LUISS Guido Carli

School of European Political Economy

CASH

Roberto Rinaldi

Working Paper

9/2019

Cash

Roberto Rinaldi

Head of the Directorate General for Currency Circulation and Accounting

Bank of Italy

May 24, 2019

Introduction[1]

The world of retail payments is changing rapidly. We observe app-based mobile payments, contactless and proximity transactions, digital wallet solutions, and payment initiation services. In the euro area instant payments, which can also be used for person-to-person payments via smartphone applications, are on the increase. The innovation in retail payments is spreading thanks to digitalization, to the activity of low-cost providers (such as financial technology companies) and of large internet platform companies (Google, Facebook, Amazon). Authorities endeavour to enhance these services and, in some cases, provide them directly in competition with the market when the latter does not work properly.[2]

In this new world the question arises as to what place cash will occupy in domestic and cross-border payments. Should we be anticipating its swift demise, leading it - in the not too distant future - to take its place among museum exhibits rather than in the pockets of our citizens? What is the role of the authorities in charge of regulation and supervision?

Any response to these questions must start from a fact: today, together with the diffusion of new payment instruments, in most industrial countries cash is increasing, both in absolute terms and relative to macroeconomic variables such as GDP or consumption. Section 1 provides a possible answer to these developments.

Section 2 discusses the issue of competition to cash from new payment tools. The competition is strengthening and takes different forms. I also report the European Central Bank (ECB) estimates of the share of total euro circulation that is held for transaction purposes: it is that share that *prima facie* is on the forefront of the competition. [3] Recently, more broadly, the interest in estimating the differently motivated portions of cash has grown.[4]

In Section 3, I start by considering whether a form of competition is arising from market-issued assets such as cryptocurrencies. Is this the case? That competition, if any, is in principle different from that launched by innovative payment tools. Cryptocurrencies are assets themselves as cash is (or for that matter, gold) in households' portfolios. There is however a strong argument against the very existence of competition: crypto-assets are not money but rather real assets, more akin to instruments such as gold or stocks. However there is at least one specific case where this is not the

---

1 This paper draws partly from speeches I gave at three events: Salone dei Pagamenti, Milan, November 2017; European Banking Conference, Milan, June 2018; Salone dei Pagamenti, Milan, November 2018. All the speeches are available on the website of the Bank of Italy. I wish to thank my colleagues Manuela Calderini, Riccardo De Bonis, Alessandra Sanelli e Ferdinando Sasso for their useful comments and contributions. I would also like to thank Riccardo De Bonis (Bank of Italy) and Professor Marcello Messori (LUISS University in Rome) for suggestions on the substance and structure of this paper. The views are my own and do not necessarily represent those of the Bank of Italy.

2 Mersch, Y. (2018), "Les paiements instantanés comme vecteur d'innovation dans les paiements", Paris, 15 February. Available at: https://www.ecb.europa.eu/press/key/date/2018/html/ecb.sp180215.fr.html.

3 Following Friedman (see reference below) it may not always be useful to draw distinctions between "motives" for holding cash. Cash is held for three main purposes (to make transactions, as a precaution, and as part of a portfolio) which may overlap. Drawing "lines" may not be fruitful; it may be appropriate to deal squarely with the "overall" demand for money. See M. Friedman (1956), 'The Quantity Theory of Money. A Restatement. Studies in the Quantity Theory of Money", The University of Chicago Press.

4 Bech, M. L., Faruqui, U., Ougaard, F., & Picillo, C. (2018). "Payments are a-changin' but cash still rules", *BIS Quarterly Review*, March 2018. Available at: https://www.bis.org/publ/qtrpdf/r_qt1803g.pdf.

case: it is when digital currency is directly issued by the central bank. In this context cryptocurrencies may lead, in extremes cases, to the physical disappearance of cash.

In Section 4, I deal with the Eurosystem's policy on cash. Is there a risk of a last ditch "defence" of banknotes, the traditional product of central banks, and could this have repercussions on efficiency? As we shall see, the Eurosystem policy on cash is a neutral one, i.e. the authorities let consumers choose the payment instrument they prefer for each transaction and, at the same time, the policy aims at enhancing the efficiency of the system through regulation, supervision and direct supply in the case of market failures.

We should however consider that supply is not "neutral": the banking system does play a role by influencing the cash cycle with the aim of cutting costs; governments can change the terms under which cash is used in transactions. Indeed, in the last few years an increasing number of EU member states introduced an upper limit to the value of payments in cash for each individual transaction. These policy measures aim at reducing tax evasion and also the financing of terrorism and money laundering, which are cash intensive activities. At the same time these measures limit the legal tender role of cash as enshrined in the Treaty on the Functioning of the European Union. The ECB suggests that these restrictions should be proportionate and effective. Lastly, in Section 5, I investigate the effects of such restrictions on the total amount of cash circulation and its composition by denomination. We finally observe that the literature concerning the effectiveness of quantitative restrictions to restrain illicit activities, in particular tax evasion, is ongoing; it is necessary to dig further into the subject to possibly get a fully fledged picture.

1. Cash and digital payments are both on the increase

We have observed over the last few years in most industrial countries two phenomena apparently in contrast to one another: a sustained growth of cash, higher than that of macro variables such as GDP and consumption; and a parallel increase in payments through instruments which are an alternative to cash (***Table 1; Figs. 1-2)***. [5] Between 2005 and 2017 the ratio of cash to GDP increased from 6.3 to 8.2 per cent in the United States, from 7.1 to 10.7 per cent in the euro area, and from 9.5 to 12.7 per cent in Switzerland. Sweden is an exception: the sharp rise in the use of non-cash alternatives (from 213 to 427 transactions per capita in 2005-17) was flanked by a drop in the ratio of currency in circulation to GDP, from 4.0 to 1.3 per cent.

[5] Jobst, C., H. Stix (2017), "Doomed to Disappear? The surprising return of cash across time and across countries", C.E.P.R. Discussion Papers. Available at: https://ideas.repec.org/p/cpr/ceprdp/12327.html

Table 1

Cash and non-cash alternatives

G12 countries	Currency in circulation/GDP			Number of transactions per capita using non-cash alternatives		
	2005	2017	Average change (%)	2005	2017	Average change (%)
Australia	4.4	4.5	0.3	225	497	6.8
Canada	3.7	4.3	1.4	244	367	3.6
Japan	16.7	20.4	1.7	34	88 (1)	19.3
Sweden	4.0	1.3	-8.8	213	427	8.5
Switzerland	9.5	12.7	2.6	140	244	8.5
UK	3.4	3.9 (2)	1.4	231	355	5.1
USA	6.3	8.2	2.3	297	421	4.0
Euro Area	7.1	10.7	3.5	166 (3)	215 (2)	3.4

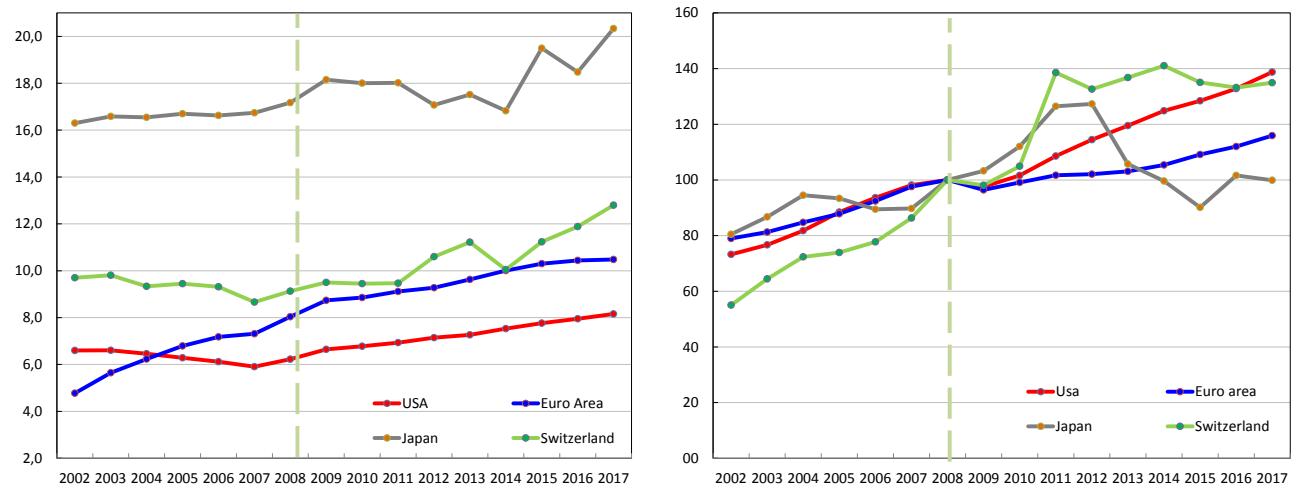
Sources: Red book (BIS) and ECB.
(1) The data refer to 2012. – (2) The data refer to 2006. – (3) The data refer to 2016.

Figure 1

International comparison of the ratio of currency in circulation to GDP

(a) Currency to GDP

(b) Index numbers relative to GDP *(base 2008)*

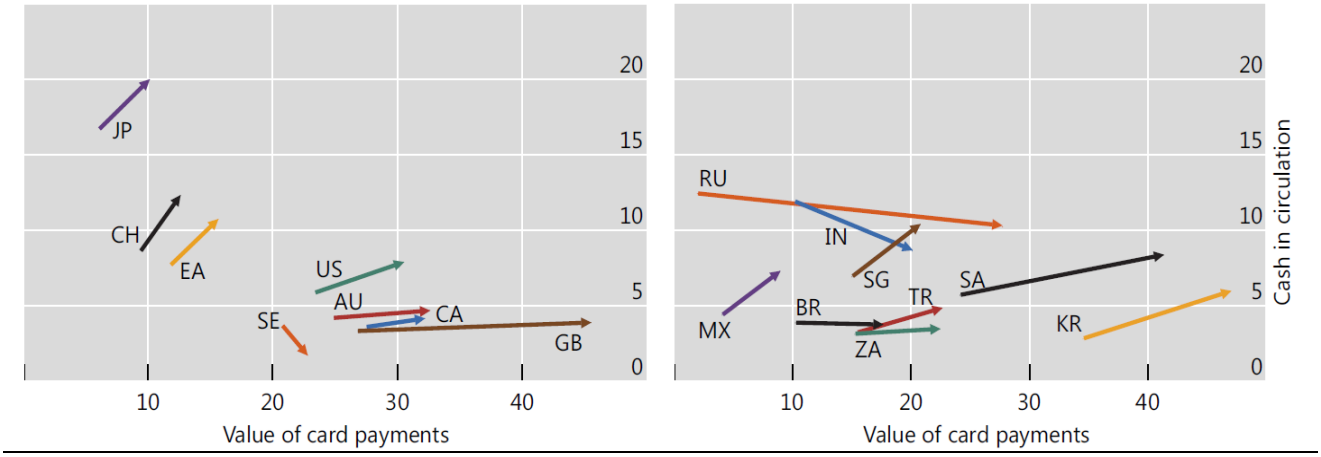


Source: Red book (BIS) and ECB; for 2017, provisional data.

Figure 2

The surprising resilience of cash: Growth of card payments along with cash

(2007–16 changes)



Source: Bech, M. L., Faruqui, U., Ougaar, F., & Picillo, C. (2018). "Payments are a-changin' but cash still rules", *BIS Quarterly Review,* March 2018, p. 68

The parallel increase of cash and alternatives is the result, on the one side, of the picking up of nominal demand from the trough in the aftermath of the Lehman crisis; on the other, interest rates have fallen to a persistently low level. Precautionary attitudes linked to financial crises and geopolitical tensions may have been contributory factors. For the euro, in relation to the Lehman Brothers' bankruptcy, in 2008 the Eurosystem's net issues rose by 13 per cent **(*Figure 3*)**; between 2009 and 2017, net issues recorded growth rates of around 4 per cent on average, with huge changes in conjunction with the 2010-2013 sovereign debt crisis.

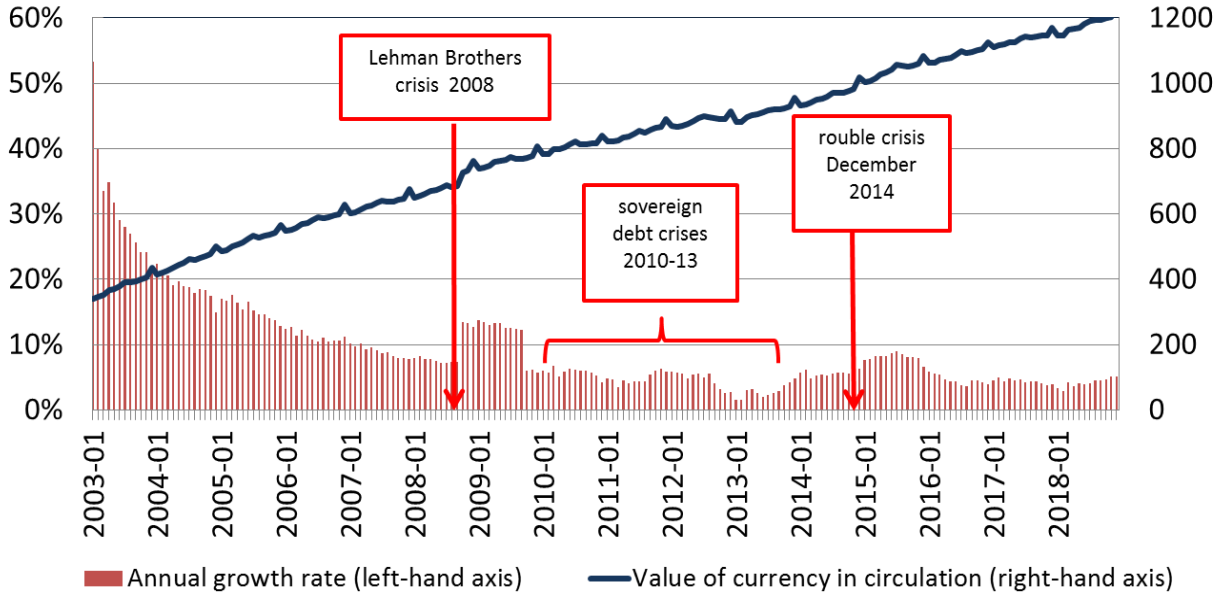
In the period under examination, we may wonder about the role of the shadow economy to foster demand for high denominations. What is available on the issue is that, notwithstanding the difficulties of measuring these transactions, in recent years there has been some evidence that an expansion of the shadow economy did not take place.[6] It is however important to highlight that the growth in cash has been driven by the larger denominations (***Figure* 4**).

[6] Medina, L., Schneider, F. (2017), "Shadow Economies around the World: New Results for 158 Countries over 1991-2015", Department of Economics, Johannes Kepler University, Linz.

Figure 3

Euro banknotes in circulation

(per cent; billions of euros)



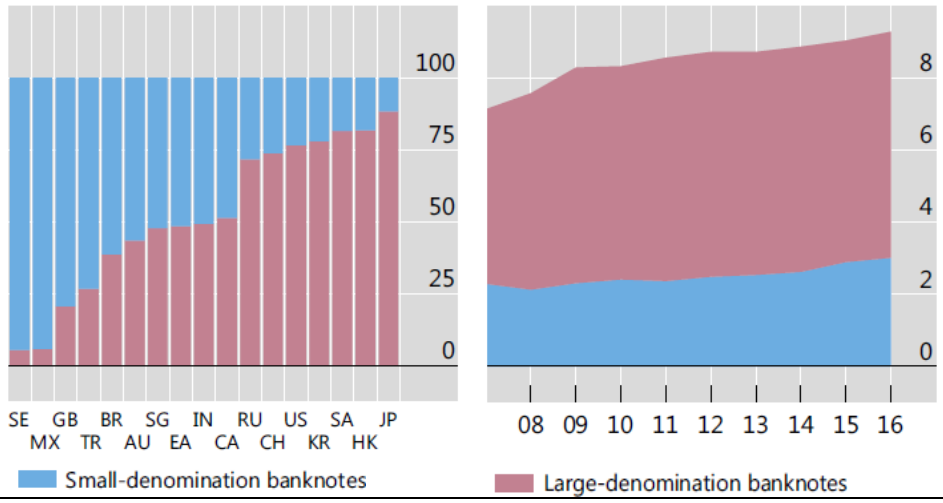
Source: ECB

Figure 4

International comparison: composition of cash circulation by denomination

a) Circulation composition *(2016; percentage shares)*

b) Trends 2007-2016 *(% GDP)*



Source: Bech, M. L., Faruqui, U., Ougaar, F., & Picillo, C. (2018). "Payments are a-changin' but cash still rules", *BIS Quarterly Review,* p. 74.

2. The replacement of cash with alternative payment instruments

Other things being equal (i.e. controlling for changes in macro variables and interest rates) there are clear signs that the substitution of cash for innovative tools has been under way for quite some time. We note however that the most evident pattern is that innovative payments have crowded out traditional non-cash instruments such as cheques (***Figure 5***).

The extent to which electronic payments have displaced cash is more difficult to quantify. Technically we would like to pin down the magnitude of the (negative) partial correlation between cash and non-cash usage. This is difficult since we need to disentangle empirically the marginal contributions of other contributing factors, controlling for changes in interest rates, in consumption, in foreign demand, etc. As we have seen, those factors may be at the root of the parallel growth of cash and innovative instruments.

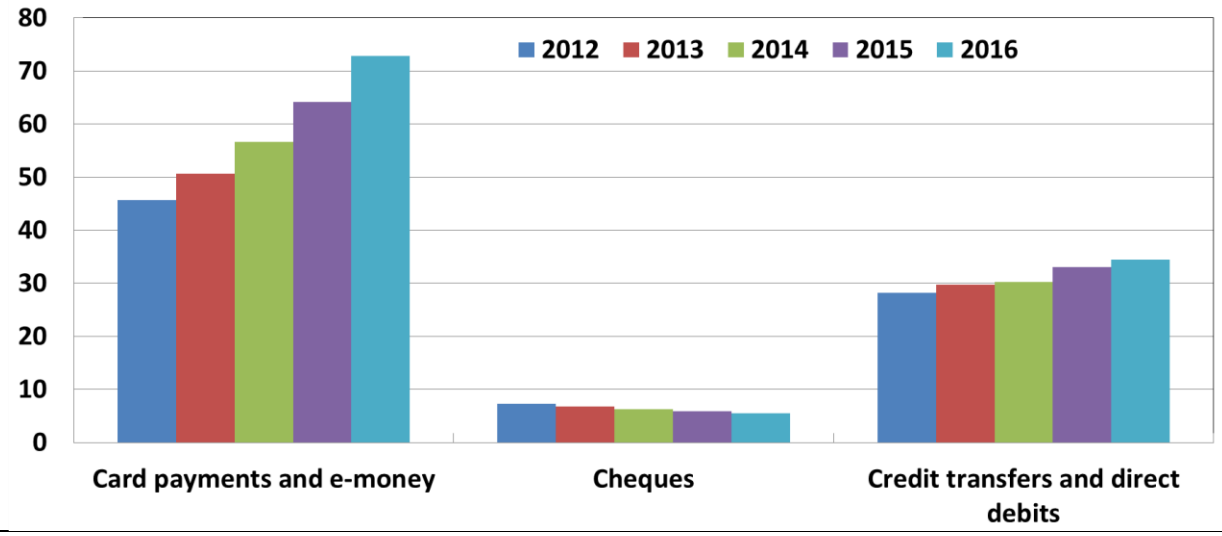
When we deal with competition in the payments system, we may first consider whether the competition/substitution concerns cash in the aggregate or the portion of it which is held specifically to carry out transactions. A comparison between overall stocks and the use of alternative payment instruments can indeed be misleading, especially for international currencies; for the latter it may be necessary to estimate solely the transaction component, subtracting the part held as a store of value.

In the case of the euro, the ECB has recently tackled this issue.[7] Two steps are envisaged. First, the balances in euros abroad, which are not generally held for spending purposes, are subtracted. Second, once the EU's internal currency estimate has been obtained, a division of the latter between the transaction and the non-transaction components can be made by means of cash cycle indicators, as quantified and monitored by the national central banks.

Figure 5

Replacement of cheques with card payments in advanced and emerging economies

(Number of payments per capita)



Source: BIS Red Book.

To carry out the first step, the ECB estimates the banknotes in circulation outside the euro area by using "net shipments", i.e. sales/purchases of euro banknotes to/by persons outside of the area on the part of financial institutions specialized in foreign exchange trading (***Figure 6***). The demand comes above all from eastern European countries and from Russia, but also from Switzerland and the United Kingdom and to a lesser extent from non-European countries. The financial crises and geopolitical tensions that have hit regions close to the area boosted demand, which increased up until mid-2015, while outflows were greatest at times of economic uncertainty and severe financial tensions. In 2016, inward flows of euro banknotes from abroad started to exceed outflows. This may

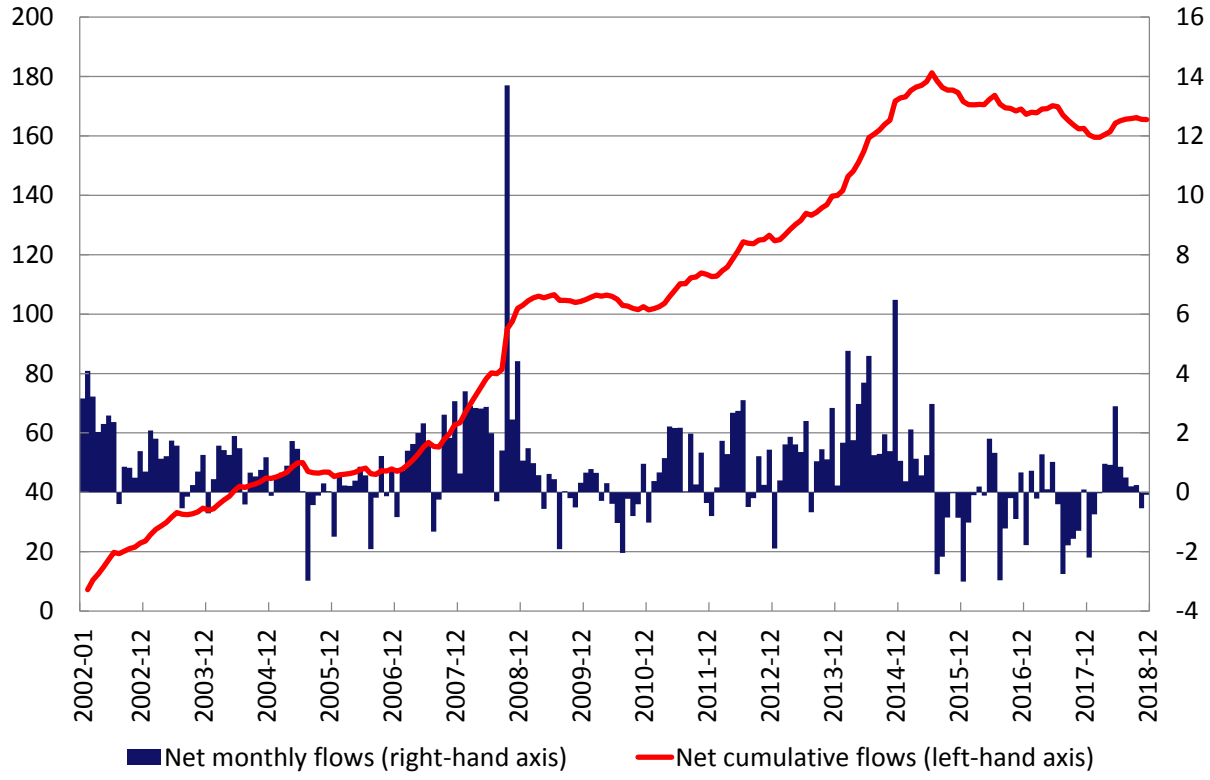
[7] European Central Bank (2017). "Estimation of euro currency in circulation outside the euro area", available at: https://www.ecb.europa.eu/pub/pdf/other/estimating_eur_in_circulation_outside_the_euro_area-201704.en.pdf.

have reflected the decline in demand associated with reduced uncertainty in neighbouring regions.[8] At the end of 2018, the stock of banknotes held outside the euro area, which had built up thanks to net shipments alone, amounted to €160 billion or 15 per cent of total issues. Net shipments allow a conservative estimate of banknotes outside the euro area since they do not include the flows associated with tourism and foreign remittances. To quantify the total net flows of banknotes outside the euro area, the ECB uses a second independent estimate by assuming that the internal circulation of banknotes maintains a stable proportion in relation to the circulation of coins, and is only marginally affected by migrations outside the area. The average of the two estimates of net shipments indicates that 400 billion euros (out of a total of 1.2 trillion euros) are held outside the euro area.

Figure 6

Net shipments of banknotes

(billions of euros)



Source: ECB.

To carry out the second step, of estimating the breakdown of internal circulation (800 billion) between the transaction component and that held as a store of value, the ECB uses methods that take account of the different characteristics of the denominations in the cash cycle. In this regard, indications are drawn from:

- the ratio between issues of individual denominations and GDP; in principle, a stable ratio indicates a strong link with transaction purposes (this is the case for €5 and €10 banknotes; ***Figure 7-a*)**, whereas an increase in the ratio could mean that the demand for a specific denomination at least partially reflects its use as a store of value (typically the large

[8] European Central Bank (2018), "The international role of the Euro", available at: https://www.ecb.europa.eu/pub/pdf/ire/ecb.ire201806.en.pdf

denominations from the €100 up) or that the denomination is a hybrid, and is used for both transactions and as a store of value (€50);

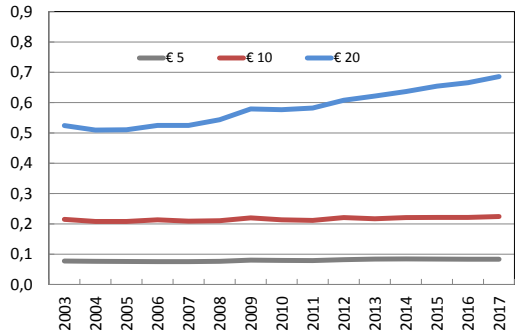
- the return rates, which indicate the average frequency with which the various denominations return to the central banks: under normal conditions it is higher for transaction denominations and lower for those typically used as a store of value (***Figure 7-b***). It should be noted that the return rate of various denominations fell considerably between 2010 and 2018. This depends first of all on the greater capacity of the private sector to recirculate banknotes without sending them back to the NCBs. This could partly reflect an increase in saving or even a slower rotation of the transaction stocks;
- the speed with which first series banknotes return, after the launch of the corresponding second series banknotes (***Figure 7-c***). The banknotes that tend to be returned more quickly to be replaced by second series ones are those for transaction purposes; in contrast, the replacement process is slower for banknotes held as a store of value and may even not take place for those held abroad.[9]

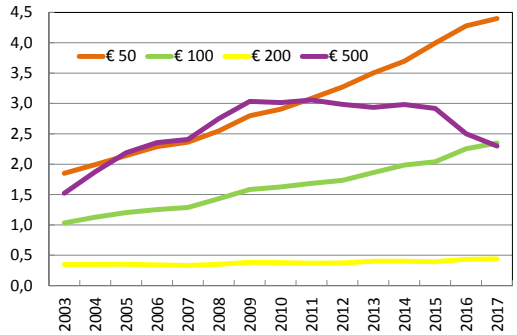
[9] The estimates based on the return of first series banknotes have some limitations. Each euro-area country has decided its issuance policy independently, namely whether or not to adopt a parallel reissuance (the central bank issues the second series of banknotes in parallel). Announcing the launch of the second series might have accelerated the return or the use of the banknotes, which would otherwise have been kept as a store of value. Finally, the minimum period after which a returned banknote can be defined as a store of value cannot be established precisely.

Figure 7

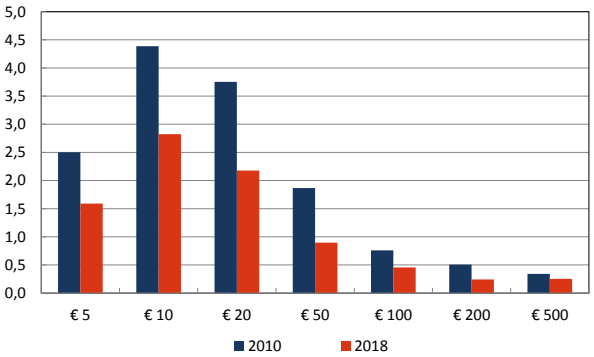
Cash indicators to estimate the transaction component of euro banknotes

(a) Circulation of currency/GDP by denomination
(percentage shares)

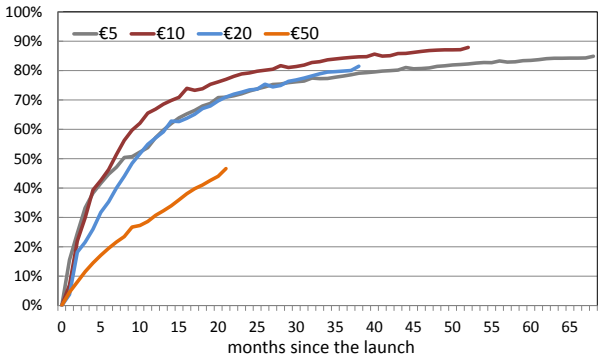




(b) Return frequency of banknotes in circulation (1)



(c) Saturation rate, second series (2)



Source: ECB.
1) The return frequency rate for each denomination is equal to the ratio between the number of banknotes returned to the NCBs each year and the average banknote circulation over the same period.
(2) The saturation rate for each denomination is equal to the ratio between the number of ES2 banknotes in circulation compared with the total banknote circulation (ES1 and ES2).

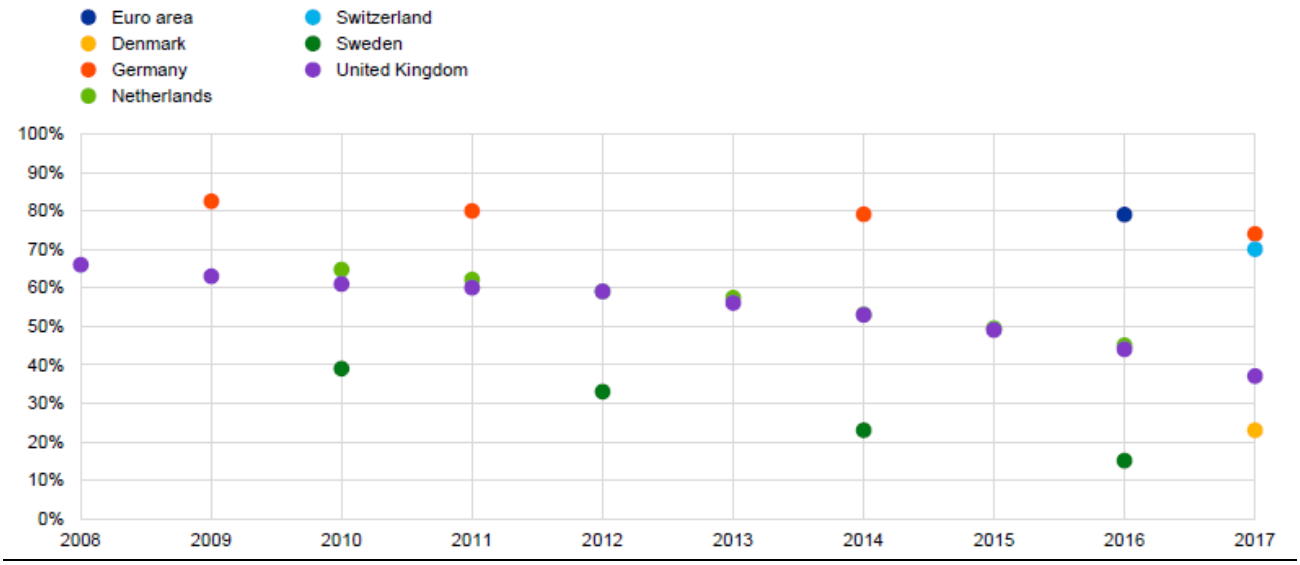
In light of these factors concerning the various denominations, the ECB estimates that about half of domestic" euros are held for transactional purposes (400 billion euros). These are approximate estimates but they do illustrate how, in the case of the euro, the share of banknotes kept and used to make transactions is relatively low, and in light of what the changes in rotation rates show, it could be still lower or, in any case, these notes could recirculate more slowly.

Once we have quantified the share of cash that directly feels the heat of competition from innovative payment instruments, we may find further clues on the actual substitution process in surveys on consumer habits in different countries (with a considerable time-lag unfortunately). These surveys have been conducted for several years in some countries, such as Germany and the USA, and make it possible to assess the changes in the use of cash over time. In other cases, this type of survey has been launched only recently; specifically for the euro area, a harmonized survey relating to the various member countries, was conducted in 2015-2016 (see Figure 8).

Figure 8

Cash transactions as a percentage of total transactions (1)

(percentage shares)



Source: ECB Economic Bulletin, Issue 6/2018.
(1) The surveys are based on various methodologies and scopes (they may only consider transactions at points of sale or consider all transactions).

The surveys show that:

- the number of payments made in cash varies considerably: in Germany and Switzerland the use of cash is widespread. In contrast, Sweden is close to being a cashless economy;
- in some countries, the drop in the number of cash purchases appears to be gradual (e.g. Germany) and suggests that despite competition from alternative instruments, cash may continue to play an important role for some time ahead. In other countries there has been instead a rapid decline in the use of cash, primarily, as mentioned, in Sweden,but also in the United Kingdom and the Netherlands (*see Figure 9*);[10]

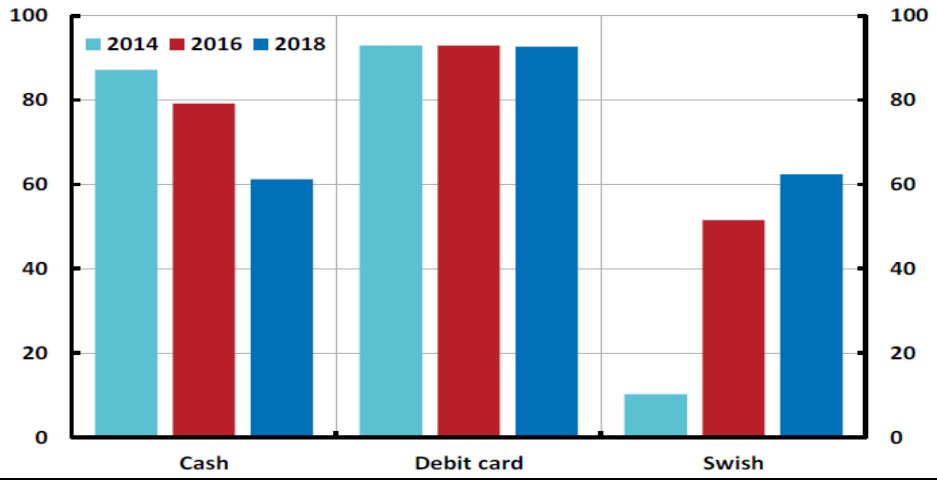
[10] Sveriges Riksbank (2017), "The Riksbank's e-krona project", Report 1, http://archive.riksbank.se/Documents/Rapporter/E- rona/2017/rapport_ekrona_170920_eng.pdf

Figure 9

Use of cash in transactions: Sweden

Which means of payment have you used in the past month?

(per cent)



Source: Sveriges Riksbank (2018a), 'Payment patterns in Sweden', Sveriges Riksbank, p. 3, May 2018

- in the United States, the number of consumer payments in cash increased after the 2008 crisis; it then decreased gradually between 2009 and 2014 and rose slightly in 2015, stabilizing in the years thereafter (***Figure 10)***. The Federal Reserve believes that innovation in retail payments translates into a broader range of payment options for consumers, who tend to use new instruments alongside traditional ones and modify their behaviour slowly;[11]
- the ECB's survey highlights that cash is the leading payment instrument (***Figure 11***): some 79 per cent of all transactions are made in cash, accounting for 54 per cent of total value. Payment cards are the second most frequently used instrument: 19 per cent (39 per cent of total value).[12] At points of sale, in 2016 there was a negative relationship between per capita card payments and use of cash (***Figure 12***);
- for Italy, the analyses carried out on ECB data suggest that cash is the instrument most used for payments at points of sale (86 per cent of transactions and 68 per cent of total value), although payment cards and alternative instruments would be preferred if people could choose payment methods with no constraints; the most frequently used instruments as an alternative to cash are payment cards, which were used to settle 13 per cent of transactions (29 per cent in value). Contactless technology is still not used much; the average value of transactions was €14 in cash and €38 for payment cards. The transactions considered in payment diaries are those at points of sale, which is why the amounts are low (90 per cent are for less than €40), and this could explain why cash is shown to be used more than other payment instruments; the choice of payment instrument is influenced more by the characteristics of the transaction than by socio-demographic factors: cash dominates low-value day-to-day payments.[13]

[11] Greene, C., Stavins, J (2018), 'The 2016 and 2017 Surveys of Consumer Payments Choice: Summary Results'. Federal Reserve Bank of Boston. Schuh, S. (2016) 'Consumer payment choice: a central bank perspective', Federal Reserve Bank Boston, Conference BAI-Payment Connect 2016, https://www.bostonfed.org/publications/cprc-presentations/2016/consumer-payment-choice-a-central-bank-perspective.aspx.

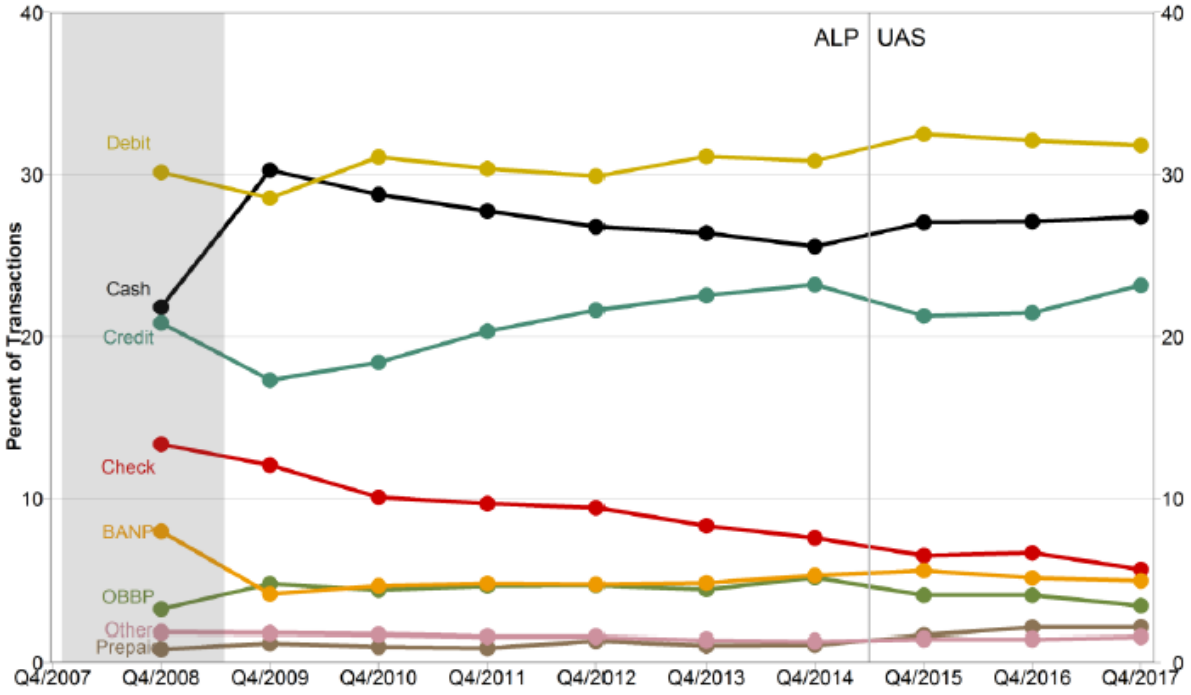
[12] Esselink, H., L. Hernández, L. (2017), 'The use of cash by households in the euro area', ECB Occasional Paper series 201/2017. Available at: http://www.ecb.europa.eu/pub/pdf/scpops/ecb.op201.en.pdf.

[13] Rocco, G., (2019), Questioni di Economia e Finanza (Occasional Papers) No. 481 – The use of cash in Italy: evidence from the ECB "Study on the Use of Cash by Households" (only in Italian).
Available at: http://www.bancaditalia.it/pubblicazioni/qef/2019-0481/QEF_481_19.pdf?language_id=1

Figure 10

Percentage of payments by type of instrument used in the United States (1)

(number of transactions)



Source: Stavins, Joanna, and Claire Greene. "The 2016 and 2017 Surveys of Consumer Payment Choice: Summary Results." (2018), p. 13, May 2018.

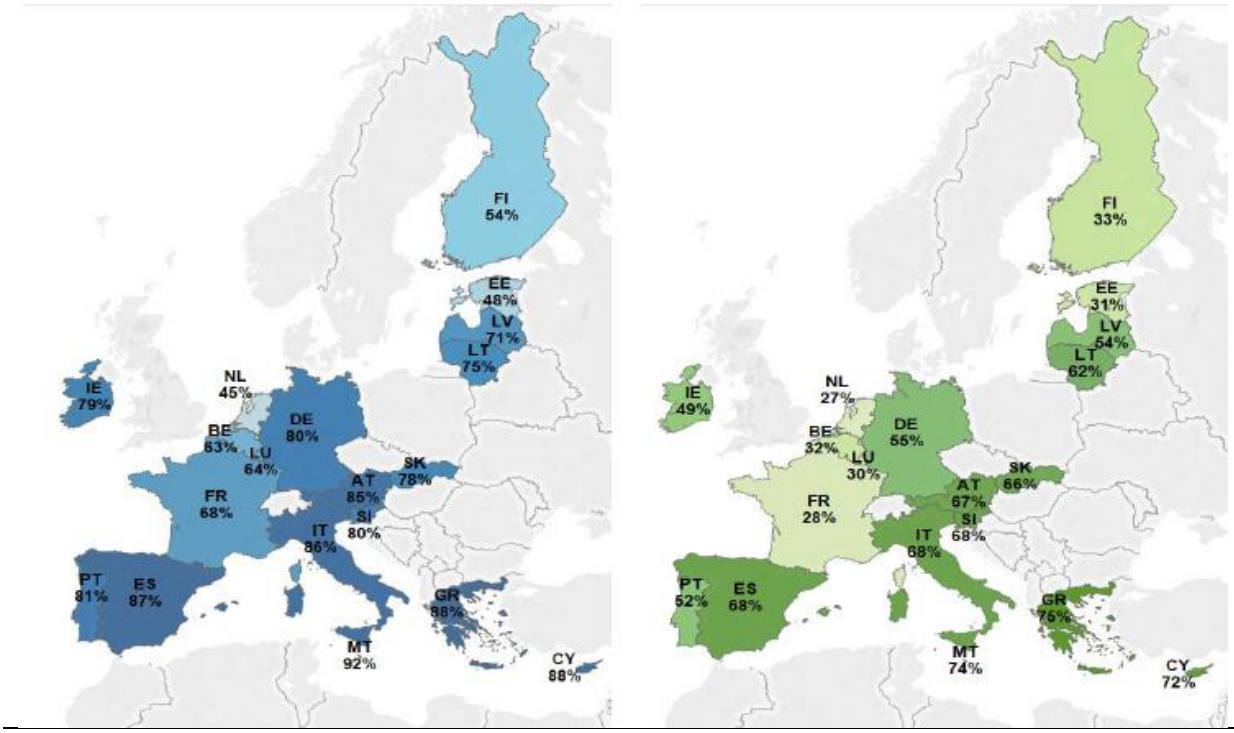
(1) The results from 2008 to 2014 are based on the American Life Panel (ALP); the results from 2015 to 2017 are based on the Understanding America Study (UAS) panel. OBBP stands for online banking bill payment; BANP stands for bank account number payment.

Figure 11

Use of cash at points of sale in the euro area (2015-2016)

Number of transactions

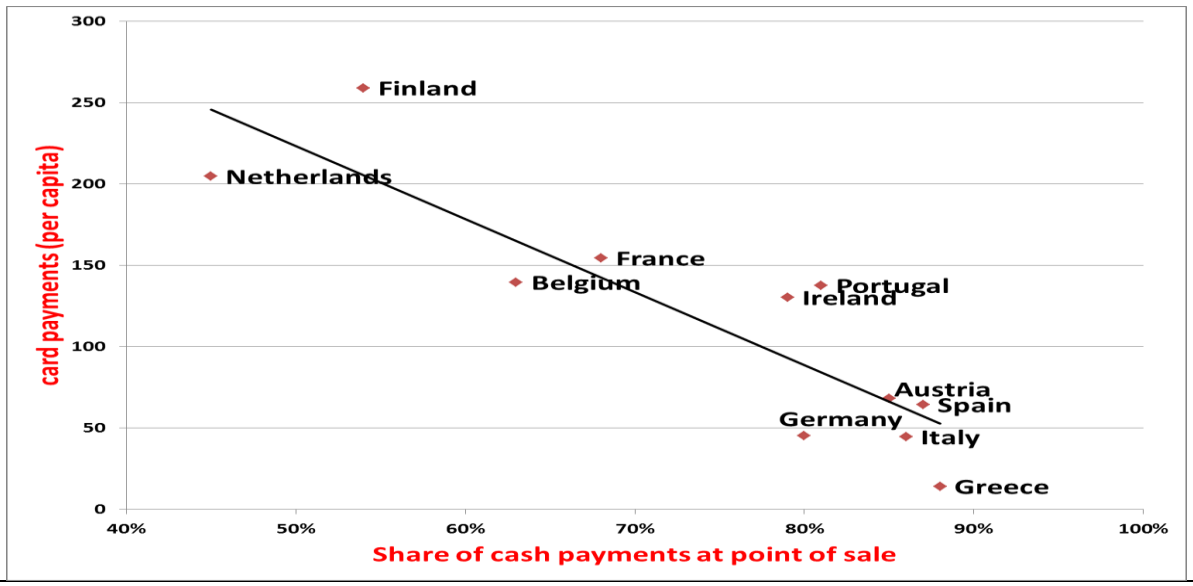
Value of transactions



Source: ECB, 'Study on the use of cash by households' (SUCH 2016)

Figure 12

Use of cash in transactions: euro area (2016)

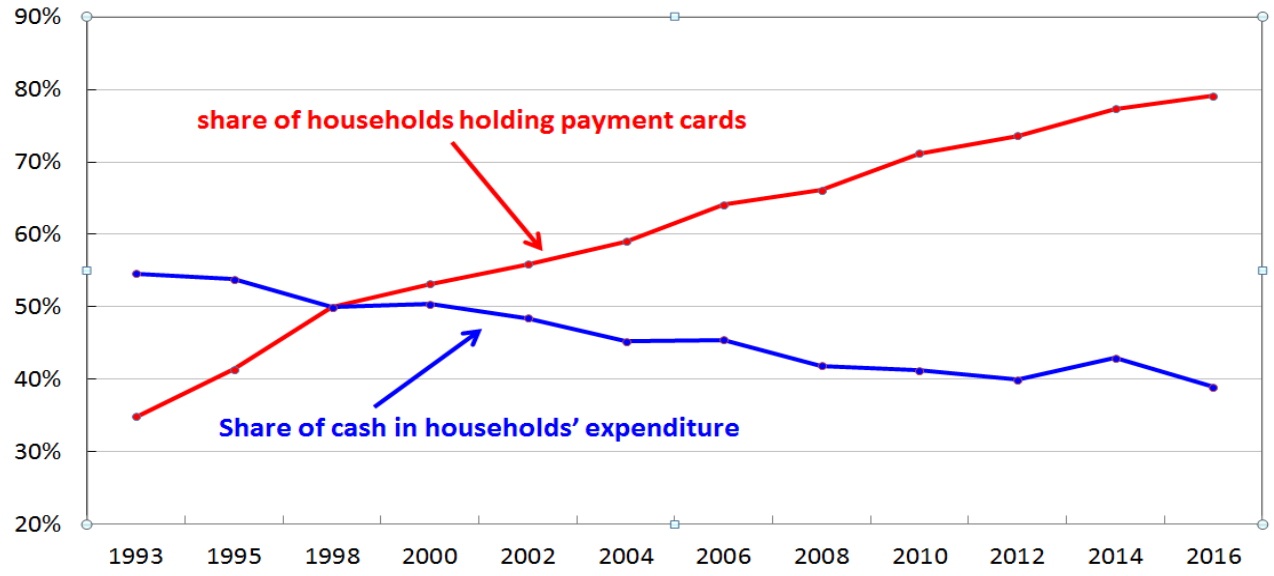


Source: our graphic based on data from ECB and Hesslink H., Hernandez L., ''*The use of cash by households in the euro area*'', ECB Occasional Paper No. 201, November 2017

- For Italy we have additional evidence from the domestic survey on household income and wealth which shows that the share of cash outlays in overall spending has decreased from 55 per cent in 1993 to about 40 per cent in 2016; the share of households holding payment cards increased from 35 to 80 per cent (***Figure 13***). [14]

Figure 13

Use of cash in transactions in Italy



Source: Bank of Italy surveys on Household Income and Wealth, 1993-2016

3. Cryptocurrencies: competitors to cash?

The innovations in payment instruments increase the efficiency and the speed of transfers of commercial bank money (***Table 2***). The underlying assets and liabilities do not change. To put it differently, these new instruments are spreading in an environment where, say, the narrow aggregate M1 is for the most part made up of the liabilities of two traditional agents: the Central Bank and the commercial banks exchanging at par their own transaction liabilities.[15]

In the last few years we have observed a change. The financial landscape has seen the creation of new assets (cryptocurrencies/crypto-assets) that use a specific kind of technology;[16] Cryptocurrencies, differently from other instruments, produce a change in the spectrum of assets available for portfolio choices. One question related to payments has arisen as to whether these assets compete with cash and the other payment instruments.

[14] For Italy information on the use of cash for payments has been collected since the end of the 1990s for the Bank of Italy's Survey on Household Income and Wealth, conducted every two years. The survey carried out by the ECB ('Study on the use of cash by households' - SUCH 2016*)* provided information enabling a more complete assessment of this phenomenon. The Bank of Italy and ISTAT are currently planning to collect data on the use of cash for payments through surveys conducted by ISTAT.

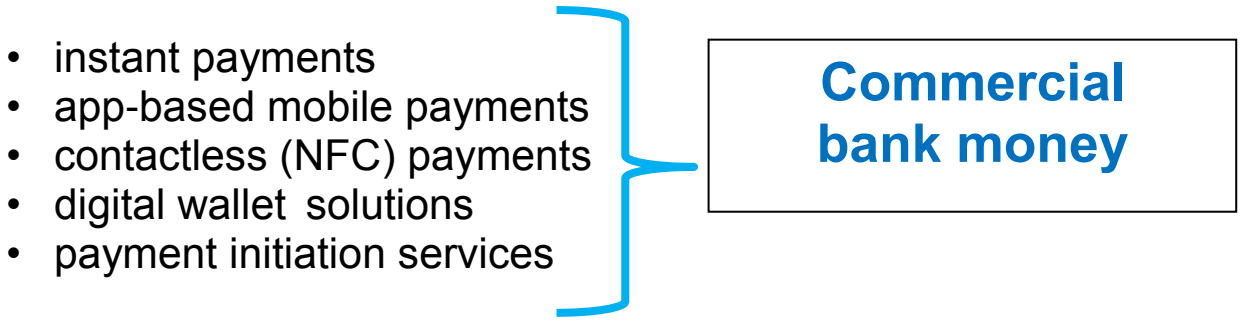
[15] There is an exception: 'electronic' money issued by non-bank financial institutions in a few countries have gained market share. According to BIS statistics on payments, they have reached 10 per cent of the total in some countries (CPMI - Red Book).

[16] It has been acknowledged that technological advances have the potential to increase the efficiency of the payment system as a whole. Visco, I. (2018), 'The Governor's Concluding Remarks', *Annual Report*, Bank of Italy, Rome 29 May.

There is consensus nowadays that they can be excluded from the range of innovations in the payment tools landscape: firstly, payment innovations hinge on the same underlying assets (deposits) while cryptocurrencies are a truly new asset; secondly, and more importantly, they do not fulfill the traditional functions of money.

Table 2

Payments instruments competitors to cash



'Crypto-assets' is the terminology produced by the Financial Stability Board (FSB) in lieu of 'crypto-currencies'. The FSB suggested the use of 'assets' instead of 'currencies' because it is clear that bitcoin and others new form of digital value do not efficiently or properly exert the basic functions of money. Other institutions share the same view. As reported by the ECB: 'virtual currency (VC) is not money or currency from a legal perspective', rather it is defined as a 'digital representation of value, not issued by a central banks, credit institution or e-money institution, …'.[17] Mersch writes: 'Do VCs herald a new world of money? No, virtual currencies are a misnomer in the first place. They are not money, nor will they become money in the foreseeable future. They lack the official recognition and backing of a public authority. Their market value is relatively small, the amount of money at risk in financial market infrastructures is insignificant and their ties to the real economy are still limited.'[18] The IMF, in the same way as the FSB, redefines cryptocurrencies as crypto-assets. In particular (see **Table 3-a**):

- as regards the unit of account function, the relative prices of crypto-assets are too volatile to establish a fairly stable reference value; their value is not linked to the value of central bank money. There is no institution, except the central bank itself, capable of guaranteeing their 1:1 convertibility into base money.
- concerning the function of medium of exchange, crypto-assets are by far inferior to existing payment options. Around 0.2 million bitcoin transactions are carried out globally on a daily basis, compared to 330 million retail payments in the euro area alone. Transactions are slow and expensive: they generally call for confirmation from 6 'bitcoin miners' which may require an hour, or even longer, due to network congestion; the cost of Bitcoin payments reached 25 euros in December 2017, in comparison with 0.2 euro cents and a maximum of ten seconds for each transaction on the TARGET Instant Payment Settlement (TIPS)

[17] European Central Bank (2015), "Virtual currency schemes – a further analysis", February. Available at: https://www.ecb.europa.eu/pub/pdf/other/virtualcurrencyschemesen.pdf.

[18] Mersch, Y. (2018), 'Virtual currencies ante portas', Speech at the 39th meeting of the Governor's Club, Bodrum Turkey, 14 May, in ECB Speeches.

service. Bitcoins are also expensive in terms of their environmental impact due to the electricity consumption required for their creation and transfer;

- as regards the store of value function, due to the volatility of these assets, households cannot rely on them as a stable store of value to optimize their spending over time by saving[19].

A different set of issues emerges when considering the case of digital currencies issued by the central banks. Indeed the opportunities opened by technological innovation have pushed academia and the central banks to consider the pros and cons of issuing a digital currency (central bank digital currency; CBDC).[20]

Table 3-a

Cryptos do not perform the functions of money

- **STORE OF VALUE:** high volatility means that they cannot represent a stable store of value; demand is predominantly driven by speculative motives
- **MEDIUM OF EXCHANGE:** low speed and high costs in terms of fees and electricity consumption;
- **UNIT OF ACCOUNT**: High volatility; not convertible at par with money

[19] Cochrane, J. (2017). Available at: https://johnhcochrane.blogspot.com/2017/11/bitcoin-and-bubbles.html, (2018), 'Basecoin'. Available at: https://johnhcochrane.blogspot.com/2018/04/basecoin.html.

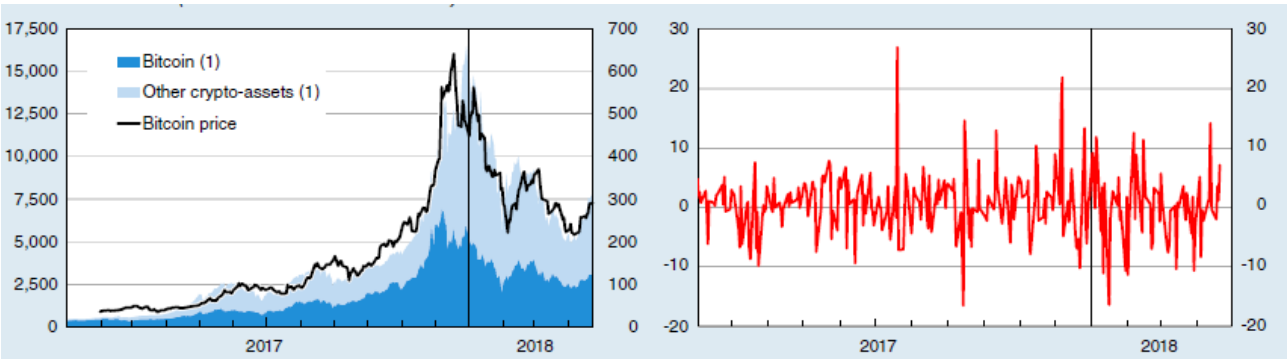
[20] Panetta, F.(2018), '21st century cash: Central banking, technological innovation and digital currencies', Bocconi University, Milan, 7 June; Sveriges Riksbank (2017), 'The Riksbank's e-krona project', Report 1, Available at: http://archive.riksbank.se/Documents/Rapporter/E- rona/2017/rapport_ekrona_170920_eng.pdf.

Figure 14

Volatility of Bitcoin

(a) Value of the crypto-assets market
(euros and billions of euros)

(b) Daily changes in the price of Bitcoin
(per cent)



1) Right-hand scale

Sources: based on Bank of Italy and CoinMarketCao data.

Table 3-b

Authorities' definitions of crypto-assets

ECB	'**Digital representation of value**, not issued by a central bank, credit institution or e-money institution…'(1)
BIS	'**Assets** with their value determined by supply and demand, similar in concept to commodities such as gold. However, in contrast to commodities, they have zero intrinsic value. Unlike traditional electronic money, they are not the liability of any individual or institution …..'

(1) From: BIS 'Digital currencies', November 2015

Central banks already provide digital money in the form of reserves or settlement account balances held by commercial banks. In principle central banks may provide digital money in different forms: individual accounts, tokens of stored value; wholesale tokens (***Table 4***). Depending on these forms, several options as a payment instrument are feasible for CBDCs: 24/7 availability, peer-to-peer management,for example. CBDCs could be used for remote payments and for e-commerce transactions. As a central bank liability, in principle a CBDC would not be exposed to credit risk and would represent a convenient store of value. In the case of CBDCs, the traditional functions of money obviously emerge; indeed they have features which make them a powerful competitor to both cash and bank transaction deposits.

Table 4

Central bank digital currencies: possible features

	Existing central bank money		Central bank digital currencies		
	Cash	Reserves and settlement balances	General purpose token	accounts	Wholesale only token
24/7/365 availability	yes	no	yes	possible	possible
Anonymity vis-a-vis central bank	yes	no	possible	no	possible
Peer-to-peer transfer	yes	no	yes	no	possible
Interest bearing	no	possible	possible	possible	possible
Limits or caps	no	no	possible	possible	possible

We should be aware that the provision of a CBDC has the potential to profoundly change the structure of the financial system. In particular CBDCs challenge the traditional role played by commercial banks in money creation. The likely substitution of bank deposits for CBDCs (presumably complete substitution in the long run and partial in the short run) would probably result in a contraction of the deposit base (***Table 5***). Banks may either accept a reduction of their role in financial intermediation or endeavour to expand longer-term liabilities, limiting maturity transformation. They might evolve towards 'narrow banks'. In bad times (and in the transitional period) the general public might convert (what is left of) its bank deposits into a CBDC in a sudden 'flight to safety', thereby reducing banks liquidity abruptly.

The question whether such possible events reinforce or weaken the financial system that has a CBDC is an open issue. It is a very important question and there are analyses under way at many central banks in an attempt to find an answer. We note however that central banks across the globe are very prudent from an operational viewpoint and indeed only a very few of them (in smaller countries) are pushing openly in that direction. [21]

[21] Barontini, C. and Holden, H. (2019), 'Proceeding with caution – a survey on central bank digital currency', in BIS Papers No 101. Available at: **https://www.bis.org/publ/bppdf/bispap101.pdf .**

Table 5

The impact of a Central Bank Digital Currency on the balance sheets of households, banks and the Central Bank

Households			
Banknotes	-	Personal loans	
CB digital currency	+	Mortgages	
Deposits	-		
MM fund shares			
Gov. Bonds			
Banks			
CB reserves	-	Deposits	-
Loans mortgages	-	MM instruments	
Bonds		Bank bonds	
		CB credit facilities	
Central Bank			
CB credit facilities		Banknotes	-
Bonds		**CB digital currency**	+
		CB Reserves	-

4. The policy of the Eurosystem

The Bank of Italy produces and distributes banknotes according to the rules established at Eurosystem level (Appendix 1 illustrates how the production of euros is distributed among national central banks). This shared framework is based on a strategy for all retail payments - for banknotes as well as for innovative tools. There must not be fragmentation of the policy on the basis of the means of payment chosen. A common strategy is also necessary to allow for the margin of the (negative) substitution between cash and innovative retail payments.

The Eurosystem has laid the foundations for the reliable and efficient delivery of cash and alternative instruments. Regarding cash, the Eurosystem is committed, both under normal conditions and in times of crisis, to meeting the demand for banknotes using efficient and reliable processes; the costs must ultimately be in line with those of the market. Euro banknotes must score highly in terms of quality and security, incorporating increasingly sophisticated technological features. The objectives of quality and security are also pursued through a detailed set of checks on the processes employed by banks and companies specializing in cash handling and also through periodic surveys of the quality of the banknotes in circulation in the various countries. The fight against counterfeiting is carried out through training and information campaigns aimed at the general public, professional operators and by means of advanced IT monitoring systems, in collaboration with the other national and supranational institutions involved.

In a recent criticism of the positions that, at their most extreme, would like to abolish cash, especially through legislation (i.e. through governmental restrictions; see below), Yves Mersch of

the ECB's Executive Board summarized the Eurosystem's policy on retail payments as follows: 'The ECB will continue to provide banknotes. We will also facilitate the further development of an integrated, innovative, and competitive market for retail payment solutions in the eurozone. If, one day, cash is replaced by electronic means of payments, that decision should reflect the will of the people, not the force of lobby groups'.[22] The Eurosystem's stance on the choice of payment instruments is therefore a neutral (demand determined) one: it is up to the consumers to decide.

Paying attention to efficiency must take into account not only private costs but also those incurred by the community. For cash, specifically, these costs are barely perceived at all, but nonetheless they are not negligible. A Eurosystem survey[23] in 2012 highlighted that:

- the social costs connected with using the various payment means were about 1 per cent of GDP (both for Italy and the euro area); approximately half of that cost comes from cash (0.40 per cent); in Italy it is estimated to be higher due to the greater use of cash (0.52 per cent);
- comparing the social costs to the number of cash transactions showed that cash is the most economical means of payment, but in relation to the value of those transactions, it is the most expensive solution;
- variable costs prevail for cash while for debit and credit cards the fixed costs of card issue and infrastructure management are greater; therefore, cards offer the greatest opportunities for exploiting ample economies of scale.

So cash has a high social cost that users are unaware of but it can be advantageous for low-value retail transactions. Cash can still be among the options because it remains a reliable instrument for low-value transactions; it is the instrument that guarantees financial inclusion for people without bank accounts and those who are not digitally literate; it sets service standards (ease of use, immediate payment finality, no user charges) that the various alternative schemes (instant payment services, for example) must emulate, thus increasing the level of competition in the payment services market to the benefit of users; it can be used as an instrument of last resort to respond to operational risks; it does not expose the holder to credit risks; and economic operators must be able to use cash in phases of uncertainty.

However, development and innovation in the field of alternative instruments, mainly thanks to economies of scale, are increasing the digital literacy of the population and progressively lowering the threshold below which cash is the better option.

5. **Quantitative restrictions.**

When dealing with policy, we should underline that the payments landscape in Europe has been increasingly influenced by laws that put restrictions on the use of cash. In Italy a tough restriction was set at the end of 2011 (a ban on cash payments of more than €1,000, which was then raised to €3,000 at the beginning of 2016). Even though these restrictions are at odds with the legal tender status of cash - as established in the Treaty on the Functioning of the European Union, under Article

[22] Mersch, Yves, 'Why Europe still needs cash'. Contribution to *Project Syndicate* by Yves Mersch, Member of the Executive Board of the ECB – 28 April 2017.
Available at: https://www.ecb.europa.eu/press/key/date/2017/html/ecb.sp170428.en.html.

[23] Schmiedel, H., Kostova, G., Ruttenberg, W. (2012). 'The social and private costs of retail payment instruments. A Europeran perspective'. Available at: https://www.ecb.europa.eu/pub/pdf/scpops/ecbocp137.pdf.

128(1), these administrative measures are spreading; notable exceptions are Germany, the Netherlands and the UK.

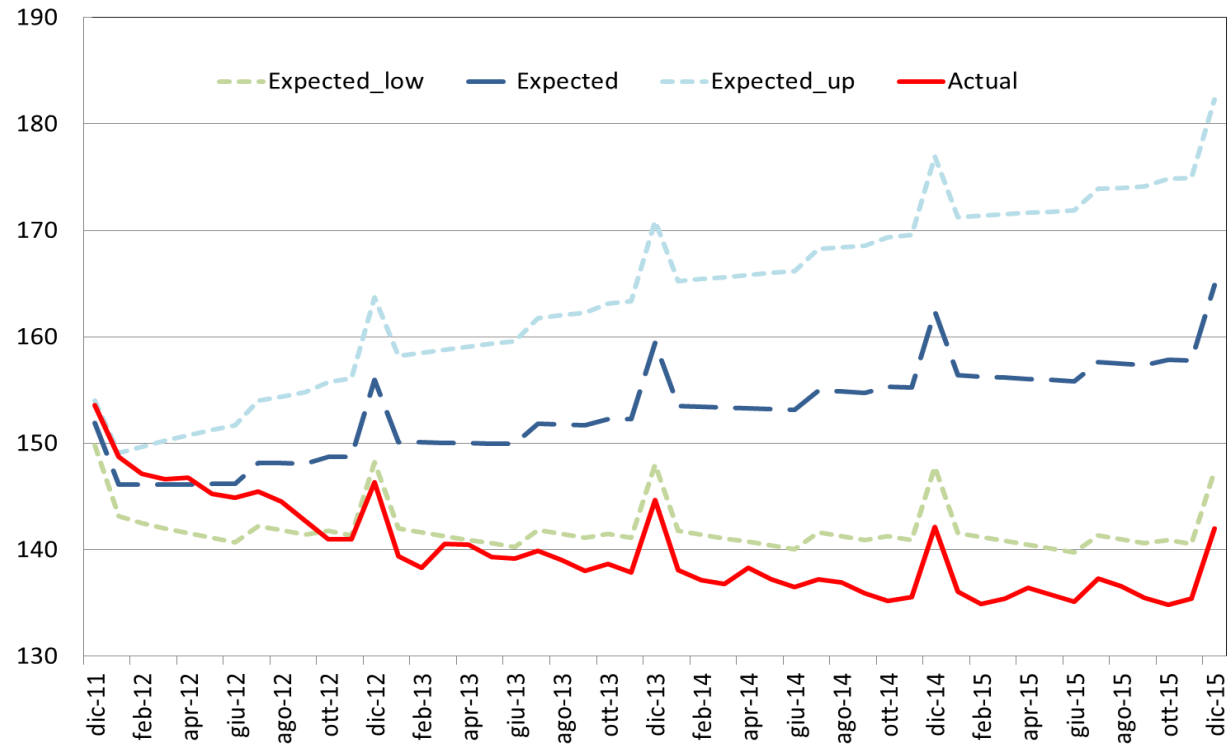
This policy tool aims to reduce tax evasion, combat the financing of terrorism, and reduce money laundering. Since administrative measures have a cost, it is important to evaluate their effectiveness in relation to the stated objectives. The task is not an easy one and it may be useful to summarize the state of the art on the subject.

First, it seems natural to evaluate the effects of the restrictions on the stock of currency and on its composition in terms of denominations. The evidence is clear on this: In Italy the limit of €1,000 has been effective in reducing the stock of cash in the economy with respect to the level that presumably it would have been otherwise: on the basis of a simple autoregressive equation estimated up to November 2011, at the end of 2015, before the raising of the limit, the forecast was greater than the actual value by approximatively 16 per cent (€25 billion; ***Figure 15***); at least €10 billion of which relate to the €500 banknote (***Figure 16***). The Bank of Italy withdrew more €500 and €100 notes (***Figure 17***). The smaller denominations, in particular the €50 note, accelerated but did not fully compensate the fall in use of the highest denominations.

Limiting cash use to low values such as the €1,000 threshold in Italy, seems therefore to have been effective in restricting the growth of cash and directing it toward smaller denominations.

Figure 15

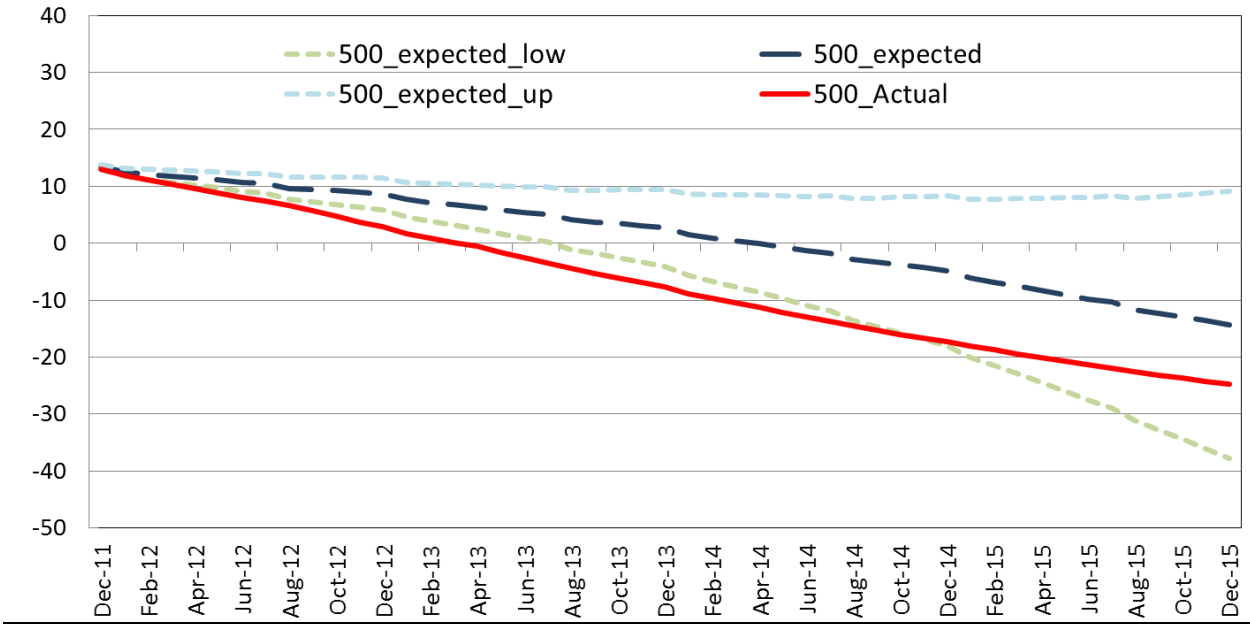
Forecast for circulation in Italy over 2012-2015
(reduction of limit from €2,500 to €1,000 as of 7 Dec. 2011)
(EUR billions)



Source: BdI, own calculations.

Figure 16

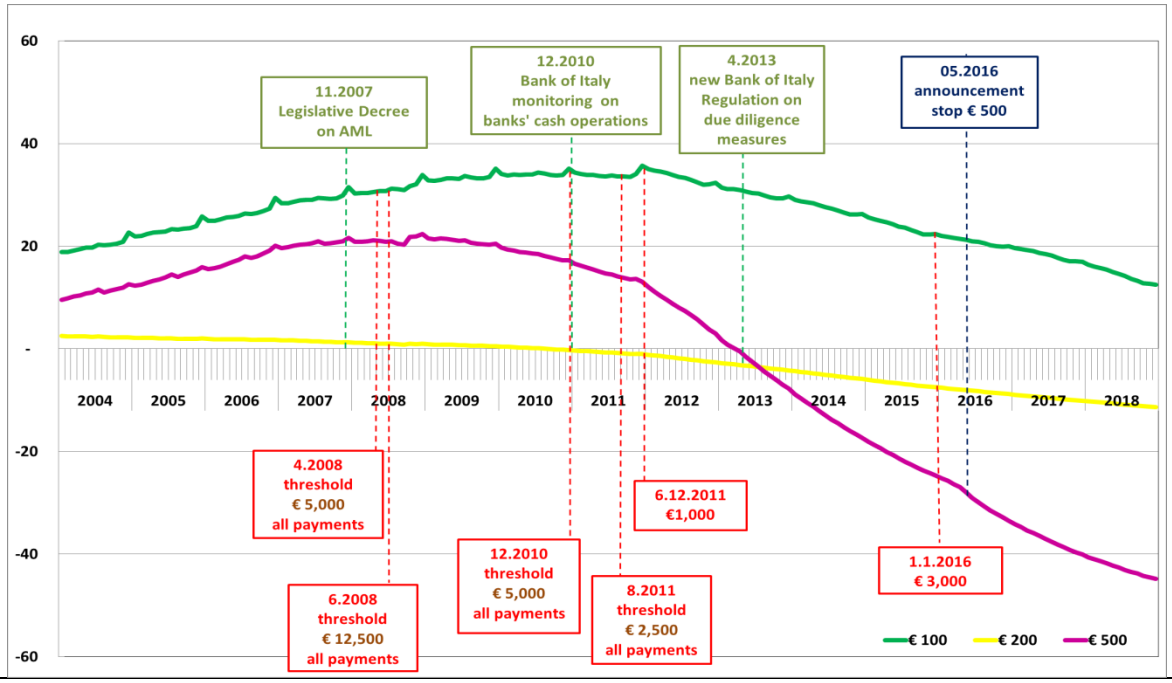
Forecast for the €500 in Italy over 2012-2015
(reduction of limit from €2,500 to €1,000 as of 7 Dec. 2011)
(EUR billions)



Source: BdI; own calculations.

Figure 17

Cash circulation, cash limits and AML regulations in italy
(EUR billions)



Source: *BdI our elaboration.*

Second, and crucially, it is necessary to evaluate whether the changes in the amount of cash and in its composition in terms of denominations do affect the targets of the restrictions (lower tax evasion, combatting the financing of terrorism and reducing money laundering). This link (between cash and illicit activities) is much harder to investigate and research has not yet reached a final result. We can

however indicate at least one factor which we deem crucial for further analysis: we are not interested in the causal link from illicit activities to cash. Illicit activities are cash intensive, although even legal activities have a different cash intensity. We are rather interested in the reversed causal link: from cash (restrictions) to illicit activities.

In the literature there are studies that do tackle this issue.[24] On tax evasion, in particular, interesting results have been obtained in two recent papers by Immordino and Russo (2018-a; 2018-b).[25] Research is ongoing; it is necessary to continue to dig into the subject to possibly get to a fully fledged picture.

Conclusions

Cash is increasing in relation to macroeconomic variables such as GDP and consumption; this takes place alongside the spread of innovative paperless instruments. I argue that this is not a puzzle since it can be traced back to the macroeconomic determinants of the demand for money: higher nominal demand in recent years following the slump in aggregate demand after the Lehman crisis and lower nominal interest rates.

Competition from innovative instruments is intense; so far it has had limited impact on cash holdings because it did not reach those segments of the payments market characterized by low value transactions; the spread of instant payments may indeed get to those markets, thus setting the stage for the competition that 'counts'. In any case that competition involves, for the euro, approximatively one third of the total stock (i.e €400 billion); the remaining part, a huge part, is held for portfolio purposes.

Crypto-assets are not money. They have financial characteristics that make them more akin to real assets such as gold or financial assets such as stocks. As such they are not a competitor as a payment instrument.

The Eurosystem's policy is a neutral one with respect to the different means of payment; in principle consumers may choose independently according to which they consider is best for them. Therefore demand will determine the proportions of the various instruments used, with values that may even be nil for some. On the supply side, the authorities do not directly provide payment tools as an alternative to cash under normal circumstances (no market failures). Instead they usually

---

[24] Centre for European Policy Studies (CEPS) (2017), 'Study on an EU initiative for a restriction on payments in cash'. Available at: https://ec.europa.eu/info/sites/info/files/economy-finance/final_report_study_on_an_eu_initative_ecorys_180206.pdf and European Commission (2018), 'Report from the Commission to European Parliament and the Council on restrictions on payments in cash'. Available at: https://ec.europa.eu/transparency/regdoc/rep/1/2018/EN/COM-2018-483-F1-EN-MAIN-PART-1.PDF . According to the study, quantitative restrictions are particularly effective in reducing money laundering, especially since the latter often takes place through purchases of high-value goods.

[25] Immordino, G. and Russo F. F. (2018-a), 'Cashless payment and tax evasion'. *European Journal of Political Economy*, 55, pp. 36-43. Immordino, G. and Russo, F. F. (2018-b**)**, 'Fighting Tax Evasion by Discouraging the Use of Cash', *in FISCAL STUDIES*, vol. 39, no.2, pp.343-364. The first paper contains an econometric analysis applied to EU countries and finds that a boost to the use of cards would reduce the VAT gap (the difference between the evasion-free VAT and actual VAT, an indicator estimated by CASE and CPB for the European Commission; see the references in their papers. In the second paper, based on a theoretical model, they also argue that it might be more efficient from a policy viewpoint not to tax/subsidise cash or cards but to act directly on the incentive for taxpayers to ask for a receipt when purchasing goods or services. However, these authors acknowledge that measures of this kind have a significant revenue cost for the government, especially in countries where tax evasion is low (since in these countries the possible revenue gains arising from the reduction of tax evasion are not sufficient to compensate for the revenue arising from the tax rebate).

intervene to ensure that competitive prices are offered for the different means of payments, that the market is transparent and integrated, including across borders; and that no disruption occurs.

One of the objectives of the Eurosystem is to combat the use of cash for illicit activities. It was decided to discontinue issuing the €500 note towards the end of 2018 after the decision to stop production some time before that; the measure has nevertheless preserved the legal tender status of the denomination. European governments have also taken decisions to limit the use of cash to combat illicit activities. Looking at Italy's experience, the restrictions (particularly the €1,000 limit imposed at the end of 2011) have been effective in relation to circulation itself, by curbing its growth and changing its composition in favour of smaller denominations. As regards the effectiveness of the restrictions in combatting illicit activities, the literature has produced insightful results. To get a fully fledged picture it is necessary to continue to dig into the subject.

Appendix 1

Cash models and forecasts; the allocation between the countries that print euro banknotes

In addition to studying the relationships between demand for currency and economic variables, the objective of economic analysis is to make forecasts, which for the euro area have important repercussions on day-to-day operations: the production and distribution of banknotes to meet the demand of economic operators, with a view to ensuring the orderly conduct of payment transactions. [26] The ECB[27] forecasts the overall demand for banknotes, relying on a set of models that go from simple extrapolative formulae (an autoregressive integrated moving average or ARIMA) to more complex multivariate models[28] designed to estimate long-term equilibria between the demand for cash and the explanatory variables. The models examine GDP to capture the transactional component; short- and long-term interest rates are used as indicators of the opportunity cost of holding cash; a linear trend is also introduced to estimate the impact of financial innovation. Distancing themselves somewhat from the more traditional models, the ECB includes the exchange rate among the explanatory variables to capture demand for banknotes from outside the area.[29] The final forecasts are based on the average of the estimates of the various models, excluding those whose performance is not satisfactory. Once the forecasts for total demand for banknotes have been finalized, simple extrapolative statistical models are used to estimate the demand for individual denominations. Over the longer term, it appears difficult to capture any discontinuities connected with the impact of innovation and changes in population demographics (for example, changes in demand reflecting the growing importance of the demographic cohort known as millennials). The Eurosystem forecasts are made over a horizon of two and a half years, an interval that takes account of production planning requirements. When determining the quantities for the bloc, the operational aspects of the banknote circuit are also taken into account, such as the estimated volume of banknotes that central banks must withdraw annually because they are no longer fit for purpose and must be replaced with new notes. Finally, it is also important to maintain logistical stocks at a minimum (the benchmark), in a way that takes account of the risks of peaks in demand (for example, linked to strikes in the cash-in-transit (CIT) sector or to other factors impeding the regular distribution of banknotes nationwide). Specific forecasting requirements are linked to the replacement of banknotes with a new series, as is happening with the introduction of the second series of euro notes: in addition to the demand for each denomination, annual lodgements of the old series must also be estimated, factoring in the issuance scenarios adopted for new issues. To estimate banknote requirements connected with these aspects, the Eurosystem draws on the operational experience of the NCBs and on data compiled through contacts with operators.

---

[26] Fish T., R. Whymark (2015). 'How cash usage evolved in recent decades? What may drive demand in the future?', Bank of England, *Quarterly Bulletin*, Vol. 55.

[27] Fisher B., P. Kohler, F. Seitz (2004), 'The demand for euro area currencies: past, present and future', ECB Working Paper Series, No. 330.

[28] VAR, (B)VAR, VECM and FAVAR models.

[29] Dummy variables are also included in relation to specific events that have led to level shifts in the demand for banknotes, such as the euro changeover in 2002 and the financial tensions following the collapse of Lehman Brothers in 2008.

References

Assenmacher, K. and S. Krogstrup (2018), "*Monetary Policy with Negative Interest Rates: Decoupling Cash from Electronic Money*", IMF Working Paper, WP/18/191.

Bank of Italy, "Survey on household income and wealth 1993-2016". Available at at: https://www.bancaditalia.it/statistiche/tematiche/indagini-famiglie-imprese/bilanci-famiglie/index.html?com.dotmarketing.htmlpage.language=1

Barontini, C. and Holden, H. (2019), "Proceeding with caution – a survey on central bank digital currency", in BIS Papers No 101. Available at: https://www.bis.org/publ/bppdf/bispap101.pdf

Bech, M., Faruqui, U., Ougaard F., and Picillo C. (2018), "Payments are a-changin' but cash still rules", in BIS Quarterly Review, March 2018

Carney, M., (2018), "The future of Money", in Bank of England Speeches, Speech at the inaugural Scottish Economics Conference, Edimburgh University, 2 March 2018.

Cochrane, J. (2017), "Bitcoin and Bubbles", Available at: https://johnhcochrane.blogspot.com

Esselink H., Hernandez L. (2017), "The use of cash by households in the euro area", ECB Occasional Papers no. 201, November 2017

Europea Central Bank (2015), "Virtual currency schemes – a further analysis", February**.** Available at: https://www.ecb.europa.eu/pub/pdf/other/virtualcurrencyschemesen.pdf

European Central Bank (2017), "Estimation of euro currency in circulation outside the euro area." Available at: https://www.ecb.europa.eu/pub/pdf/other/estimating_eur_in_circulation_outside_the_euro_area-201704.en.pdf

European Central Bank (2018), "The international role of the euro". Available at: https://www.ecb.europa.eu/pub/pdf/ire/ecb.ire201806.en.pdf

European Commission (2018), "Report from the Commission to the European Parliament and the Council on restrictions on payments in cash". Available at: https://ec.europa.eu/transparency/regdoc/rep/1/2018/EN/COM-2018-483-F1-EN-MAIN-PART-1.PDF

Esselink, H. and L. Hernández, L. (2017), "The use of cash by households in the euro area". ECB Occasional Paper series 201/2017. Available at: http://www.ecb.europa.eu/pub/pdf/scpops/ecb.op201.en.pdf

Fish T. and R. Whymark (2015). "How cash usage evolved in recent decades? What may drive demand in the future?", Bank of England, Quarterly Bullettin, Vol. 55.

Fisher B., Kohler P. and Seitz, F. (2004), "The demand for euro area currencies: past, present and future", ECB Working Paper Series, No. **33.**

Friedman M, (1956), " The Quantity Theory of Money. A Restatement. Studies in the Quantity Theory of Money. The University of Chicago Press.

Greene, C., Stavins, J. (2018), The 2016 and 2017 surveys of Consumer Payments Choice: Summary Results. Federal Reserve Bank of Boston. Schuh, S. (2016). " Consumer payment choice: a Central bank perspective", Federal Reserve Bank Boston, Conference BAI-Payment Connect 2016, https://www.bostonfed.org/publications/cprc-presentations /2016/consumer-payment-choice-a-central-bank-perspective.aspx

Immordino, G. and Russo, F.F. (2018), "Fighting Tax Evasion by Discouraging the Use of Cash?", in FISCAL STUDIES, vo. 39, no. 2, pp. 343-364, 0143-5671.

Immordino, G. and Russo, F.F. (2018), "Cashless payment and tax evasion". European Journal of Political Economy 55, pp. 36-43.

Jobst, C. and H. Stix (2017), "Doomed to Disappear? The surprising return of cash across time and across countries. C.E.P.R. Discussion Papers. Available at**:** https://ideas.repec.org/p/cepredp/12327.html

Kumhof, M. and Noone, C. (2018), "Central bank digital currencies – design principles and balance sheet implications". Available at: https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2018/central-bank-digital-currencies-design-principles-and-balance-sheet-implications

Medina, L. and Schneider, F. (2017), "Shadow Economies around the World: New Result for 158 Countries over 1991-2015", Department of Economics, Johannes Kepler, University of Linz.

Mersch, Y. (2017), "Why Europe still needs cash." Contribution for Project Syndicate. Available at: https://www.ecb.europa.eu/press/key/date/2017/html/ecb.sp170428.en.html

Mersch, Y. (2018), "Les paiements instantanés comme vecteur d'innovation dans les paiement", Paris, 15 février 2018. Available at: https://www.ecb.europa.eu/press/key/date/2018/html/ecb.sp180215.fr.html in ECB Speeches.

Mersch, Y. (2018), "Virtual currencies ante portas", Speech at the 39th meeting of the Governor's Club, Bodrum Turkey, 14 May, 2018, in ECB Speeches.

Panetta, F. (2018), "Fintech and banking: today and tomorrow", Speech at Harvard Law School Bicentennial - Annual Reunion of the Harvard Law School Association of Europe, Rome 12 May 2018.

Rocco, G. (2019), Questioni di Economia e Finanza (Occasional Papers) No. 481, "The use of cash in Italy: evidence from the ECB - Study on the Use of Cash by Households" (only in Italian). Available at: http://www.bancaditalia.it/pubblicazioni/qef/2019-0481/QEF_481_19.pdf?language_id=1

Schmiedel, H., Kostova, G., Ruttenberg, W. (2012). "The social and private costs of retail payment instruments. A Europeran perspective". Available at: https://www.ecb.europa.eu/pub/pdf/scpops/ecbocp137.pdf

Seitz, F., Reimers, H.E and Schneider, F. (2018), "Cash in Circulation and the Shadow Economy : An Empirical Investigation for Euro Area Countries and Beyond". Available at: https://www.cesifo-group.de/DocDL/cesifo1_wp7143.pdf .

Sveriges Riksbank (2017), "The Riksbank's e-krona project", Report 1, http://archive.riksbank.se/Documents/Rapporter/E- rona/2017/rapport_ekrona_170920_eng.pdf

Visco, I. (2018), "The Governor's Concluding Remarks – Annual Report" Bank of Italy, Rome 29 May 2018.