fact follows the same pattern as those observed in Figure 1.

Comparing the per capita ratio of value of card transactions (both credit and debit) to the per capita value of ATM related use, we find that more than half of the countries have a ratio greater than 1, that is, the value of card transactions is bigger than the value of cash. Remarkable cases are those of France and Sweden that start the period below 1 and end up with cards over cash in 2002. The E.U. as a whole presents also a

dominance of card in value terms. This does not hold for the Euro-zone since the six countries in which cash is still the most important payment instrument are within the monetary union. Again, in 2002, the ratio indicates a rise in cash use in this euro-zone.

With regards to the intensity of card and cash per EFTPOS and ATM terminals in terms of value, although no general trend can be identified in the relative importance of each there is an increase in the intensity of card use, that is, each EFTPOS is processing a greater value of transactions. This growth pattern holds for almost every country, including the E.U. and Euro-zone countries. Interestingly, for the Euro-zone countries this increase also holds 2002.

The intensity of cash use by ATM, on the contrary, does not follow a clear tendency. Some countries grow, some others decline, and some remain nearly constant and figures are more stable in all cases. The E.U. and the Euro-zone experience relative growth until 2002, when the increase becomes more profound.

It can be concluded then that cards are being more intensively used than cash. Consequently, financial authorities and bankers could increase more than proportionally the acceptance and use of cards, and in the process decrease the use of cash, just by increasing the relative number of EFTPOS to ATMs.

Cash and non-cash electronic payments

We also looked at the relationship between cash use (as a percentage of narrow money) and non-cash electronic payments and their evolution from 1996 to 2002 across these countries (Figure 2). We found that at the beginning of the period almost every country had a high cash use and a more variable electronic component. By 2002, most countries had lower usage of cash and increased the proportion of non-cash electronic payments. Only Ireland remains with a high degree of cash usage, however given its starting point of very high cash use and low usage of non-cash electronic payments its develop-

European payment systems and monetary union

ment is one of the most remarkable of any country. We do not find a clear distinction between the E.U. and Euro-zone countries. Although the origin is different, less cash use in E.U. countries, they both end up in a pretty much similar position by 2002. Therefore, in terms of volume, we find that there is a clear trend towards lower cash usage and to greater usage of non-cash electronic means of payment.

Evolution of non-cash payment instruments

As shown in Figure 2, there is a trend from cash to non-cash payment instruments, although paper-based instruments are still important in many E.U. countries. What we intend to do in this section is to assess the relative importance of the non-cash payment instruments in volume and value between 1996 and 2002.

We find that the use of cheques decrease significantly between these two periods⁶. The use of credit and debit cards increase considerably during this period, although their relative importance in terms of value is small. Hence, it seems that card use is probably more related to daily operations⁷. Credit transfers account for the majority of total value transactions and are important in terms of volume of transactions, although it falls during the period. Direct debits, instead, remain fairly stable in all countries.

Although one would expect that electronic instruments would experience a significant increase in popularity during this period, we find their usage remains quite small, particularly in value terms. Belgium, Luxembourg, and The Netherlands are the countries with highest usage of electronic instruments and experience the largest increase. This lack of growth takes place at a time when access to new technologies and the Internet has experienced a huge increase in E.U. countries (876% in the period 1996-2001 according to Eurostat figures). It seems logical, therefore, that should financial institutions wish to increase the usage of electronic money across Europe, they would need to invest heavily in better security systems, transparency, and publicity in order to increase consumer reliability and the success of these payment instruments.

We also examined the potential impact of the euro on the usage of non-cash electronic payments and instruments, by looking at the changes in the years 1998-1999 and 2001-2002, and found no 'euro effect'. We found that there was no break in tendency present. On the contrary, results confirm the trends and patterns found in the whole period, in particular relative to the value of transactions. Therefore, the introduction of the new bank notes and coins do not seem to have dramatically impacted the relative importance of non-cash instruments.

Econometric analysis

The previous sections show that both the relative importance of cash and non-cash use and the distribution of non-cash instruments are not homogeneous across the European countries and suggest that financial structure, as well as the introduction of the single currency, may have affected the decision to use them. In this section, we want to investigate more deeply the empirical evidence on these relationships. In particular, we test three hypotheses:

- Whether the facilities developed by financial institutions significantly influence the use of cards instruments?
- If the degree of economic development can also affect card use?
- Whether the introduction of new coins and bank notes influence the evidenced increasing trend in card use?

Specifically, we distinguish between the use of cards to withdraw money from bank accounts and the use of cards as payment instrument at point of sale. We estimate the following equations:

$$\text{Card use}_{i,t} = \alpha + \beta * \text{banking industry facilities}_{i,t} + \gamma * \text{gdp}_{i,t} + \psi_t + \varepsilon_{i,t} \quad (1)$$

where $i = 1, \dots, n$ refers to countries and $t = 1, \dots, T$ to time periods.

From an econometric point of view, for the estimation of the coefficients α , β , and γ we take into account the structure of

6 Ireland is the country where cheques have the most relevant use both in volume and value, but we find that its importance also falls during this period.

7 It is important to remark that ATM and EFTPOS terminals increase 54% and 86% respectively in the E.U. during the period (computed from Eurostat figures).

European payment systems and monetary union

the error terms, ε_{it} ⁸. We also allow for the presence of unobservable individual effects⁹.

The variables that account for the banking facilities are the number of branches and the number of ATM and EFTPOS available. All variables are controlled for the population of the country in order to allow comparisons. The number of branches is included in all regressions. However, we use the number of ATMs when the dependent variable is the use of card to withdraw money and the number of EFTPOS instead when the dependent variable is the payment function of credit/debit cards. The number of branches accounts for the proximity of the banking institution to customers. The expected sign of this variable in the use of cards is not obvious *ex ante*. On the one hand, close service to customer might reduce card use both to withdraw money and to pay, such that customers have access to a direct and personal service easily (substitute effect). On the other, the closer service associated to a larger number of branches can transmit trust and reliability in the banking institution and foster the use of cards (reliability effect). We will try to shed some light as to which effect is stronger.

The physical facilities, namely number of ATMs and the number of EFTPOS positively influence the use of cards. The larger number of ATMs (EFTPOS) the larger the probability of using them. Therefore, the expected sign is positive.

To capture the effect of the introduction of the euro, we include two different dummy variables, one for the year 1999 when the European single currency was introduced and one for the year 2002 when the bank notes and coins were physically introduced. Finally, we include the per capita GDP in each country to control for the degree of economic development. The expected sign is positive. The use of cards requires a minimum degree of electronic facilities and communications to operate correctly. We assume that economic development is a good proxy for technological development.

Figure 3 presents the results for the withdrawal functions of cards. We estimate the equation using three different meas-

ures of the dependent variable. The cash use of cards is computed in terms of the total volume of transactions, number of transactions done, and the average value per transaction in Panels A, B, and C respectively.

ATM network influences significantly and positively card use to withdraw money both in terms of volume and the number of transactions, as it can be observed in all runs in Panels A and B. However, the average value of transactions is not affected by ATM network (panel C). Column 1 in each panel presents the results when the dummy variable that accounts for the introduction of the single currency is introduced. The 1999 variable is not significant in any of the realizations, that is in volume, number of transactions, or average value. However, the dummy for the introduction of the bank notes and coins is positive and

Panel A: Total volume of transactions

The dependent variable, Cash value, is the total volume of card transactions to withdraw money. Financial facilities are number of ATMs (N° ATMs) and number of branch offices (branch) per 1000 inhabitants. D1999 and D2002 account for the year of introduction of the common currency and notes and coins respectively.

	(1) Cash value	(2) Cash value	(3) Cash value	(4) Cash value
N° ATMs x 1000 inhab	2679939 ^c [428515]	2748867.65 ^c [438,145.177]	2779121.05 ^c [436,816.852]	1236233.59 ^c [431,538.405]
D1999	-63003.57 [132541.4]			
D2002		512,332.699 ^c [133,264.997]	543,062.722 ^c [134,744.668]	443,695.083 ^c [119,858.977]
Branch x 1000 inhab			734,546.0198 [562,480.867]	1788831.82 ^c [499,017.945]
Per Capita GDP				96,257.126 ^c [15,444.7848]
Constant	694017.1 ^b [314588.3]	575,140.862 ^b [235,788.986]	207,085.4122 [366,794.189]	-1.6117e+06 ^c [443,397.185]
Obs	95	95	95	90
R-squared	0.4872	0.57	0.58	0.69
Hausman test	0.00	187.85 ^c	32.92 ^c	125.59 ^c

Standard errors in brackets

a – significant at 10%; b – significant at 5%; c – significant at 1%

Figure 3: Use of cards to withdraw money

8 The error term, $\varepsilon_{i,j,t}$ is identically distributed and uncorrelated across observations and with exogenous variables, but $\text{cov}(\varepsilon_{i,j,t}, \varepsilon_{i,j,s})$ may be different from zero if $t = s$.

9 Individual effects can be treated as fixed or random. The problem is not if effects are fixed or random. The problem is whether the effects are correlated to the observable variables. When correlation is present, conditional inference must be

done (fixed effect estimation) [Arellano and Bover (1990)]. The Hausman test show that individual fixed effects are not correlated with the explicative variables, therefore the random effect estimator is consistent. However, in some specifications the Hausman test rejects the hypothesis that the random effect estimator is consistent, therefore fixed effect estimation is used.

European payment systems and monetary union

Panel B: Number of transactions				
	(1) transactions x 1000 inhab	(2) transactions x 1000 inhab	(3) transactions x 1000 inhab	(4) transactions x 1000 inhab
N° ATMs x 1000 inhab	24005.42 ^c [2460.575]	21598.94 ^c [2858.337]	21423.62 ^c [2897.677]	14271.28 ^c [2998.799]
D1999	78.20867 [705.4583]			
D2002		1271.141 [853.0511]	1375.165 [887.9476]	883.5491 [826.8769]
Branches x 1000 inhab			1537.869 [3637.473]	8420.163 ^c [3418.001]
Per Capita GDP				513.3503 ^c [104.8599]
Constant	9254.231 ^c [3284.545]	10414.3 ^c [3071.285]	9771.093 ^c [3472.797]	-1007.743 [4014.939]
Obs	96	96	96	91
R-squared	0.58	0.59	0.60	0.70
Hausman test	0.000	0.000	0.000	0.000
Panel C: Average value of transactions				
The dependent variable, transact (respectively Atmvaptr), is the number of card transactions to withdraw money per 1000 inhabitants (the average value of each transaction in Panel C).				
	(1) Atmvaptr	(2) Atmvaptr	(3) Atmvaptr	(4) Atmvaptr
N° ATMs x 1000 hab	47.3895 ^c [10.82327]	21.73221 ^b [11.149]	21.1738 ^b [11.252]	1.984646 [12.9219]
D1999	.22863 [3.1227]			
D2002		16.36994 ^c [3.4754]	16.91159 ^c [3.587]	14.5724 ^c [3.8473]
branch x 1000 hab			9.372596 [14.008]	22.6672 [14.5687]
Per Capita GDP				1.28423 ^c [0.4399]
Constant	80.5646 ^c [11.9013]	92.616 ^c [10.6675]	88.4251 ^c [12.301]	64.1529 ^c [14.794]
Observations	95	95	95	90
R-squared	0.21	0.38	0.38	0.42
Hausman tests	2.42	4.24	0.16	3.97
Standard errors in brackets a – significant at 10%; b – significant at 5%; c – significant at 1%				

Figure 3 (continued): Use of cards to withdraw money

significant, in particular in total volume and the average value of transactions. Therefore, it can be claimed that although the changeover to the euro took place in 1999, it is the introduction of notes and coins that enhances the use of cards at ATMs. Hence, the 'euro effect' takes place in 2002.

What is most interesting is that transactions do not increase but the value of each transaction is higher. One possible explanation could be the value of the euro bank notes; larger than the national ones. Moreover, perhaps the increase in prices due to the rounding might have affected this result as well. As the dummy 1999 is not significant, we introduce the dummy corresponding to 2002 for the rest of the realizations.

The degree of economic development affects positively the cash use of cards, independent of the type of measure introduced (Column 4). Hence, the more developed the country, the more use of cash instruments. The effects of the branch network are not conclusive. When it is introduced alone with the 2002 time variable (Column 3), its coefficient is not significant. However, when it is included with the degree of economic development, its coefficient is positive and significant (Column 4). In this case, the 'reliability effect' overcomes the substitutive effect of larger branch network. The fact that the branch network is only significant jointly with the economic development may mean that the 'reliability effect' is taken into account by consumers in economically developed environments.

Figure 4 presents the results for the use of cards as a payment instrument. Again, we measure the use of cards in terms of total volume, number of transactions, and average value of transactions in Panels A, B, and C respectively. In this case, we replace the number of ATMs with the number of EFTPOS available. The EFTPOS network influences significantly and positively card use to pay both in terms of volume and the number of transactions (Panels A and B of Figure 4). However, the average value of transactions is not affected by the EFT-POS network (Panel C).

European payment systems and monetary union

Panel A: Total volume of transactions				
The dependent variable, Card value (transact respectively in panel B), is the total volume of card transactions to pay (number of transactions per 1000 inhabitants in panel B). Financial facilities are number of EFTPOS (N° EFTPOS) and number of branch offices (branch) per 1000 inhabitants.				
	(1) Card value	(2) Card value	(3) Card value	(4) Card value
N° EFTPOS x 1000 inhab	156,810.932 ^c [15,586.6287]	121,445.9548 ^c [17,011.3802]	123,352.5818 ^c [16,356.7001]	78,832.6894 ^c [20,965.4774]
D1999	-42,835.8330 [109,146.4338]			
D2002		458,201.2561 ^c [115,378.6766]	400,076.4758 ^c [112,836.9966]	382,155.4983 ^c [110,798.7588]
Branch x 1000 inhab			-1.3803e+06 ^c [428,152.4659]	-977463.0924 ^b [410,066.2826]
Per Capita GDP				49,812.2575 ^c [15,261.9106]
Constant	-243328.4348 [276,408.5673]	32,956.2763 [278,312.3132]	683,449.0571 ^b [324,643.9854]	-220039.2793 [404,918.4418]
Obs	105	105	105	100
Number of cntry	15	15	15	15
R-sqd	0.24	0.27	0.40	0.53
Hausman test	2.60	1.54	0.03	5.84

Panel B: Number of transactions				
The dependent variable, N° trans (transact respectively in panel A), is the total number of card transactions to pay (number of transactions per 1000 inhabitants in panel A). Financial facilities are number of EFTPOS (N° EFTPOS) and number of branch offices (branch) per 1000 inhabitants.				
	(1) N° trans x 1000 inhab	(2) N° trans x 1000 inhab	(3) N° trans x 1000 inhab	(4) N° trans x 1000 inhab
N° EFTPOS x 1000 inhab	3,056.3032 ^c [300.3363]	2,389.7544 ^c [330.6613]	2,409.6415 ^c [328.3495]	1,779.6621 ^c [468.6010]
d1999	-763.6574 [2,085.3649]			
d2002		8,449.3579 ^c [2,226.9987]	7,673.1950 ^c [2,251.3461]	7,855.6110 ^c [2,376.2326]
Branch x 1000 inhab			-18,881.4428 ^b [8,683.1587]	-11,658.9786 [9,080.0094]
Per Capita GDP				726.5331 ^b [348.2890]
Constant	-3,146.8811 [5,903.6937]	2,095.4014 [5,955.6091]	11,055.6887 [6,824.2131]	-2,927.7474 [9,377.8244]
Observations	101	101	101	96
R-squared	0.23	0.25	0.39	0.40
Hausman Test	1.86	1.19	0.06	4.53

Panel C: Average value of transactions				
The dependent variable, posvaptr, is the average value of card transactions to pay. Financial facilities are number of EFTPOS (N° EFTPOS) and number of branch offices (branch) per 1000 inhabitants.				
	(1) Posvaptr	(2) Posvaptr	(3) posvaptr	(4) Posvaptr
N° EFTPOS x 1000 inhab	0.0601 [0.1939]	-0.1498 [0.2267]	-0.1514 [0.2242]	-0.7356 ^b [0.2949]
D1999	-0.6359 [1.3386]			
D2002		2.6534 ^a [1.5227]	3.0135 ^b [1.5222]	1.7008 [1.4256]
Branch x 1000 inhab			9.7409 [6.0324]	16.9185 ^c [5.6443]
Per Capita GDP				0.7928 ^c [0.2243]
Constant	53.7210 ^c [4.2114]	55.3227 ^c [4.2955]	50.6277 ^c [5.2119]	34.9544 ^c [6.3063]
Observations	105	105	105	100
R-squared	0.01	0.02	0.04	0.27
HausmanTest	0.70	0.28	4.63	3.78

Standard errors in brackets
a – significant at 10%; b – significant at 5%; c – significant at 1%

Figure 4: Use of cards to pay

European payment systems and monetary union

As in Figure 3, Column 1 in each panel presents the results when the 1999 dummy is introduced. The 1999 variable is not significant in any of the realizations. However, the 2002 dummy, which accounts for the introduction of the bank notes and coins, is positive and significant. Therefore, it can be claimed that there is a euro effect that also enhances the use of cards as payment instrument. A possible interpretation could be that consumers prefer to use cards to pay due to lack of knowledge and confidence in the new bank notes.

Contrary to ATMs use, the number of EFTPOS transactions do increase significantly in 2002, although the value of each transaction is not altered significantly. This result reinforces the hypothesis that the incremental increase in value of ATM transactions is caused by the larger new bank notes, rather than the increase in prices after the introduction of the single currency. If the latter was the cause it would also have impacted the value of EFTPOS operations.

Branch network has a significantly negative impact on use of cards for payment, in terms of volume and number of transactions. Therefore, in the case of EFTPOS, it seems that the substitute effect is dominant. Results for the average value of transactions, however, are not conclusive. When the branch variable is introduced alone with the 2002 time variable, its coefficient is not significant (Panel C); but, when it is included with the degree of economic development, its coefficient is positive and significant. In this case, the reliability effect overcomes the substitutive effect of larger branch network. Therefore, the trust in the financial sector is important for the increase in the value of card operations.

Finally, we introduce the degree of economic development. The coefficient is positive and significant in all three cases, as expected. Hence, the more economically developed, the more use and trust in cards, both to withdraw and to pay.

Conclusion

This paper illustrates that the use of cash declined between 1996 and 2002. There was an increase in non-cash payment instruments due to new technologies, in particular card use. Accordingly, traditional instruments such as checks experience a decline, but surprisingly electronic money relevance is still very small. The econometric estimations confirm the descriptive analysis results concerning cash use. Furthermore, there is evidence that the introduction of the euro banknotes and coins enhances card use significantly, both at ATMs and EFTPOS. Economic development and financial systems facilities affect card use as well. Hence, reliability in the financial system is crucial for the use of cash less instruments. Therefore, should financial institutions want to support the use of these payment instruments they would need to invest in security systems, transparency, and publicity.

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