

Approaching 20 years of euro cash in Austria: What has changed, and what's next?

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This article discusses how the use of cash has evolved in Austria since euro banknotes and coins were introduced in January 2002 and how the underlying production/logistics processes have changed. Regarding the role of cash in Austria, we show that Austria is among the more cash-intensive economies within the euro area. In general, euro cash has remained an important medium of exchange and store of value. Its overall circulation has increased, in particular after the global economic and financial crisis, both in the euro area as a whole and in Austria. In the context of a growing demand for cash, we discuss how technical progress in the production of euro banknotes and in euro cash logistics has contributed to cost-efficiency. As euro cash is the joint product of all Eurosystem national central banks, we also address the role of the OeNB in the supply of banknotes. Finally, we provide a brief discussion about the likely future of cash.

Overall, there are three main messages that can be drawn from our brief contribution. First, euro cash is here to stay, although it is likely that its demand will decline in the coming years, mainly due to innovations in payment technologies and prospective increases in interest rates. Second, cash is not outdated given the technical developments in cash production and dissemination, the continued use of cash by consumers and the costs of cash vis-à-vis other payment means that merchants face. Third, there is a need for more research in order to better understand the demand for cash, in particular referring to those aspects that are unrelated to short-run payment needs.

In the context of the 20th anniversary of the euro, this article looks at euro cash and, in particular, at euro banknotes – both from the user side and from the production side.² We consider this a worthwhile endeavour for at least three reasons.

First, euro banknotes and coins are the most tangible symbol of European monetary unification. The use of cash by citizens is a manifestation of trust in the Eurosystem. This trust builds upon economic conditions, mostly low and stable inflation, as well as on the “technical quality” of euro banknotes – with the latter referring both to the tangible quality as well as to the counterfeit resilience of banknotes which is the outcome of the entire production process, from the design and printing stage to banknote recycling.

Second, as euro cash is a joint product of all Eurosystem national central banks, the planning and production processes involved provide a vivid example of how cooperation within the Eurosystem works in practice. We describe how the Eurosystem aims for providing euro cash in the most efficient manner, safeguarding a very high quality of banknotes.

The third reason is that the rapid spread of new technologies in the field of payments and banking has the potential of fundamentally changing demand for cash and therefore gives rise to numerous questions: Will consumers continue to

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² The euro was introduced as an accounting currency on January 1, 1999. Euro banknotes and coins have been circulating since January 1, 2002.

use cash despite the availability of new payment and banking technologies? Why do consumers use cash more intensively in some euro area countries than in other countries (given that their institutional environments are rather similar)? How much of the circulating amount of cash is used for payments, as a store of value or for shadow economy transactions? How big a share circulates within the euro area and abroad? These are just a few examples of questions that are important for assessing the future of cash but for which researchers and central banks have only partial answers. Somewhat exaggerating, one could probably state that the best manifestation of the bounded knowledge about the demand for cash is that cash has repeatedly been declared to be outdated and doomed to disappear – while in actual fact cash demand has continued to grow.

Our article covers all these aspects. First, we take stock of the amounts of currency that have been circulating since the changeover to euro cash in 2002. This view is supplemented by survey information on the role of cash for Austrians and citizens of other euro area countries. This discussion shows that cash is still of major importance for daily transactions, both in Austria and in many other countries in the euro area.

Second, we address the various steps in a life of a banknote (design, production, logistics, anti-counterfeit measures, etc.) and the complex logistics required to ensure that only banknotes of the highest quality will enter or re-enter circulation. Given the costs involved in producing and disseminating cash and the importance of cost efficiency, we describe the considerable technical progress in cash production and logistics that has occurred over the past two decades or so. As euro cash is the joint product of all national central banks within the Eurosystem, we also address how this cooperation works in practice and the role of the OeNB in the supply of banknotes.

Finally, we provide a brief discussion about the likely future of cash. From today's perspective, it can be expected that the amount of cash used by the public will decline somewhat, in particular for day-to-day payments, but that public demand for cash is here to stay in the near future.

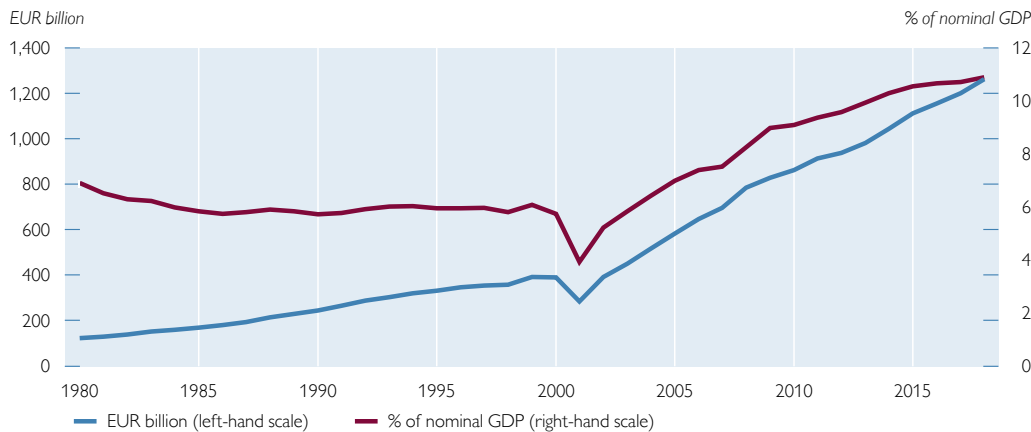
1 Euro cash in circulation has increased considerably

Chart 1 shows the evolution of currency in circulation in the euro area since 2002.³ The underlying time series is a reflection of the public's desire to hold cash, given that the public is free to choose cash over bank deposits (or other financial assets) and that central banks accommodate any demand for banknotes. To put the recent development into perspective, the time series starts in 1980, using a synthetic aggregate of the euro's legacy currencies in circulation based on fixed conversion rates. Moreover, the second time series relates cash demand to changes in income, plotting the amount of currency in circulation as a percentage of nominal GDP (for both series, see Jobst and Stix, 2017).

³ The chart shows the value of euro and legacy currency cash that is circulating (i.e. that has left the vaults of central banks).

Chart 1

Euro currency in circulation



Source: ECB, OeNB, authors' calculations.

Note: Currency in circulation refers to the euro and all its legacy currencies.

While currency in circulation was rather stable from 1980 to 2000 relative to nominal GDP, it trended upward strongly after 2002: from 2002 to 2018, the ratio of currency in circulation to nominal GDP roughly doubled, subject to an acceleration of the upward trend during the global economic and financial crisis and a growth slowdown after 2015.

Given the evolution of cashless payment innovations, such a rise in cash demand is indeed striking. As discussed by Jobst and Stix (2017), the nominal GDP ratio of euro cash in circulation may be understood to have risen until 2006 to catch up with the value that the German mark used to have, with the euro taking over the role of the German mark as an international currency. Since 2007 however, the additional increase is likely to have been associated with (i) very low interest rates after the crisis, (ii) increased domestic hoarding, presumably to some extent as a consequence of increased uncertainty after the global economic and financial crisis and (iii) increased foreign demand.⁴ Jobst and Stix (2017) further show that increases in cash demand after 2007 can be observed in many economies, and not just the euro area (see also Lalouette and Esselink, 2018).

At the end of 2018, a total of 22,614,824,598 euro banknotes were in circulation, representing an overall value of EUR 1,231 billion. In purely statistical terms, this means that every inhabitant of the euro area was holding 66 euro banknotes worth EUR 3,605. This compares with a per capita circulation of 30 banknotes worth EUR 1,536 in 2004.⁵

⁴ Typically, a distinction is made between transactional demand and nontransactional demand for cash. The latter arises from various sources, e.g. foreign demand, hoarding, precautionary demand, demand for shadow economy transactions, demand due to uncertainty, etc. As these concepts overlap, we prefer to distinguish between transactional demand, foreign demand and hoarding (hoarding being the residual demand that does not arise from the desire to conduct transactions and that does not arise from abroad). However, this does not solve the problem that the separation between transaction demand and hoarding is difficult conceptually, e.g. if people save in cash for later purchases.

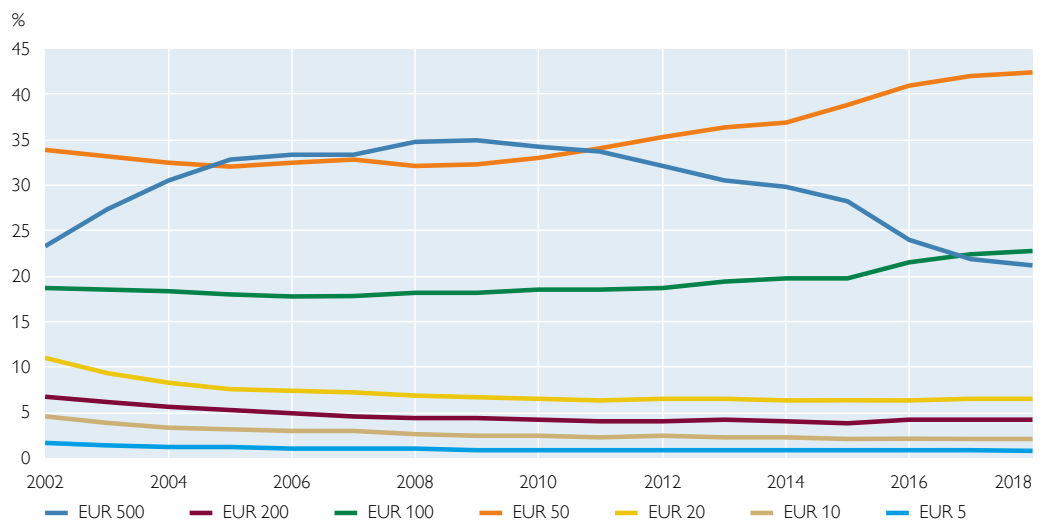
⁵ We consider 2004 a better comparison year as the figures for 2002 and 2003 were hugely influenced by the cash changeover. For the sake of completeness, the corresponding figures for 2002 are a per capita amount of EUR 1,111 and 25 euro banknotes. Moreover, it should be added that the general price level increased by roughly 30% from 2004 to 2018, i.e. by about 1.75% annually, on average.

The 30 banknotes that circulated on average per capita in 2004 were held in the following denominations: three EUR 100 bills, ten EUR 50 bills, six EUR 20 bills, five EUR 10 bills and four EUR 5 bills – amounting to 64% of the total value of per capita circulation – plus one EUR 500 bill and four-tenths of a EUR 200 bill.⁶ The comparison with end-2018 figures is quite impressive: the list for 2018 includes eight EUR 100 bills, thirty-one EUR 50 bills, twelve EUR 20 bills, eight EUR 10 bills and six EUR 5 bills – amounting to a total share of 75% of per capita currency in circulation – plus one-and-a-half EUR 500 bill and seven-tenths of a EUR 200 bill.

Chart 2, which visualizes the relative contribution of individual denominations to the overall value of banknotes in circulation over time (with the relative shares summing to 100% each year), highlights that the relative demand for individual denominations is not constant over time. In particular, the demand for EUR 50 banknotes has increased considerably (from 33% in 2004 to 42% of the total value of banknotes in circulation at the end of 2018). The relative importance of the EUR 500 bill, which is assumed to be the banknote that is used most for hoarding or for illicit activities, decreased after its peak in 2009. The ECB Governing Council's decision from May 4, 2016, to discontinue production of the EUR 500 banknote, seems to have induced a further decrease of its circulation.⁷ In turn, the relative importance of EUR 50 and EUR 100 banknotes has increased.

Chart 2

Contribution of individual denominations to euro banknotes in circulation



Source: ECB.

Note: This chart shows the relative contribution of individual banknote denominations to the overall value of banknotes in circulation in the euro area. These shares sum to 100% for each year.

⁶ The number of banknotes is, if possible, rounded to integer values.

⁷ The issuance of the EUR 500 banknote was stopped across the euro area at the end of January 2019 with the exception of Germany and Austria, where such bills were issued until the end of April 2019. The EUR 500 banknote remains legal tender, though, and can be exchanged at cash desks of Eurosystem central banks for an unlimited period of time.

Altogether, the sheer facts indicate both a high circulation of euro cash and a considerable increase after 2007/2008. However, it is clear that the per capita circulation figures are purely hypothetical, as considerable amounts of euro cash are held outside the euro area, thus narrowing down the amount of euro cash that is actually used domestically, for a range of purposes. The relative importance of the different uses can only be assessed indirectly, though, given the anonymity of cash. The ECB (2017) estimates that at the end of 2016 between 23% and 35% of euro cash were circulating outside the euro area.⁸ Lalouette and Esselink (2018) estimate that roughly a quarter of the total value in circulation is used for day-to-day transactions within the euro area and that about 7% are held in bank vaults. The remaining share is either hoarded domestically or lost. For Australia, Finlay et al. (2018) present estimates according to which about 7.5% of banknotes are lost. Applying these estimates (30% foreign circulation, 25% used for domestic transactions, 7% held by banks in vaults, 7.5% destroyed) suggests that about 30% are hoarded within the euro area, which would amount to around EUR 1,080 per capita.⁹ To our knowledge, no recent estimates exist on how much of this amount can be assigned to licit and to illicit activities.

Using banknote shipment data and return frequencies of banknote denominations, the OeNB computes an approximate estimate of the amount of euro cash that is circulating within Austria (chart 3).¹⁰ Despite the necessary caution when interpreting the resulting figures, two observations are evident. First, demand for euro cash has evidently gone up in Austria as well, both in nominal and in real terms. Second, the absolute amounts circulating per capita in Austria are relatively high. At the end of 2018, the per capita amounts held by consumers, merchants, companies and banks totaled about EUR 3,500. This compares with a euro area average of about EUR 2,500 (EUR 3,605 euro minus the estimated foreign circulation of 30%).

Some of the difference can be attributed to the fact that per capita GDP in Austria exceeds the euro area average by 18%. Furthermore, statistical data on cash holdings by banks show that roughly 15% of the total estimated cash circulation in Austria are stored in banks' vaults, which is more than twice the euro area percentage.¹¹ In per capita terms, about EUR 540 can be identified as vault cash of banks.¹² Some part can also be attributed to a heightened cash preference of households in Austria, as established by surveys on cash holdings and payment behavior, which will be discussed in the next section. To our knowledge, no information is available about whether cash balances held by merchants or corporations are higher in Austria than in the euro area.

⁸ *Jobst and Stix (2017) study the increase in the circulation of the euro, the U.S. dollar and the Swiss franc since the global economic and financial crisis of 2007. Their results suggest that roughly one-third of the increase in the circulation of these currencies since 2007 is due to international demand.*

⁹ *Given the above-mentioned difficulties in separating transactional demand from hoarding, these estimates can be seen as indicative only.*

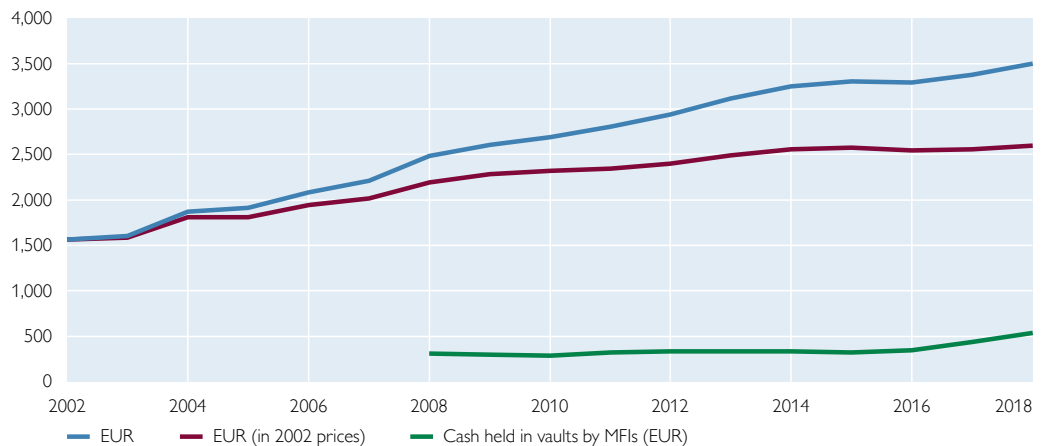
¹⁰ *Cross-border flows (e.g. via banknote wholesale traders) are largely excluded.*

¹¹ *Source: ECB Statistical Data Warehouse.*

¹² *Cash held in vaults by banks increased from EUR 2.8 billion (EUR 323 per capita) in 2015 to EUR 4.8 billion in 2018 (EUR 536 per capita).*

Euro currency in circulation in Austria

Euro amounts per capita



Source: OeNB, authors' calculations.

2 Despite profound changes in payment technologies, cash usage remains strong among Austrian consumers

Most information on the use of cash is available in the field of consumer payments. Although the demand for cash that arises from payments comprises only a relatively small share of the overall demand for currency, it is an interesting field as profound changes in payment technologies have occurred over the past 20 years. As a case in point, the number of point-of-sale payment terminals in Austria rose from 1,500 in 2002 to roughly 16,200 in 2017 (Mooslechner et al., 2012; ECB Statistical Data Warehouse). From 2002 to 2018, the share of Austrians (aged 14 or older) who were in possession of a debit card increased from 66% to 95% (Mooslechner et al., 2012; unpublished OeNB survey). In 2002, about 39% of Austrians were paying with a debit card once per week or more often. This share increased to 60% in the period until 2018. At the same time, the share of Austrians who indicated to withdraw cash from cash dispensers once per week or more often increased from 31% in 2002 to 45% in 2018.

2.1 The use of cash for payments

Information on the use of cash and other payment instruments is provided by payment diary surveys. In such studies, survey participants are asked to record all payments (except regular bill payments that are automatically deducted from accounts) over a prespecified period of time. The OeNB conducted the first such survey in 1996 and has since repeated the surveys every four to five years. Essentially, these surveys indicate that the use of cash in daily transactions has been declining in Austria, but that the vast majority of transactions are still settled in cash (Rusu and Stix, 2017).

A similar survey conducted by the European Central Bank in 2016 confirmed the preference of Austrians for paying cash, putting the percentage of transactions conducted in cash at 85% in terms of the number of transactions and at 67% in terms of the value of transactions (Esselink and Hernandez, 2017). Chart 4 summarizes

the results for most euro area countries.¹³ The main messages of these findings are: First, cash is still important in euro area economies. Second, there are large differences across countries. This has also been confirmed by another international comparison which includes Canada, Australia and the U.S.A. (Bagnall et al., 2016). Third, Austria is among the countries with a high use of cash for payments.

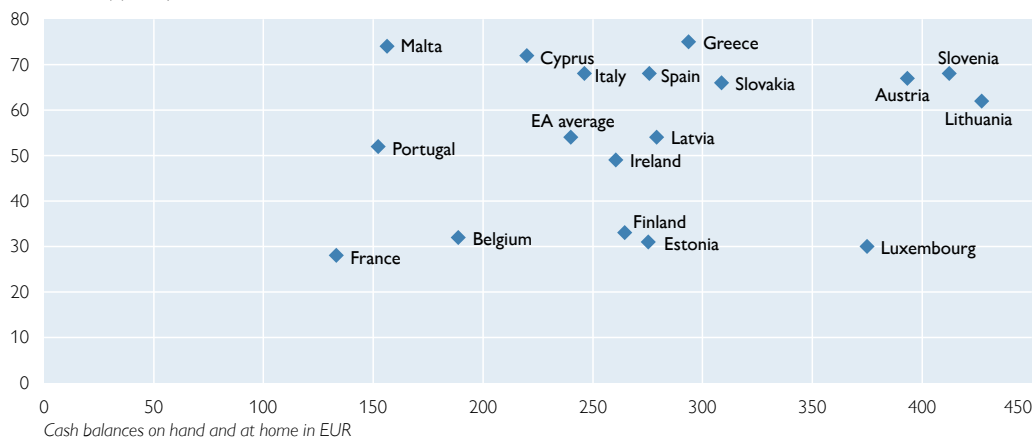
2.2 Cash holdings

The ECB's payment diary study also aimed to identify the amount of cash respondents tend to carry with them. Austrians have, on average, EUR 89 on hand (in their pockets, in their wallets, etc.), which is the fourth-highest value among the countries which participated in the ECB study. Also, the survey asked about cash held at home or in vaults. Adding both – cash kept at home and cash carried on hand – yields that adult Austrians (aged 18 or over) hold on average roughly EUR 400 in cash, which is the third-highest value among the countries depicted in chart 4.¹⁴ It is evident that the intensive use of cash for payments and cash holdings are interrelated. Although this holds for Austria, chart 4 does not reveal a strong correlation between the mean value of cash holdings and the use of cash for payments.¹⁵ Differences across countries in withdrawal fees from cash dispensers, the density of cash dispenser networks, crime rates (affecting the risk of theft), wealth levels or in the propensities

Chart 4

Consumers' use of cash for payments and average cash holdings

Share of cash (by value) in %



Source: Esselink and Hernández (2017) and authors' calculations.

Note: "Cash balances on hand and at home" denotes the average value of cash held per respondent per country. This value should be treated as a rough and imprecise estimate and should be used only for the purpose of country comparisons. "Share of cash (by value)" denotes the importance of cash for payments, measured by the value share of cash for all recorded transactions (see Esselink and Hernandez, 2017).

¹³ Germany was not covered in the ECB study. The Deutsche Bundesbank (2017) reports a value share of 55%.

¹⁴ This mean value should be treated with caution and should only be used for rankings across countries. The main reason is that the mean value is derived from categorical answers to which numeric values have been assigned – for instance, an arbitrary value of EUR 8,000 was assigned for the top category (EUR 5,000 or more). Assigning different values will slightly change the resulting estimate of the mean but will not affect the country ranking.

¹⁵ The correlation is significantly stronger if we compare cash held on hand and the intensity of use of cash for payments.

for hoarding play a role. Furthermore, some euro area countries have introduced cash transaction limits, which might also blur the correlation.¹⁶

3 The supply side of euro banknotes: specialization, automation and technical progress to maintain cost efficiency and high quality

In the following, we describe the main aspects of banknote production and logistics in the euro area as well as the role of the OeNB. Moreover, we discuss the main developments since 2002.

Since the introduction of the euro as the sole legal tender in the euro area, cash has no longer been the responsibility of individual central banks alone. Specifically, euro banknotes are produced jointly by the national central banks of the euro area, whereas responsibility for minting euro coins lies with the national governments of the euro area countries (subject to approval of the overall value of coin production by the Governing Council of the ECB). As a result, cash logistics has become a cross-border issue, which is coordinated at a level superordinate to the individual central banks. For this purpose, the ECB acts as a platform for Eurosystem central banks. This cooperation is a basic prerequisite for the functioning of the “European cash cycle”.

3.1 Banknote production: specialization within the Eurosystem

The volume of euro banknotes produced annually must be sufficient to cover any increases in banknote demand as well as to replace banknotes which are unfit for circulation. Moreover, sufficient logistical stocks must be available in order to cover seasonal and holiday fluctuations as well as hypothetical crisis scenarios.

On this basis, the Governing Council of the ECB decides on the volume to be produced. Based on this decision, the actual production of various banknote denominations has been handled by means of a decentralized pooling system since

Table 1

Banknote production volume in 2019

Denomination	Quantity (in million)	Value (in EUR million)	NCBs commissioning production
EUR 5	613.3	3,066.6	BE, ES, AT, PT
EUR 10	424.6	4,245.6	DE
EUR 20	970.9	19,417.4	EE, IE, FR, CY, LU, MT, NL, SI, SK, FI
EUR 50	1,729.2	86,457.9	DE, GR, ES, FR, IT, LV, LT
EUR 100	0.0	0.0	
EUR 200	0.0	0.0	
EUR 500	0.0	0.0	
Total	3,738.0	113,187.5	

Source: ECB.

2002. This means that each NCB in the euro area is assigned a certain share of the overall annual production volume for euro banknotes.¹⁷ Moreover, each national central bank is only responsible for producing certain denominations. To exemplify this, table 1 shows the banknote production plan for 2019 according to which Austria produces only EUR 5 banknotes, together with Belgium, Spain and Portugal. Furthermore, no EUR 100 and EUR 200 banknotes will be produced in 2019 as the launch stock for the new series of those two denominations, to be introduced at

¹⁶ As of end-2017, cash payment thresholds existed in 9 out of the 19 euro area countries (i.e. Belgium, France, Greece, Spain, Italy, Latvia, Portugal, Slovenia and Slovakia). The limits as well as the addressees of such limits (B2B, B2P, etc.) vary across countries, though.

¹⁷ The allotted shares are based on the capital share of the central banks participating in the Eurosystem.

the end of May 2019, was already printed and distributed among the Eurosystem national central banks in 2018.

As not all banknote denominations are produced at each printing facility, and as stocks of banknotes are built up or reduced at different speeds due to specific national circumstances, it is necessary to transport cash between central banks. These cross-border transports ensure that banknotes are distributed in the euro area according to national banknote demand, which is affected by a multitude of factors (e.g. cross-border commuting, labor migration, tourism, population size, income levels and the public's preferences for specific payment methods or for hoarding as well as shipments of banknotes outside the euro area).

Together with the national central banks, the ECB monitors the circulation and generates detailed monthly reports on stocks, circulation and handling as well as on the quality of cash in circulation, based on cash-handling statistics (the number of unfit banknotes) or random statistical testing.

Box 1

Euro banknotes are an R&D-intensive product

Given that a banknote is, in the end, only a piece of printed paper, a considerable amount of research and development goes into it – in fact, it would not be an exaggeration to refer to banknotes as high-tech products. After all, banknotes must meet very high standards in terms of counterfeit resilience, production efficiency, sustainability and environmental aspects.

The initial design of the euro banknotes was the result of a competition among banknote designers. The winning design, contributed by the Austrian designer Robert Kalina, has since been overhauled by the German banknote designer Reinhold Gerstetter. The second euro banknote series, launched in stages from 2013 onward, comes with new and further advanced security features. Moreover, the design was adjusted to better meet the requirements of the visually impaired.

The counterfeit resilience of euro banknotes is not only provided by the well-known “FEEL-LOOK-TILT” security features (which banknote users are encouraged to test in authenticity checks) but also ensured with security features that are invisible to the naked eye, like micro-print, UV and IR features. These features, which can only be checked with special devices or sensors, facilitate the automation of cash payments and cash processing.

While euro banknote paper is made of cotton, the enhanced EUR 5 and EUR 10 banknotes, which started circulating in 2013 and 2014 respectively, have also been coated, which makes these banknotes more durable and hence reduces costs. As a case in point, 28.3% of all processed EUR 5 banknotes were sorted to unfit due to soil or stains in 2008. By 2018, this percentage had dropped to 19.1% mainly – but not exclusively – due to coating.

It is a general objective of the Eurosystem to ensure public confidence in euro banknotes by maintaining their quality in circulation. Banknotes of poor quality aggravate the recognition of counterfeits by the broad public and are more likely to be rejected by vending machines. The lifespan of a banknote, from first issuance to destruction at a national central bank, depends not only on its physical durability but also on national peculiarities, e.g. the use of higher denominations for transactions. Basically, the higher the denomination, the higher the average lifespan, as higher-denomination banknotes are used less often for transactions and more likely to be stored. Additionally, environmental factors such as humidity play an important role in the time it takes for a banknote to become unfit. As an example, the EUR 20 banknote has an average lifespan of about 2.6 years in the euro area (computed from the total number of EUR 20 banknotes in circulation and the number of EUR 20 banknotes destroyed per year).

3.2 Banknote processing volumes have increased considerably

Newly printed euro banknotes are first delivered to the euro area central banks and then distributed onward to credit institutions, which supply the economy – businesses and households – with cash. The return flow of cash from economic actors is also handled by credit institutions, which return cash received from customers to the central bank. Due to the need to cut costs and increase efficiency, specialized players – like cash management companies or cash-in-transit companies – have increasingly taken over the role of credit institutions. This specialization has made it possible to achieve economies of scale in cash logistics. Acknowledging these developments, the Eurosystem created a legal framework in 2010 designed to ensure a level playing field among professional cash handlers while safeguarding minimum standards for the authenticity and fitness checking of euro banknotes.¹⁸ Credit institutions and professional cash handlers currently process more banknotes (about 54% of all processed banknotes) than the Eurosystem central banks.

Every single banknote that is returned to a professional cash handler or a Eurosystem central bank is checked for both fitness and authenticity. The OeNB uses high-speed cash processing machines that check more than 30 banknotes per second. Across the entire euro area, some 68 billion banknotes are currently checked per year. This implies that euro banknotes are on average checked three times a year by either central banks, credit institutions or cash handlers. On average, banknotes return 1.33 times per year to a Eurosystem central bank, which compares with a value of 3.35 times per year in 2004. The decrease not only reflects the stronger involvement of private companies in the cash-handling process but also the increased share of banknotes that is circulating outside the euro area or that is hoarded.

In Austria, about 1.8 billion banknotes were checked by the OeNB in 2018 (compared to some 800 billion banknotes in 2002). Currently, about 25% of banknotes are processed outside the OeNB by credit institutions and other professional cash handlers in Austria. This is a lower share than in other euro area countries as the OeNB has opted for a stronger involvement in the cash cycle in order to better control the quality of banknotes in circulation as well as to realize economies of scale.

In cash logistics, processing is a key element that allows to control the quality of banknotes in circulation and to filter counterfeits. Since 2002 the capacities and the throughput of cash processing machines has increased considerably. This has contributed to the efforts to further increase efficiency.

3.3 Cash automation has grown in importance

In the first decade of the 21st century, cash automation focused primarily on cash distribution (i.e. mainly cash dispensers). Since then, new types of machines – so-called cash-handling machines (staff-operated or customer-operated) – have emerged which facilitate both cash payments and cash deposits. These machines process banknotes locally, i.e. they can conduct authenticity and fitness checks and reuse deposited banknotes. This shortens the cash supply chain and contributes to a more efficient cash cycle.

While the number of staff-operated machines has remained stable over the last couple of years, the number of customer-operated machines increased strongly. In

¹⁸ See "Decision of the European Central Bank of 16 September 2010 on the authenticity and fitness checking and recirculation of euro banknotes" (ECB/2010/14).

2013, in total, some 21,500 machines were in use all over the euro area; by 2018 this number had increased to more than 51,000 machines. Austria is no difference in this respect; here, the number has gone up from 1,170 machines in 2013 to almost 2,400 machines in 2018. The growing importance of customer-operated machines reflects the trend in the banking sector to offer automated cash services rather than over-the-counter cash services, on one hand, and to close bank branches and/or replace them with automated cash service points, on the other hand.

4 Conclusions and some considerations about the way forward

This article's goal was to discuss almost 20 years of euro cash in Austria – from the user side and from the production side – and the changes that have occurred over this time period. The stylized facts presented in this short article are clear and unambiguous: Euro cash continues to remain an important medium of exchange and store of value. A strong increase in cash holdings, in particular after 2007, can be observed both in the euro area as a whole as well as in Austria, which is one of the more cash-intensive euro area economies.

The growth in euro cash circulation might seem surprising, given the continued growth in the availability and use of cashless payment options. In fact, the use of cash for payments has been declining over time – although the decline was relatively modest in Austria, compared to other countries like Denmark, Sweden or France, for example. The overall increase implies that non-payment motives more than offset the declining cash demand for transactions. While increased circulation of euro cash in countries outside the euro area explains a sizeable portion of the increased circulation, the bulk of the increase is domestic, i.e. related to domestic hoarding (see Lalouette and Esselink, 2018). Low interest rates are an important driver of this development. A rise in uncertainty might be another factor – reflecting that cash is the only way for consumers to hold (safe) central bank money, which might have been important after the outbreak of the global economic and financial crisis and some turbulences thereafter. However, the evidence on this uncertainty effect is not clear (Bech et al., 2018; Jobst and Stix, 2017). Analyses by the Bundesbank (2019b), Seitz et al. (2018) and Jobst and Stix (2017), overall, cannot link a large share of euro currency in circulation with the shadow economy – although it is inherently difficult to assess the role of shadow economy transactions for cash demand.

How will demand for euro cash evolve in the coming years? Assessing the future of euro cash requires a profound understanding of the drivers behind its use for payments and its use as a store of value – and as argued in this article, this is the area where many questions are unresolved and more research is required. Studies have shown that consumers value the distinguishing features of cash (e.g. its ease of use, the speed of transactions, its anonymity and its suitability for monitoring expenses) and continue to use cash for payments mainly according to their preferences (e.g. Bagnall et al., 2017; Rusu and Stix, 2017) – and not because they are forced to use cash. However, most of the available research results refer to the field of payments and relatively little is known about the other uses of cash: hoarding or the use of cash for licit versus illicit activities, which are affected by a multitude of factors (interest rates, uncertainty, agents' desire for privacy and anonymity, the size of the shadow economy, tax enforcement rules, etc.). Apart from the prediction that a normalization of interest rates will reduce cash demand for hoarding, it is thus rather difficult to assess how this important demand component will evolve. The

experience of Japan suggests that a prolonged period of very low interest rates could lead to the build-up of substantial cash holdings (Fujiki and Kiyotaka, 2019).

On the payment side, it can be expected that new payment instruments will gain importance in the coming years – rapidly growing contactless and mobile payments as well as new payment solutions based on instant payments have a large potential. It is rather likely that this development will reduce the use of cash for payments – the experience of countries where cashless payments are already used more intensively than in Austria, like Sweden, Norway or Canada, suggests that the decline in cash use for payments can be substantial. Nevertheless, we think that these changes will not occur rapidly and might be less strong in countries like Austria where the public seems to have had stronger cash preferences than in other countries. As a case in point, digitalization must not automatically replace cash but can also foster its use – provided that some consumers continue to have a preference for using cash: Apps have already been developed that allow for cash withdrawals at zero costs for consumers in stores (such withdrawals also reduce the costs to both banks and merchants) or apps which allow to settle online payments by cash in physical stores.

Apart from preferences, relative costs are an important determinant.¹⁹ If cash becomes expensive for consumers to use or for merchants to accept, relative to other payment instruments, then the use of cash will decline. A recent study on the costs of payment instruments arising for the German retail sector, which might be broadly comparable to the Austrian situation, finds that cash generates the lowest overall per transaction costs, in comparison to debit and credit cards (Deutsche Bundesbank, 2019a). Amount-wise, cash generates lower costs for retail payments up to payment amounts of EUR 20, beyond which debit card payments are cheaper.²⁰ These results challenge claims that cash is universally more expensive than payment cards and therefore should be replaced by the latter, notwithstanding that the overall economy-wide costs of the payment system are considerable, and that further potentials for cost-savings should be realized. The utilization of technical innovations and automation along the entire supply chain will contribute to achieving this goal (e.g. high-speed cash-processing machines, customer-operated cash-handling machines). Moreover, the new euro banknote series that was launched in 2013 has increased counterfeit resilience and contains security features that can only be checked with sensors and which facilitate the automation of cash payments and cash processing. However, this covers just one side. For consumers and merchants, the other side, withdrawal or deposit costs are relevant, inter alia. If cash is to remain relatively inexpensive for consumers and merchants, it is essential for a dense network of withdrawal and deposit facilities to be maintained. This might

¹⁹ Due to brevity, we do not discuss the general pros and cons of cash, which go beyond the mere cost aspect. The reader is referred to McAndrews (2017) and Krueger and Seitz (2018) for a more general discussion of the advantages of cash. For Rogoff (2016), the disadvantages of cash (e.g. because of its use for criminal activities and because of the implied zero lower bound on interest rates) dominate.

²⁰ Although these results refer only to the costs of the retail sector, they are similar to studies which refer to the economy-wide costs with respect to the finding that cash is cheaper for low transaction values than cards. With regard to Austria, Abele and Schäfer (2016) find that cash payments are cheapest for transaction values up to roughly EUR 10. A comprehensive study conducted by the Bank of Canada reports a threshold of 6 Canadian dollars above which debit cards are cheaper than cash (Kosse et al., 2017). Krueger and Seitz (2018) present an overview of results from cost studies.

become a challenge given the tendency of the banking sector to automate or to downsize the branch network.

Overall, we think there are three main messages that can be drawn from our brief contribution. First, euro cash is here to stay, although it is likely that its demand will decline in the coming years, mainly due to innovations in payment technologies and prospective increases in interest rates. Even though digitalization has the potential of making cash transactions superfluous, in principle, some consumers will nevertheless continue to prefer cash over other payment instruments because of the distinguishing attributes of cash. Second, cash is not outdated given the technical developments in cash production and dissemination, the continued use of cash by consumers and the costs of cash vis-à-vis other payment means that merchants face. Third, there is a need for more research in order to better understand the demand for cash, in particular referring to those aspects that are unrelated to short-run payment needs. The quantitatively important demand component of hoarding is influenced by a multitude of factors and currently is difficult to predict.

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