Digitalisation

The use of cash and its determinants

Javier Alonso / Hicham Ganga / Jesús Lozano Belio / Álvaro Martín / Pablo Mirón / Cristina T. Plata / Ana Rubio / Adrián Santos / Javier Villar Burke

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Executive summary

The digital revolution is leading to an increased use of electronic payment instruments, including not only debit and credit cards, but also new payments methods such as mobile payments. Moreover, an increasing debate in the academia about the possibility of evolving towards a cashless economy has even led some towns to undertake controlled trials to become cashless for short periods of time[1].

However, according to a recent ECB survey, cash is still used in 79% of retail payments in terms of number of transactions in the euro area as a whole (54% in terms of value). In countries like Spain, Italy and Greece, cash payments account for around 90% of the number of transactions or 70% in terms of value (Figure 1).

We have analysed the factors driving the prevalence in the use of cash as a payment method across European countries. For this, we have considered a list of more than 20 factors classified into four categories: access to cash and banking products, degree of digitalisation, macroeconomic environment and cultural factors. According to our calculations, the most relevant variables explaining the prevalence in the use of cash are the share of senior population, the level of digitalisation and the average size of card transactions. This latter variable is explained by two effects: on the one hand, the decrease in the amount of commissions and fees charged for the use of cards and, on the other, users getting more familiar with their electronic means of payments and therefore being willing to use them for everyday transactions. According to these results, the relative use of cash is expected to decrease over time due to the double effect of generation replacement and an increased penetration of digital technologies. The share of rural population and the existence of legal limitations to the use of cash appear to have a lower influence in the preference for the use of cash.

A number of potential explanatory variables appear to be non-significant. Those include variables for the access to cash and banking products (number of bank accounts, volume of deposits, number of cards and banking concentration) and macroeconomic variables (banking strength, GDP per capita, tourism and inflation). This does not necessarily mean that these factors are not relevant, as they may be included in the country fixed effects.

In order to complement the analysis at macro level, we have used micro data for Spain extracted from a sample of BBVA clients (more than 3 million users). According to our data, we observe a sustained increase in the value of card payments in the last four years while the value of cash withdrawals has remained constant. On the other hand, we observe a clear seasonality behavior in both payment practices, which indicates that the consumption patterns of the clients are the same for both cash withdrawals and card payments.

As for the European analysis, the Spanish microdata point to the age as a clear determinant in the use of cards as a payment method compared to cash withdrawals. On average, the older population (60 and over) withdraw 33% more cash (in terms of the value of transactions) and the young population (below 30) 44% less cash than the overall average in Spain.

1: Three recent examples in Spain are "Cantabria Pago Digital", "Morella Cashless City" and a Kutxabank and Visa project in Álava.

Within a trend of a generalised decrease in the relative use of cash as a means of payments, significant differences are still patent across Spanish regions. Galicia, Asturias, Ceuta and Melilla are the regions with the highest importance of cash withdrawals while citizens from Catalonia, Balearic Islands and Madrid rely much more in cards as a payment method. The differences observed across regions may probably be explained by similar factors to the ones observed for European countries (e.g. regional differences in terms of ageing population, degree of digitalisation, the extent of the shadow economy and the income level).

We have also assessed the evolution of cash in the UK due to its early adoption of new payment methods and rules. In particular, contactless cards and instant payments are available in the UK since September 2007 and May 2008, respectively. Therefore, the experience in the UK can provide some clues on how the recent launch of the SEPA Scheme of Instant Payments (SCTInst) and the entry into force of PSD2 may impact the use of cash in other EU countries.

However, despite the range of payment instruments available in the UK being wider than in most European countries during the last decade, the evidence we have gathered does not confirm a better performance in cash displacement than in other comparable European countries or even than the EU average.

Overall, we can conclude that the use of alternative means of payments has been gaining grounds while the use of cash has remained constant for several years. This has been mainly driven, on the one hand, by an increased adoption of digital methods both by consumers and by retailers and, on the other, by the natural generation replacement (as the youngsters tend to be earlier adopters than the elderly). The evolution of regulation, which has led to the reduction in commissions and fees and has facilitated the adoption of innovative payment methods, has also contributed to the trend. However, it seems quite unlikely that cash as a means of payment will disappear or become marginal in the short or even medium term.

1. Introduction

The digital revolution has led to an increasing use of electronic payment instruments, including not only debit and credit cards, but also new payments methods based on devices such as mobile phones or wearables. This trend has led to an increasing debate about the possibility and convenience of evolving towards a cashless economy with intense lobbying for and against cash[2] and different actors taking different approaches towards cash ranging from the hard push of Sweden in favour of electronic payments[3] to the controlled cashless trials that are taking place in countries such as Spain, where banks are promoting digital payment pilots in some towns and villages[4].

However, according to a recent ECB survey[5], cash is still used in 79% of retail payments in terms of number of transactions (54% in terms of value) in the euro area as a whole. In countries like Spain, Italy, Malta, Greece and Cyprus, cash payments account for around 90% of the number of transactions or 70% in terms of value (Figure 1)[6].

While the trend towards a wider use of electronic payment instruments seems inexorable, understanding the reasons that explain the differences in the use of cash across countries and its evolution over time can provide an indication of the potential future path in the use of cash and electronic payment instruments. In this document, we will try to analyze the determinants of the use of cash in the European countries, using an econometric approach.

2: For example, there is an international lobby group in favor or cash named the International Currency Association (https://www.currencyassociation.org/) and VISA has a site and some reports on the benefits of cashless for cities (https://usa.visa.com/visa-everywhere/global-impact/cashless-cities.html)
3: Although the fast pace of cash displacement is starting to rise some concerns on the impact of this strategy on some social groups or even the resilience of the country during an important crisis of a war that affects payment systems.
4: Three recent examples are "Cantabria Pago Digital" (https://goo.gl/PF77RW), "Morella Cashless City" (https://goo.gl/rTEuCh) or the Kutxabank and Visa project in Álava (a province in the Basque Country (https://goo.gl/2ojzgr).
5: See ECB (2012).
6: This trend is generalised at global level. According G4S (2018), in 75% of countries, cash is used in more than 50% of transactions. Moreover, 2 billion people worldwide do not have access to a bank account, so that they do not have access to most alternative payment methods.

Figure 1 Use of cash at point of sale, percentage of all transactions, 2016

■ Number of transactions ● Value of transactions
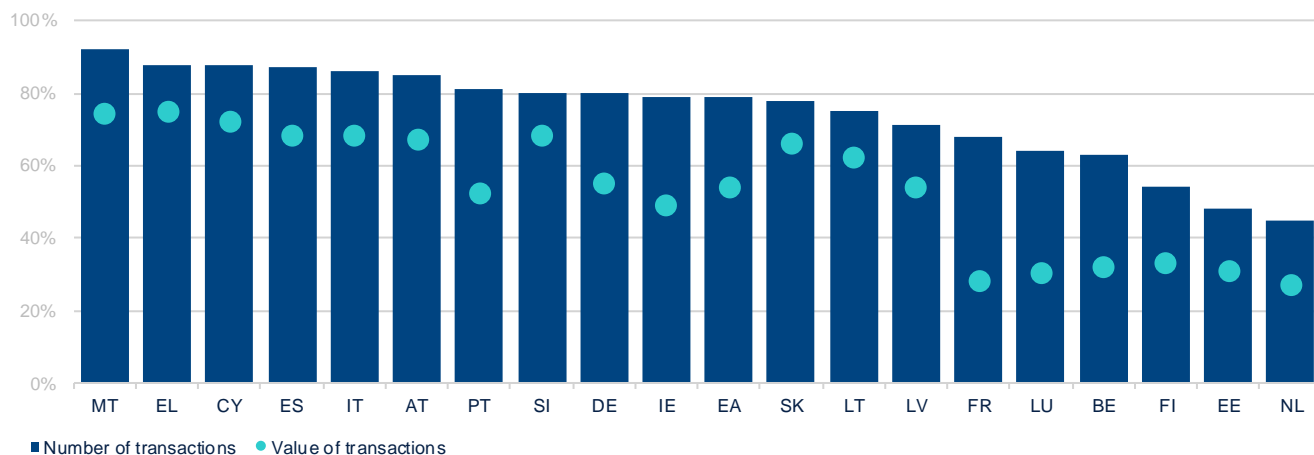
Source: ECB (2017): *The use of cash by households in the euro area.* Occasional Paper Series 201

The use of cash will probably be impacted by the recent launch of the SEPA Scheme of Instant Payments (SCTInst) and the entry into force of the Payment Services Directive (PSD2). As the United Kingdom has already implemented similar initiatives, we will use the experience in the UK to gain some insights on the potential impact of the new European rules in the use of cash for retail payments.

2. Scope: retail transactions

Cash can be used for two main functions: as a mean of payment in a transaction or as a store of value (hoarding)[7].

Given that cash can be used for transactions between any two economic actors - either business-to-business (B2B), consumer-to-business (C2B) or peer-to-peer (P2P), ensuring the transactional function requires not only that families hold cash but also that retailers keep cash received from their customers, financial institutions have cash available in ATMs and vaults, or cash-handling companies stock and transport funds, for instance.

On the other hand, cash can be hoarded by many different agents: households, companies, banks and other financial institutions. Cash denominated in foreign currencies can also be used abroad, both for transactional and hoarding purposes. This is the case for a number of "dollarized" economies, but also for the euro (for instance, Montenegro and Andorra use the euro as their national currency even though they are not part of the euro area, not even of the European Union)[8].

Therefore, cash is distributed throughout many economic agents. However, the motivation for holding and using cash may be different depending on the economic agent, the cash function and the agent needs. This makes the analysis of the use of cash complex.

For the purpose of this note, **we will focus on the usage of cash in retail transactions** compared to other means of payment.


7: Money more in general has the additional function of being the unit of account.
8: Note that the dollar may circulate in parallel to a national currency (e.g. in Peru or Argentina) or replace it (e.g. in Ecuador). In the case of the euro, Andorra, the Vatican, San Marino and Monaco can use the euro following the respective bilateral monetary agreements with the EU while Montenegro has adopted the euro unilaterally.

# 3. Measuring the use of cash for transactional purposes

While statistics on the use of electronic means of payments (e.g. card payments or direct debits) are easily available, this is not the case for the use of cash. Among the several methods proposed to estimate the use of cash,[9] we have chosen the "cash withdrawal data" approach and the "consumption residual" method due to data availability and ease of calculation. Through these methods, we have obtained an estimation of the use of cash between 2000 and 2016 for most EU Member States. As a complement and robustness check, we have used the data from the ECB surveys published in 2012 and 2017[10]. In addition, we have considered the "circulation residual" method, which is based on the cash in circulation, but it was discarded due to several problems such as the circulation of cash abroad, the cash held by financial institutions and the fact that no breakdown per country was available for the euro area.

Figure 2a Use of cash at point of sale: withdrawals index (number of transactions) vs ECB share of cash transactions (number), 2009, percentage
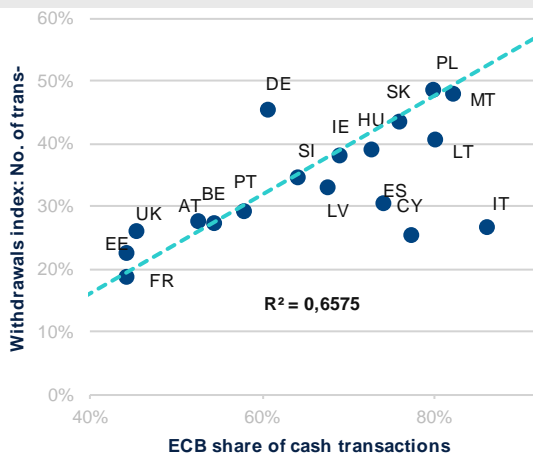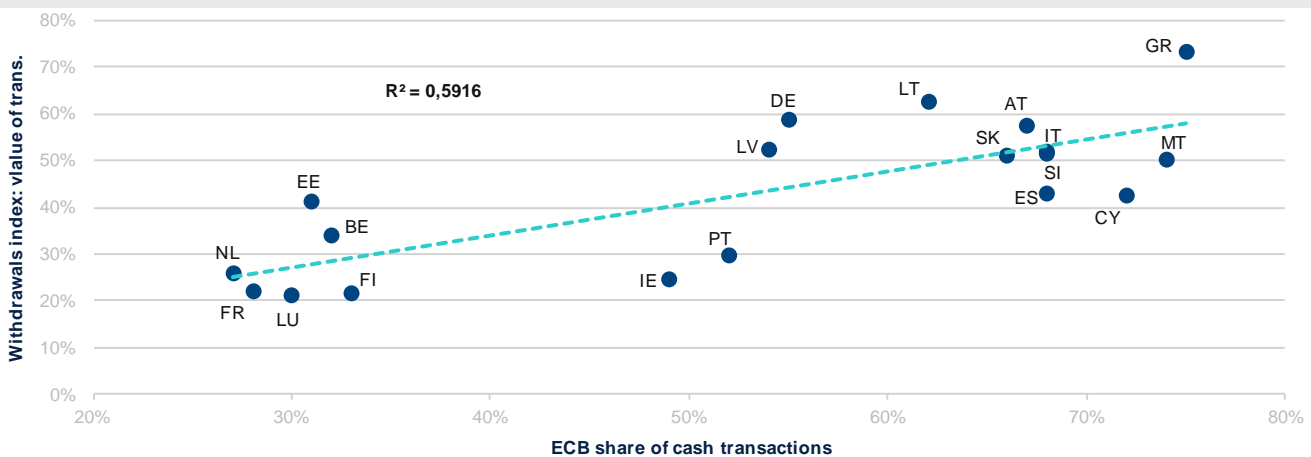

Note: Withdrawals index has been calculated as share of total number of withdrawals to the sum of total card payments transactions and withdrawals number of transactions in 2009.
Source: ECB (2012) and BBVA Research

Figure 2b Use of cash at point of sale: withdrawals index (number of transactions) vs ECB share of cash transactions (number), 2016, percentage
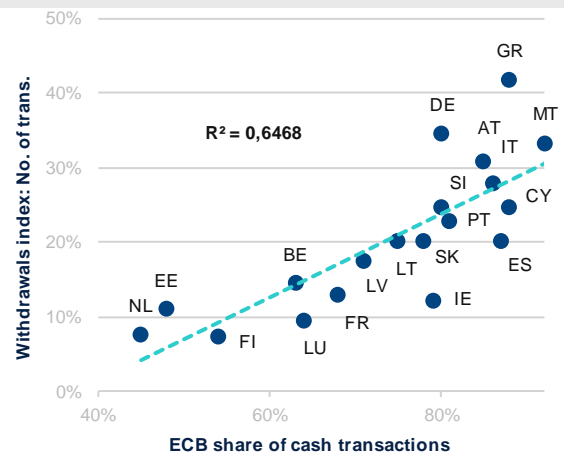
Note: Withdrawals index has been calculated as share of total number of withdrawals to the sum of total card payments transactions and withdrawals number of transactions in 2016.
Source: ECB (2017) and BBVA Research

Figure 2c Use of cash at point of sale: withdrawals index (value of transactions) vs ECB share of cash transactions (value), 2016, percentage

Note: Withdrawals index has been calculated as share of total number of withdrawals to the sum of total card payments transactions and withdrawals number of transactions in 2016. Data for 2009 are not available.
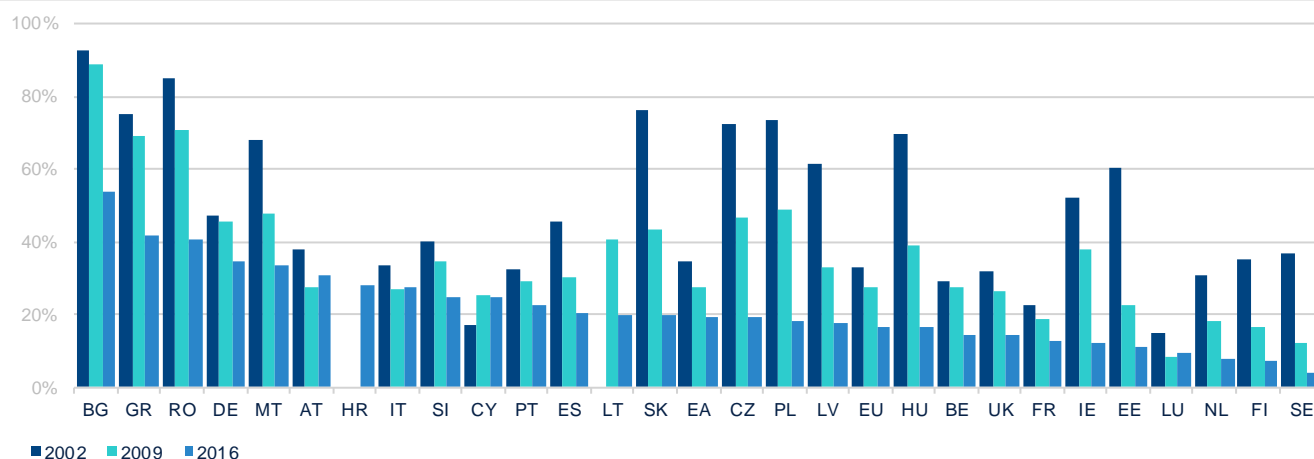Source: ECB (2012) and BBVA Research

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9: See ECB (2012), Annex, for details of several methods of estimating the use of cash.
10: ECB (2012) and ECB (2017).

3.1 The cash withdrawal data approach

Starting from the withdrawals of cash in ATMs per country (both in terms of number and value of withdrawals), we have built different variables in relative terms: withdrawals in a year to GDP, withdrawals per capita, withdrawals as a share of total payments[11] and withdrawals as a share of payments in the point of sale[12]. We have compared these indicators in 2009 and 2016 with the data from the ECB surveys about the use of cash. Among the various options that we have considered, the highest correlation appears for withdrawals as a share of card payments both in terms of number of transactions (correlation of 0.80 and R^2 of 0.65) and in terms of total value of transactions (correlation of 0.77 and R^2 of 0.59), (see Figures 2a, 2b and 2c). Therefore we have chosen these two variables as proxies for the use of cash based on the cash withdrawal approach.

In Figure 3a and 3b we observe several features. First, there is a generalized decrease in the relative use of cash in the last 15 years, in some cases quite drastically. Second, a wide dispersion appears across countries. In general, the countries from the former Eastern Bloc, with a shorter banking tradition, tend to use more often cash than Western countries. However, there are also exceptions; for instance in Greece and Germany the use of cash is still quite dominant while in Estonia it is seldom used. Third, in a few countries (e.g. the Netherlands, Finland and Sweden), our proxy indicates that the use of cash has become almost marginal. In Section 4 we discuss how the combination of different factors in each country helps to explain the disparities across countries and the evolution over time.

Figure 3a Use of cash at point of sale, withdrawals index, number of transactions, percentage

Note: Withdrawals index has been calculated as share of total number of withdrawals to the sum of total cards payments value and total value of withdrawals transactions in 2009.
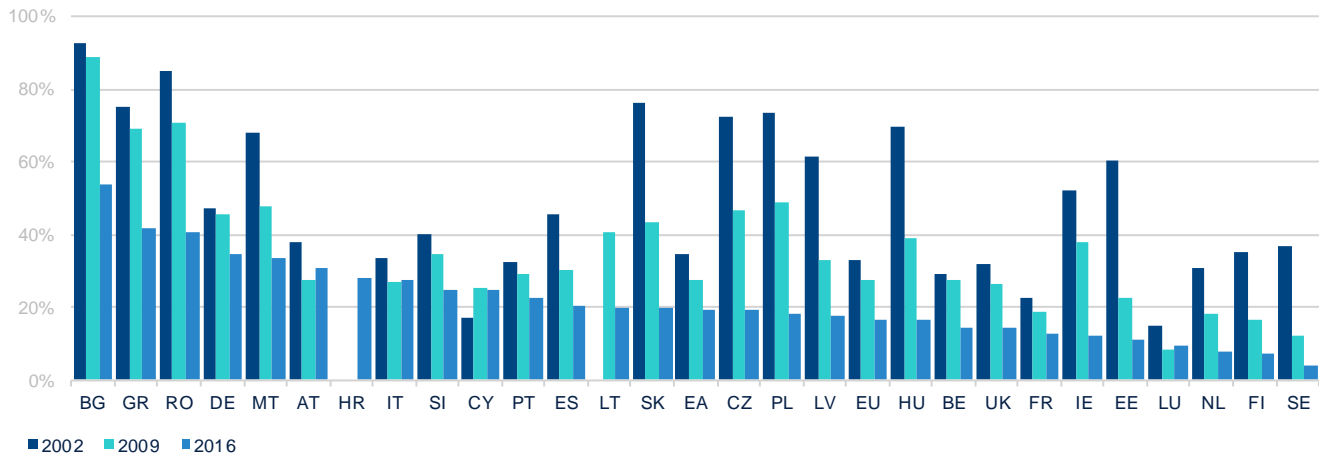Source: ECB and BBVA Research

In general, there is a correspondence in the use of cash in terms of value and number of transactions (Figure 3c and 3d). However, in a few countries we observe a proportionally higher withdrawal index in terms of number of transactions than in value (for instance in Bulgaria, Malta or Portugal in 2016). This indicates that consumers in these countries tend to use cash for small payments. On the other hand, in countries like Hungary, Lithuania, Poland or Estonia, the withdrawal index for the number of transactions is proportionally smaller than for the value of transactions, which means that consumers use their credit cards even for relatively small transactions.

11: Total payments include cards, cheques, cash, direct debits and transfers.
12: We have considered the two main methods of payments in the point of sale: cards and cash, the latter being proxied by cash withdrawals. After considering also the use of cheques, it was discarded as it did not yield any improvements in our estimates. This goes in line with the approach followed by ECB (2012); in any case, the use of cheques is marginal in most countries and, in the few countries where it is still material, it has been significantly declining in the last few years.

Figure 3b Use of cash at point of sale, withdrawals index, value of transactions, percentage
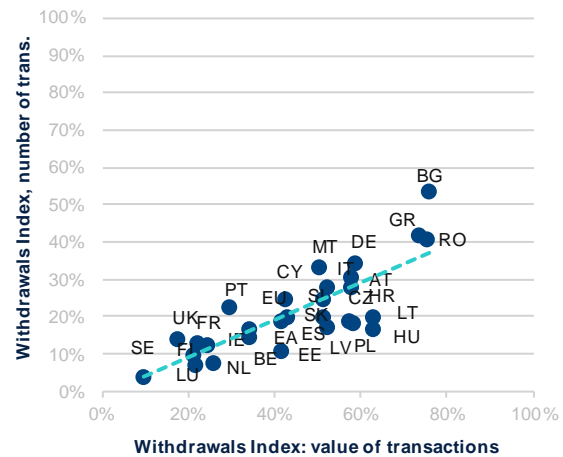

Note: Withdrawals index has been calculated as share of total value of withdrawals to the sum of total cards payments value and total value of withdrawals transactions.
Source: ECB and BBVA Research

Figure 3c Withdrawals Index, number of transactions vs value of transactions, 2002, percentage
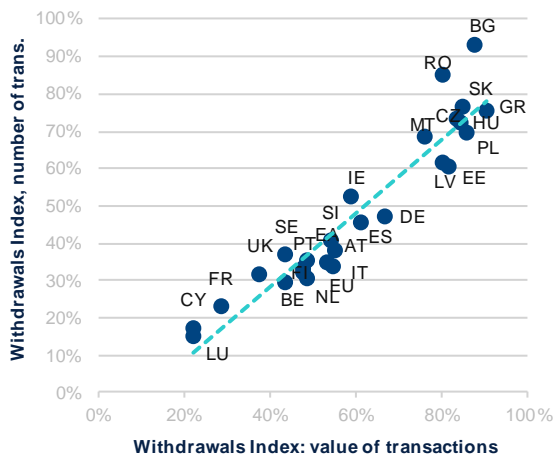
Note: Withdrawals index has been calculated as share of total number of withdrawals to the sum of total card payments transactions and withdrawals number of transactions in 2002.
Source: ECB (2012) and BBVA Research

Figure 3d Withdrawals Index, number of transactions vs value of transactions, 2016, percentage

Note: Withdrawals index has been calculated as share of total number of withdrawals to the sum of total card payments transactions and withdrawals number of transactions in 2016.
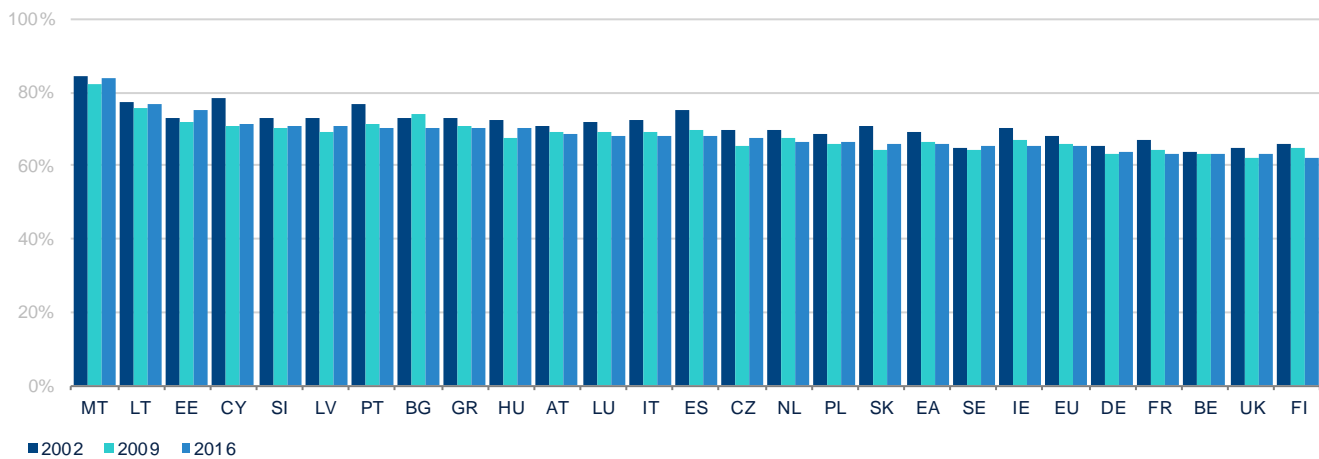Source: ECB (2017) and BBVA Research

3.2 The consumption residual method

As an alternative approach to the use of cash, we have taken the "consumption residual" method. This estimate starts from household expenditure provided by national accounts and applies some corrections. Following ECB (2012), we have made the following two corrections: 1) subtracting credit card payments (considered to be the main alternative to cash at the point of sale) and 2) excluding the sub-items that are usually paid by direct debit or transfer (i.e. housing, utilities, education, health and financial services). We have also considered subtracting direct debits, but the results were not consistent, particularly because we obtained negative values in many countries. This could be due to the fact that, depending on the countries, direct debits are used not only for retail payments but also for many other purposes including B2B payments. Therefore, we have discarded this second option.

This method of estimating the use of cash also indicates a declining trend, but much slower than what is suggested by the cash withdrawal method. While some heterogeneity across countries is observed, countries appear to have less

dispersion in the use of cash for transaction at the point of sale. Finally, this indicator tends to indicate a higher importance of the use of cash (65% in terms of value for the EU as a whole) than what is suggested by the cash withdrawal index (35%), and less dispersion among countries (Figure 4). These differences are probably explained by how cash circulates after being withdrawn from an ATM. A specific amount of cash can be split into several transactions. Moreover, cash can circulate several times before it is deposited back in the financial system and removed from circulation until it is withdrawn once again. The granularity of publicly available data does not allow to analyse these types of behavior across countries and over time.

Figure 4 Use of cash at point of sale, consumption residual method, value of transactions, percentage

Source: ECB and BBVA Research

4. Determinants of the use of cash

The prevalence in the use of cash as a payment method can in principle depend on a number of factors. We have classified them into four categories: access to cash and banking products, degree of digitalisation, macroeconomic environment and cultural factors (Table 1). In this section, we explain how each of these factors can potentially influence the use of cash.

Table 1 Factors influencing the use of cash

Access to cash and banking products	Cultural factors
Number of ATMs	Crime
Number of bank accounts	Shadow economy
Volume of deposits	Corruption
Number of cards	Senior population
Average size of transactions with cards	Rurality
Banking concentration	
Cash limitation	**Degree of digitalisation**
Macroeconomic environment	Mobile phones
Banking strength	Access to Internet
Economic development	Level of digitalization
Tourism	Internet purchases
Inflation	Internet banking

Source: BBVA Research

4.1 Access to cash and banking products

This block includes factors such as number of bank accounts, volume of deposits, number of cards, number of ATMs, concentration in the banking sector and existence of limits in the use of cash.

Having a bank account is a precondition for having access to most payment methods other than cash (e.g. cards, direct debits or transfers). In countries like Romania and Bulgaria about 50% of the population did not have a bank account in 2011, although bank access has significantly improved since then. On the other hand, a high density of ATMs facilitates the access to cash through cash withdrawals; however, the causality here is unclear as modern ATMs offer a wide range of functionalities that could boost the use of electronic payments (transfer initiation, payment of non-domiciled invoices, etc.) and a reduction in the number of ATMs could be a response to a decreased use by customers.

Besides ATMs and bank counters, consumers may have access to cash through other means. In particular, according to Jiménez Gonzalo and Tejero Sala (2018) 21% of Spanish population received at least 25% of their regular income in cash.

Besides the availability of those basic banking products, an important factor is their cost; in particular, the cost for the use of ATMs and cards. When commissions are high, merchants tend to ask a minimum amount for the use of bank cards. Similarly, with higher commissions applied to ATMs, consumers tend to reduce the frequency of withdrawals and to increase the withdrawn amount. This behaviour implies that the average size of transactions for withdrawals and card payments can provide an indication of the commissions and fees.

We were unable to obtain detailed and comparable information about the commission and fees charged for the use of cards to consumers and merchants, as well as the fees and commissions linked to cash withdrawals. Therefore, we will use the average size of card transactions and withdrawals as an indication of the evolution of commissions and fees.

As a way of fighting shadow economy, crime activities and money laundering, some governments have introduced a limit in the maximum amount that can be paid in cash usually for transactions where at least a business is involved. In principle, introducing this kind of restriction could reduce the use of cash.

Bank business decisions may influence the incentives to use cash or alternative payment methods. Banking concentration may affect competition (either positively or negatively) influencing for instance the level of commissions and fees. Also, a higher concentration of banks may lead to a reduction in the number of ATMs and offices to gain efficiency; this would put pressure to a more wider use of alternative payment methods other than cash.

4.2 Degree of digitalisation

Although traditional non-cash payment methods are electronic in the interbank space, direct debits, bank transfers or credit cards have been available for decades in the offline world. The initiation of these transactions did not require that users had any technological endowment: direct debits were accepted by users when signing a contract, bank transfers were ordered by consumers in branches and only credit cards required a basic physical device (a plastic card) to be initiated.

But the advent of internet, mobile phones and smart devices has removed the constraints on these payment services. Now users can order transfers in online banking, authorize direct debit through electronic means and pay with cards with enhanced functionalities (instant debit, reinforced security, etc.).

Moreover, new technologies have made possible leveraging the existing interbank infrastructures to offer new payment methods (e- and m- payments, virtual cards or p2p payments, for instance), As a consequence of the

increased convenience of new payment instruments, their adoption has increased as well as the demand of electronic payments options at point of sale.

For these new payment methods to become mainstream, the underlying technology must be widely available and customers must get used to the technologies enabling them and build confidence on their security and convenience.

Following this reasoning, this group of factors tries to measure the penetration of technology in a country and its adoption by consumers, under the assumption that a higher adoption of new technologies would reduce the reluctance of consumers and merchants to use and accept non-cash payment methods.

Thus, we have assessed the degree of digitalisation through some different variables:

- **Level of digitalization**. We have used the DiGiX index created by BBVA (Cámara & Tuesta, 2017). DiGiX is a composite index that summarizes relevant indicators on countries' digital performance. The DiGiX is structured around six dimensions: infrastructure, households' adoption, enterprises' adoption, costs, regulation and contents. As can be noticed, most of the other variables assessed in our study are included in this index. This indicator is only available for the last two years, so that, for historical comparisons we have used the alternative indicators.

- **Access to Internet**. This variable measures the penetration of internet in the country. The more broadband connections are available, the more likely is that users have been exposed to new technologies, reducing the barriers to adopt new payment methods by users,

- **Internet purchases**. It usually takes a time until consumers browsing the internet decide to purchase goods and services through internet. The main reasons behind this are security and trust concerns as well as the need to hold a payment method that allows online purchases. Therefore, having engaged in internet purchases hints that those barriers have been overcome and that consumers have probably adopted an electronic payment method.

- **Mobile phones**. Similarly to the number of broadband subscriptions, the number of mobile phones are a proxy of technology diffusion. Nevertheless, mobile phones have an additional role in the adoption of electronic payments, due to the fact that many payment solutions require that the user has a mobile device (contactless mobile payments, QR payments or payment solutions based on instant messaging apps, for instance).

- **Internet banking**. This variable can be understood as a precondition for electronic payments, since it enables customers to initiate traditional payments electronically and some electronic payments require that consumers access or give permission to its use through internet banking (OBeP - Online Banking electronic Payments -, card payments using the 3D Secure protocol, etc.).

A summary of the data sources and the measures used can be found in Table 2, in section 5.1.

4.3 Macroeconomic environment

We consider that a series of macroeconomic factors can have an influence in the use of cash. So that we have included strength of the banking system, economic development and tourism as control variables.

The financial crisis put many banks on the brink of collapse. This may have eroded the confidence in the banking system and the willingness of consumers to rely on banks for holding deposits and, therefore, as the basis for retail payments. The crisis led to severe cases such as the run on Northern Rock in the UK in 2008 or the bank freeze in Greece in the summer of 2015. Without arriving to these extreme cases, we have tested whether the distance to default of the banking system (measured through the z-score) has had an effect on the use of cash through the confidence effect on citizens.

Economic development may also influence the prevalence in the use of cash against other methods of payments. Therefore, we have included GDP per capita as a control variable.

Foreigners and travelers may have different preferences in the use of cash than local population. Using a payment card (or withdrawing money) abroad could imply significant commissions; sometimes, banks do not allow their clients to use their cards abroad. Although the introduction of SEPA (Single Euro Payment Area) has significantly improved this issue across the European Economic Area (EEA), some payments involving non-EEA parties are not affected by SEPA rules. On the contrary, foreigners may not be familiar with the banking system in other countries and may prefer cash when travelling abroad. In this context, we have introduced a variable measuring the intensity of tourism as a factor that could explain the differences in the use of cash across countries.

Finally, we have considered the potential influence of inflation in the use of cash. Inflation can erode the value of cash and may push the preferences of households to use other assets for storing value. Although inflation in Europe has not reached the levels observed in some emerging countries, we have tested if the different rates of inflation observed across countries would have an effect in the preference for cash payments. This being said, the impact of changes in inflation may only be observed after a certain period as certain behaviour may be culturally rooted and only change after some time.

4.4 Cultural factors

Historical developments and traditions as well as other cultural factors may have an important influence in the perception of the different types of payment methods. Among cultural factors we have considered: level of crime, shadow economy, corruption, age and level of rural population. With the inclusion of those variables we try to capture not only pure demographic changes across countries and periods, such as age or level of rural population, but also other factors related to fraud and criminal conducts that may be linked with higher use of cash.

Age appears as a very good candidate for explaining the differences in the use of cash: while young people are more used to new technologies and therefore to digital payment methods, we expect older people to be more reluctant in the adoption of innovative payment methods alternative to cash. Geographically, the penetration in rural areas of other payment methods could be lower than in urban areas due to the particular idiosyncrasies of both. On the other hand, access to ATMs and bank offices, as well as the logistics of cash in general, may not be obvious in some rural or remote areas, which may foster the use of alternative payment methods. Finally, we have considered corruption, the level of crime and the size of the shadow economy. This type of activities relies on the anonymity of cash transactions as a way to remain unnoticed by authorities.

5. The Model

5.1 Data

Data were compiled from several sources: the ECB, the World Bank, Eurostat, the IMF and BBVA Research. The list of variables that we have used for our analysis, its definition and sources is provided in Table 2. We have considered the 28 EU Member States and data from 2000 to 2016. We have tested several cross-section regressions for 2016, the last available year, and several panel regressions. Because of data availability, we have used 26 countries for the cross-section regressions and 23 countries for the panel regressions[13]. We have used OLS estimators for the cross-section regressions and fixed-effects for the panel regression.

13: Data were incomplete for Denmark and Luxembourg in 2016 and for Slovakia, Croatia and Ireland in previous years.

5.2 Results and interpretation

Before running the regressions, we checked for possible correlations among the variables to avoid multicollinearity problems. We found corruption to be highly correlated (negatively) with the variables that measure digitalization[14]. Also, as we expected, all digitalization variables were highly correlated among each other. We have used the DiGiX index in the cross-section regressions and internet banking for the panel regressions because they were the variables yielding the best fit in the regression. Finally, crime, shadow economy and corruption also showed important levels of correlation.

Variable	Measure	Source
Access to cash and banking products		
Number of ATMs	ATMs per 100,000 adults	ECB
Number of bank accounts	Accounts per 1,000 adults	ECB
Volume of deposits	Deposits to GDP	ECB
Number of cards	Number of cards per adult	ECB
Average size of card transactions	Value of card transactions over number of card transactions	ECB
Average size of cash withdrawals	Value of cash withdrawals over number of cash withdrawals	ECB
Banking concentration	CR5: Percent of total assets of the five biggest firms over the assets of the whole system.	ECB
Cash limitation	There is a regulation limiting the maximum amount per transaction that can be paid with cash (dummy).	Several sources
Degree of digitalisation		
Mobile phones	Mobile subscriptions per 1,000 inhabitants	World Bank
Access to internet	Broadband subscriptions per 1,000 inhabitants	World Bank
Level of digitalization	Digital index (DiGiX)	BBVA Research
Internet purchases	Individuals having purchased through Internet in the last three months, percentage	Eurostat
Internet banking	Individuals who used internet banking in the last 3 months, percentage	Eurostat
Macroeconomic environment		
Banking strengthen	Distance to banking default (Z-score)	World Bank
Economic development	GDP per capita	World Bank
Tourism	Tourism nights over total population	Eurostat
Inflation	HICP, interannual rate	Eurostat
Cultural factors		
Crime	Number of crimes per 1,000 inhabitants	Eurostat
Shadow economy	Size of the shadow economy as percentage of GDP	IMF
Corruption	Corruption index	Transparency.org
Senior population	Population with an age of 55 years or older, percentage	Eurostat
Rurality	Population living in rural areas, percentage	World Bank

Table 2 Variables and measure

Notes: For the panel regression, we have transformed some variables to make them stationary.

As mentioned above, we have considered three dependent variables: the withdrawals index for the number of transactions, the withdrawals index for the value of transactions and the use of cash estimated through the consumption residual method.

14: Explaining such correlation and whether it works through GDP per capita or through other mechanism goes beyond the scope of this note.

The most relevant regressions are summarized in Table 3. Overall, the most significant variables explaining the use of cash in 2016 or in the period 2006-2016 appear to be the share of senior population, the level of digitalisation and the average size of card transactions. This latter variable is explained by two effects: on the one hand, the decrease in the amount of commissions and fees charged for the use of cards and, on the other, users getting more familiar with their electronic means of payments and therefore being willing to use them for everyday transactions. These are the only significant variables in the second and fourth regressions, which are the ones more in line with our expectations. According to these results, the relative use of cash is expected to decrease over time due to the double effect of generation replacement and an increased penetration of digital technologies. Variables such as the level of rurality, the existence of legal limitations in the use of cash or inflation appear to be significant in Regression 1 but not anymore in the rest of regressions.

The structure of the panel data, with a relevant number of time periods (11 years), called for a control of stationarity. For that, we ran a Levin-Lin-Chu test in order to verify the existence of unit roots in the series. The results showed that the number of ATMs and tourism were not stationary. To solve it, we used first differences for these variables. As we now used time series, we also transformed the senior population variable into the difference of its logarithms to measure growth over time.

Table 3 Table of regressions

	Cross-section 2016			Panel data 2006-2016	
	Reg. 1 ols	Reg. 2 ols	Reg. 3 ols	Reg. 4 fe	Reg. 5 fe
Cash withdrawal index (number)	*	*		*	
Cash withdrawal index (value)			*		*
Intercept	5,3321 (**)	3,3526	1,2823	0,4824 (***)	0,7835 (***)
Number of ATMs	0,0009 (*)			0,0008	0,0006
Average size of card transactions	0,0020 (*)	0,0030 (***)	0,0001	0,0027 (***)	-0,0007
Cash limitations	-0,1080 (**)	-0,0508	-0,0901	-0,0180	-0,0137
Tourism	-0,0027			0,0027	0,0016
Inflation	-0,0517 (**)	-0,0348	-0,0069		
Senior population	1,3796 (**)	1,6780 (***)	1,3969	7,4381 (***)	4,2130 (***)
Rurality	-0,2902 (*)				
Level of digitalization	-0,6592 (***)	-0,4599 (**)	-0,8918 (***)	-0,6166 (***)	-0,4646 (***)
R^2	80,1%	74,0%	67,6%	58,0%	52,0%
Adjusted R^2	70,7%	67,5%	59,5%	-	-
N	26	26	26	234	234

Notes: Level of digitalization: DiGiX for the cross-section regressions (Reg. 1 to 3) and internet banking for the panel regressions (Reg 4 and 5). We have also controlled for GDP per capita but this would not yield a material improvement in the regressions.

A number of potential explanatory variables appear to be non-significant after testing many different regression specifications. Those include most of the variables for the access to cash and banking products (number of bank accounts, volume of deposits, number of cards and banking concentration) and the variables for the macroeconomic environment. This does not necessarily mean that these factors are not relevant, but rather that they are included in the country fixed effects. Finally, as indicated above, given the high correlation among some variables, it was not possible to include several of the cultural factor variables in the same regression. Similarly, we had to choose among the digitalisation variables.

In order to check the robustness of the results, we completed a pooled mean group estimation, with very similar results to the fixed effect regressions. We have also tried regressing the consumption residual variable, but the results weren't as satisfactory as with the other two dependent variables, probably due to the flat and invariant trend of this variable.

Figure 5 Volume of cash withdrawals and card payments, Index: Jul-2014 = 100
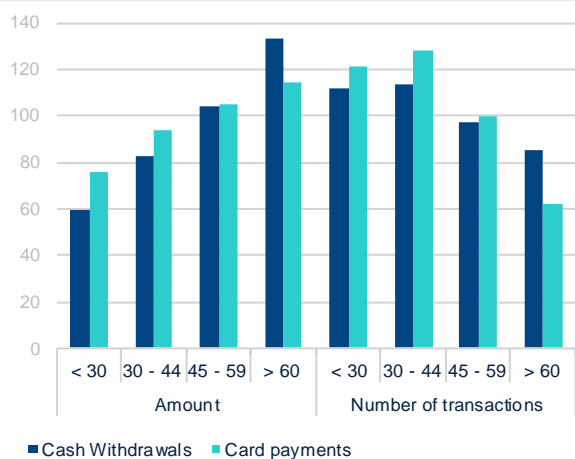

Cash withdrawls　　Card Payments
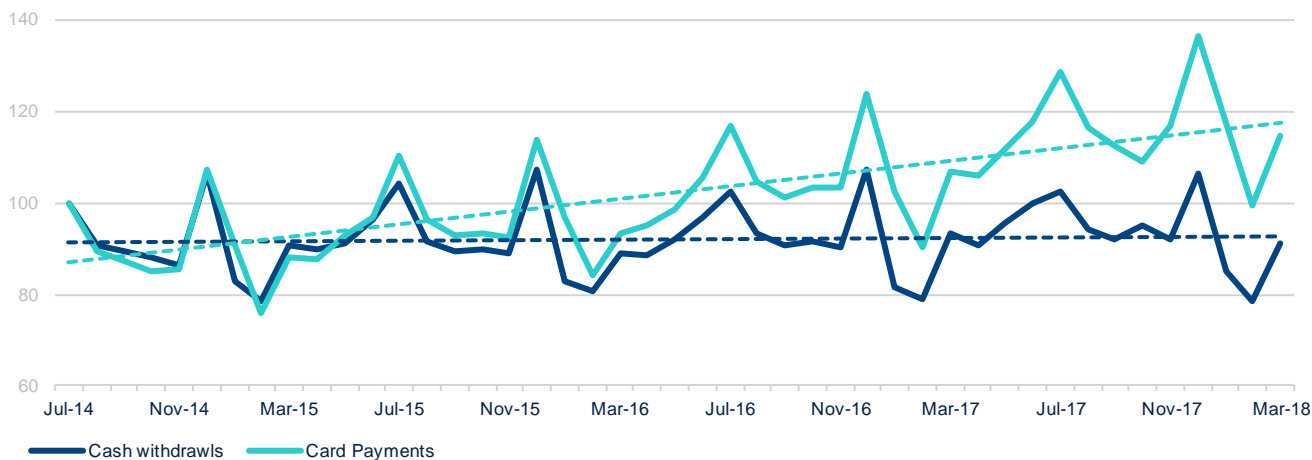
Source: BBVA Research

## 6. Cash vs. cards: the Spanish case

In order to complement the analysis at macro level, we have used micro data for Spain extracted from a sample of BBVA clients (more than 32% of BBVA's clients in Spain). According to our data, the total value of card payments was very similar to the total value of cash withdrawals in 2014. However, since early 2016, a constant increase in the usage of cards has led to an increasing gap between both. On the other hand, we observe a clear and similar seasonality behaviour in both payment practices, which indicates that the consumption patterns of the clients is the same for both cash withdrawals and card payments, although the fluctuations are slightly more pronounced in the case of card transactions (Figure 5).

Figure 6a Volume of cash withdrawals and card payments according to age, Index = 100, 2017

Cash Withdrawals　　Card payments

Source: BBVA Research

Table 6b Use of cash withdrawals and card payments according to age, value of transactions, 2017

Cash Withdrawals　　Card payments
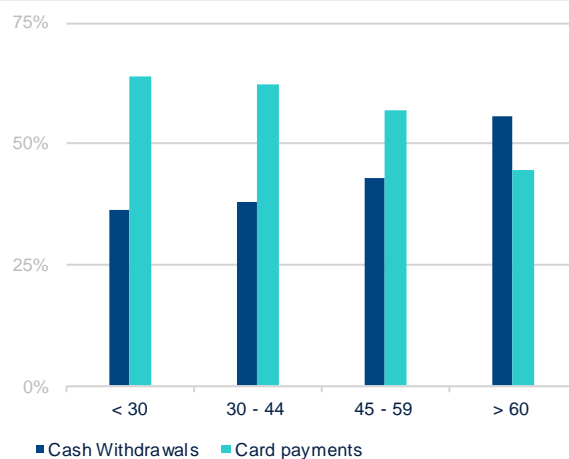
Source: BBVA Research

The fact that the withdrawal of cash has remained constant over time, while the use of cards has followed an upward trend indicates that the increase in consumption is reflected more in the use of cards than in the withdrawals of cash. These results are in line with the national data published by the Bank of Spain, which shows 2016 as the first year when card payments were higher than the amount of cash withdrawn from ATMs in the country (not only in BBVA clients).

This trend may be related to several factors. Regarding supply-side factors, in Spain during the last few years there has been an increase in the commissions charged for the use of ATMs from a bank other than the customer's bank, a practice that had to be regulated by a Royal Decree Law in October 2015 and, at the same time, the commissions paid for the use of cards at the points of sale (both the fixed and the variable commissions) have been reduced partly because the enactment of the IFR Regulation - Reg (EU) 2015/751 -. Another factor may be associated with the reduction of the ATM network (whose number decreased a 14.2% between 2010 and 2017, although the causality of this reduction cannot be clearly established, as stated in section 4.1) and an increase in the availability of terminals at the point of sale of 14% during the same period (see Bank of Spain, 2018).

We have also analysed the demand-side to see how some demographic factors such as age or region of residence can have an influence in the use of cash. Data show that the average amount of cash withdrawals increases with age. While the youngest (under 30) make withdrawals of cash almost 40% lower than the average, older people (60 and over) withdrawals are a 33.2% higher than the average (Figure 6a and 6b). Average card transactions follow a similar pattern but the differences from the average are smaller than in the case of the withdrawal of cash.

The above analysis shows that the younger generations have more preference for the use of credit cards, although this statement would be nuanced by some variables not considered such as income. Therefore, and structurally speaking, as the current older generations (more cash users) give way to new generations who prefer electronic means of payment, we get closer to a cashless economy in the long term.

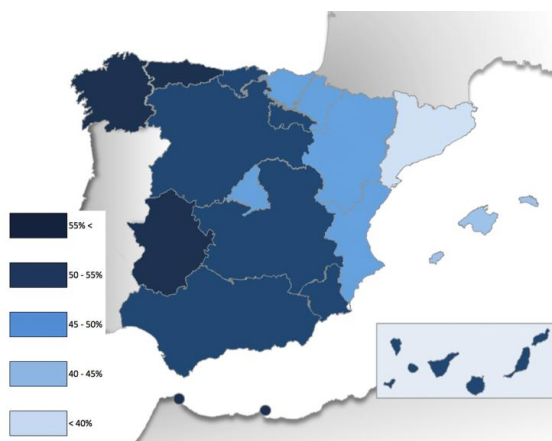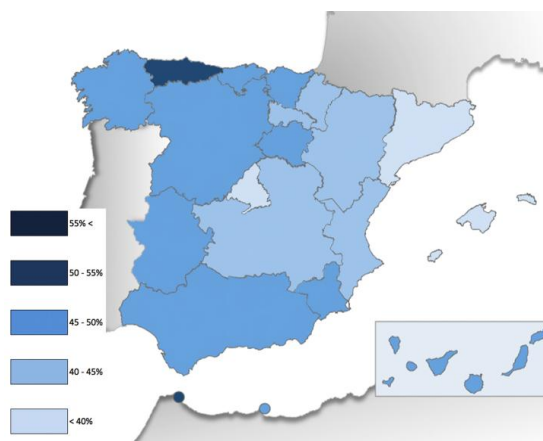| Figure 7a Use of cash withdrawals compared to card payments by region, value of transactions, 2015 Q1	Figure 7b: Use of cash withdrawals compared to card payments by region, value of transactions, 2018 Q1

Source: BBVA Research.

Source: BBVA Research.

In 2015 H1, in most regions the amount of cash withdrawals was higher than the amount paid with cards (figure 7a). Galicia, Asturias, Ceuta and Melilla were the territories with the highest importance of cash withdrawals. On the other hand, Catalonia, Balearic Islands and Madrid were the regions with the lowest ratio of cash withdrawals compared to card payments.

Only three years later (2018 H1), we observe that in the majority of regions consumers spend more money through card payments than what they withdraw from ATMs (figure 7b). The trend towards an increased importance of card payments is observed across the board, with the ranking of regions remaining unchanged. The differences observed across regions may probably be explained through similar factors to the ones observed for European countries (Section 5), e.g. regional differences in terms of ageing population, degree of digitalisation, the extent of the shadow economy and the income level, although we do not have access to regional data so as to check it.

In short, an analysis with micro data from BBVA clients confirms some of the trends identified at macro level: the use of cash is losing importance in relative trends, the age of population is positively correlated with the use of cash and fixed effects per region (or country when using macro data) remain significative over time.

7. Impact of new regulation and payment instruments on cash usage

During the last decade both regulatory changes and market innovation have caused important changes in the payment sector. These efforts have not been independent and innovation has frequently triggered new regulation and vice versa.

Undoubtedly the consecution of a Single Euro Payments Area (SEPA) has been the main payment harmonization project in Europe and one of the most relevant across the globe. The project was triggered by a regulation aimed at equalising the cost of national and cross-border transactions in euros across Europe (Regulation 260/2001). As banks felt compelled to go further to simply complying with this Regulation, they engaged in the development of new and harmonized pan-european payment schemes.

This project required the accommodation of the national payment laws to a common European rule, the original Payment Service Directive (PSD) (Directive 2007/64/EC). Finally, the SEPA schemes were imposed as the European payment standards by the SEPA Regulation (Regulation 260/2012).

In parallel, some countries have tried to discourage cash usage, either by eliminating the anonymity of some transactions, by removing the legal obligation to accept cash or by imposing limits on cash usage[15]. The latter measure was common for business-to-business transactions aimed at reducing tax evasion and hindering shadow economy or illicit activities. However, the European Commission has recently run a consultation to assess the convenience of harmonizing cash restrictions across Europe and it seems that the imposition of an European cap on cash has been discarded for the time being. On the other hand, other regulatory initiatives have preferred to encourage the use of electronic payment means without restricting the use of cash. One recent example of this is the proposal made by the Spanish government to introduce an obligation for businesses to have electronic payment methods for purchases over 30 Euros[16].

Further to these efforts, the recent launch of the SEPA Scheme of Instant Payments (SCTInst) and the entry into force of PSD2 will probably impact the use of cash in Europe in the near future.

SCTInst widens the range of payment services available to customers and offers an enhanced user experience thanks to the extended operating hours (24/7) and the faster settlement of transactions (10 seconds). The combination of this new payment service with the full adoption of PSD2 (Directive (EU) 2015/2366) is expected to boost the development of alternative payment methods, promote the overall security of payment services and harmonize usage rules across Europe. Nevertheless, a positive impact on the replacement of cash cannot be assumed, since new security requirements on some types of payments (e-commerce and contactless) could have a negative effect on some use cases.

In addition, commissions and fees are expected to experience a downward pressure due to the caps on fees already imposed by the cards Regulation (Regulation (EU) 2015/751) and the increased competition that PSD2 is expected to bring to the payments market. This could increase the willingness to offer electronic payment methods by those merchants currently reluctant to do so due to a perceived high cost of non-cash means of payments or lack of interest of their clients to use these methods.

15: For instance, in August 2007, the Portuguese government imposed a 3000€ limit on any cash transaction, a measure very criticised by the ECB.
16: http://www.mineco.gob.es/portal/site/mineco/menuitem.ac30f9268750bd56a0b0240e026041a0/?vgnextoid=43dd2aeb31373610VgnVCM1000001d04140aRCRD&vgnextchannel=2f0e154527515310VgnVCM1000001d04140aRCRD

Some clues on how these trends can impact the use of cash can be provided by the UK experience[17]. UK adopted contactless cards and Instant Payments (known as Faster Payments) in September 2007 and May 2008 respectively and since then both payment methods have evolved in terms of penetration and amount limits. In particular, the cap of these instruments has been raised as follows:

- Faster payments where launched in May 2008 with an upper limit of 10,000 GBP. In Sep 2010 once the industry and the market became confident with this payment instrument, the limit was raised to 100,000 GBP. Finally, in Nov 2015 the upper threshold was set at 250,000 GBP.

- When UK adopted contactless payments, they were capped at 20 GBP. In September 2015 the limit was raised to 30 GBP.

Once again, the UK has pioneered the Open Banking[18] trend with the launch of a wide-industry initiative in 2018. Although it is likely that this project also helps to reduce the use of cash, data on the initial impact on cash usage are not available yet. Nevertheless, taking into account that some of the biggest 9 banks have not met the project deadline and that it takes some time until customers get used to this kind of new functionalities, the impact of this ambitious project on cash usage will probably only be felt after some time.

Figure 8a Evolution of number of payments in UK (index = 100 in 2000)
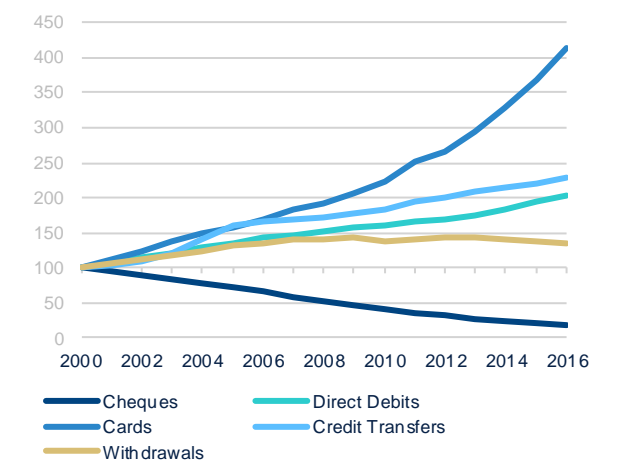
Source: ECB, Eurostat and BBVA Research

Figure 8b Evolution of value of payments in UK, inflation adjusted (index = 100 in 2000)
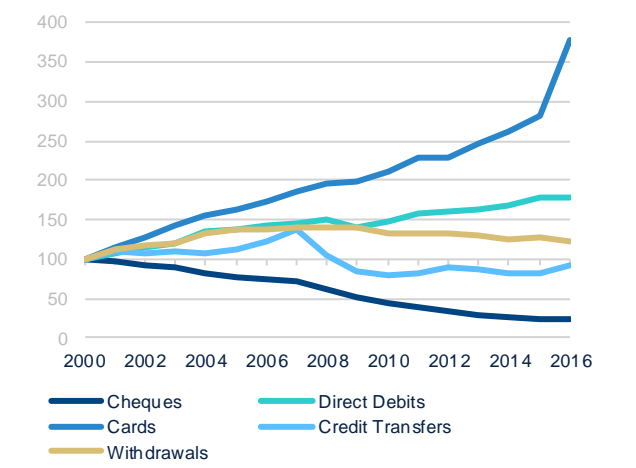
Source: ECB, Eurostat and BBVA Research

In order to assess the impact of these innovations introduced in the UK, we have analysed how the different payment methods have evolved over time (Figures 8a and 8b).We observed that the use of cheques has sunk since 2000 while cash withdrawals have slightly increased during the same period even in aggregated amount. Number of cards and credit transfers have also increased, but more significantly in the case of cards, which have risen steeply during the period and their use seems to have speeded up since contactless cards where launched.

Although the introduction of Faster Payments in 2008 has clearly improved the features of credit transfers, their steady growth rate in terms of number of payments is not comparable to that of credit cards. In fact, the total amount of credit transfers has decreased during this period, probably reflecting the impact of the Great Recession in business transactions (the reason for most of the high-value transfers) and the wider range of electronic payment means


17: For further details about the UK experience, see: http://www.businessinsider.com/the-uk-loves-contactless-payments-2017-9 and https://www.pymnts.com/cash/2017/united-kingdom-cash-usage/
18: Open Banking is a UK project promoted by the CMA and the UK Treasury that requires the 9 largest banks to develop PSD2-compliant APIs (Automated Programming Interfaces) so that third parties can access account holder data and/or initiate payments on their behalf. Although the scope of the project is different from that of the new Payment Services Directive - PSD2, Directive (EU) 2366/2015 -, in practice it can be considered an advanced application of the PSD2 in the UK. More information on this project is available at https://www.openbanking.org.uk/

available for retail purposes, including direct debits whose credit risk associated with their refund rights make them less attractive during economic downturns but are very convenient for recurrent payments.

To check if this increased adoption of electronic payments is specific for the UK and is caused by its unique position in payments innovation, we have compared the evolution of our cash usage indicator with that of Netherlands and Finland, which are countries similar to the UK in terms of economic indicators but different in terms of penetration of cards and instant payments, and with EU aggregates. Data indicate that the use of cash has declined across these three countries at a similar rate, slightly faster than in the aggregated EU (Figures 9a and 9b).

Figure 9a Withdrawals Index, number of transactions
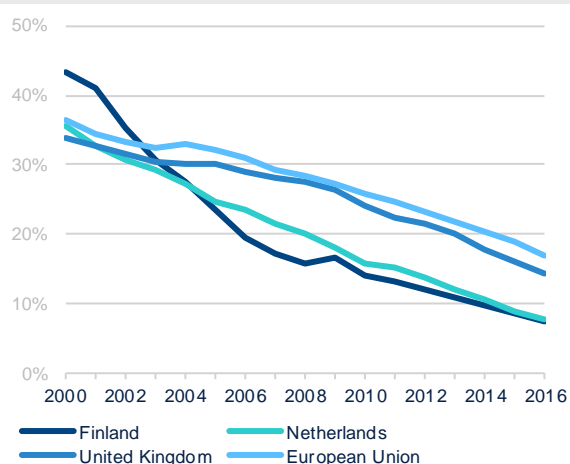
Source: ECB and BBVA Research

Figure 9b Withdrawals Index, value of transactions
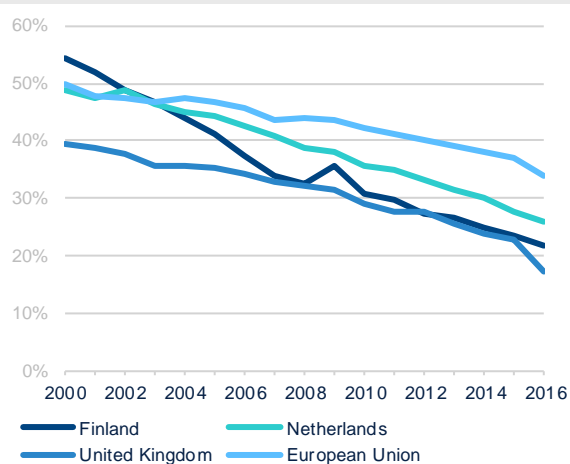
Source: ECB and BBVA Research

The only remarkable difference that can be observed appears in the last period assessed, when the use of cash in terms of value has decreased more significantly in the UK than in the other three countries, maybe because the increase of the contactless cap to 30 GBP has made them more convenient for consumers.

Out of this preliminary analysis, we can conclude that, although the range of payment instruments available in the UK has been wider than in most European countries during the last decade, available data does not confirm a better performance in cash displacement than in other comparable European countries or even than the EU average.

Unfortunately, the unavailability of payment statistics referring to London City only, does not allow us to assess if some major advancements such as the possibility to pay the fare of any public transport with any contactless payment card[19] could actually have a significant effect in cash displacement. However, this functionality is believed to have boosted contactless payment adoption in London, since it avoids using cash in one of the services that make users to carry some cash in their pockets.

9. Conclusions

Our analysis confirms the observed trend of a replacement of cash with electronic payment instruments for the last several years. This has been mainly driven, on the one hand, by an increased adoption of digital methods both by consumers and by retailers and, on the other, by the natural generation replacement (as the youngsters tend to adopt technological breakthrough earlier than the elderly). The evolution of regulation, which has led to the reduction in commissions and fees and has facilitated the adoption of innovative payment methods, has also contributed to the trend.

19: https://tfl.gov.uk/info-for/media/press-releases/2014/july/contactless-payments-set-to-launch

However, it seems quite unlikely that cash as a mean of payment will disappear or become marginal in the short or even medium term. This being said, unforeseen non-linearities in the variables or the advent of disruptive changes could accelerate the generalisation of means of payments alternative to cash.

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