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Pros and Cons of Cash: The State of the Debate

Malte Krueger and Franz Seitz*

Abstract

This study investigates the benefits and disadvantages of cash in a general context. First, we explicitly address the arguments of cash critics, who are calling for cash to be abolished altogether. Second, we show that cash plays a crucial role in the current two-tier banking system. Third, we are discussing selected benefits of cash, inter alia its use in financial crises and the provision of privacy. We conclude that the abolition of cash would have major drawbacks and could entail undesirable and unintended consequences.

Vor- und Nachteile des Bargeldes: Eine Bestandsaufnahme

Zusammenfassung

In der vorliegenden Untersuchung werden einige der wichtigsten Vor- und Nachteile von Bargeld analysiert. Erstens werden die Argumente der Bargeldkritiker, die Bargeld abschaffen wollen, eingehend erörtert. Zweitens, wird gezeigt, welche fundamental wichtige Rolle Bargeld in einem zweistufigen Bankensystem spielt. Drittens werden einige ausgewählte Vorteile des Bargelds untersucht, insbesondere die Bedeutung des Bargelds in Finanzkrisen und für die Erhaltung der Privatsphäre. Wir kommen zu dem Ergebnis, dass die Abschaffung des Bargelds erhebliche Nachteile hätte und zu unerwünschten und unbeabsichtigten Nebenwirkungen führen würde.

Key words: cash, payments, cash abolition, monetary policy

JEL Classifications: D12, D61, E41, G21, O33

I. Introduction

For many years, there has been a debate about the pros and cons of cash and the imminent appearance of the cashless society.¹ In the recent past, however,

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¹ Critics of cash are, for instance, Rogoff (2016), Salmony (2011), Sands (2014) and van Hove (2007). The benefits of cash are stressed by Berentsen/Schär (2016), Kahn/McAndrews/Roberds (2005), Lepecq (2015) and Häring (2015).

this discussion has received an increasing amount of public attention. The reasons for this development are manifold:

- Governments have intensified their efforts to fight the black economy.
- Terrorist attacks have triggered demands for more control of payment flows.
- Economists see cash as an impediment on the way towards negative interest rates.
- Card schemes (and some regulators) argue that cash is inefficient.

However, not everybody agrees that cash is doomed because it provides a mix of attributes that are hard to match by potential electronic substitutes:

- Anonymity in use.
- Use without other service providers.
- Neither payer nor payee have to be online.
- Usable for large and small amounts.
- Payments are easy, comfortable and quick.
- Payment is definitive and final.
- Cash is relatively secure against counterfeits.

Given this mix of attributes, it is not surprising that cash is still widely used and the quantity of currency in circulation is rising in many countries (see, e.g., *Jobst/Stix* 2017). Therefore, the critics of cash call for regulation to either limit the use of cash or even abolish cash altogether. In some countries, public authorities have already taken action. For instance, in May 2016, the ECB announced that the issue of the Euro 500 banknote will be discontinued. In November 2016, the government of India announced a drastic step. The two most popular denominations, the 500 rupee and the 1000 rupee notes would lose their legal tender status. Moreover, only a short period to deposit these notes in banks and post offices was provided (Cards International 2016).

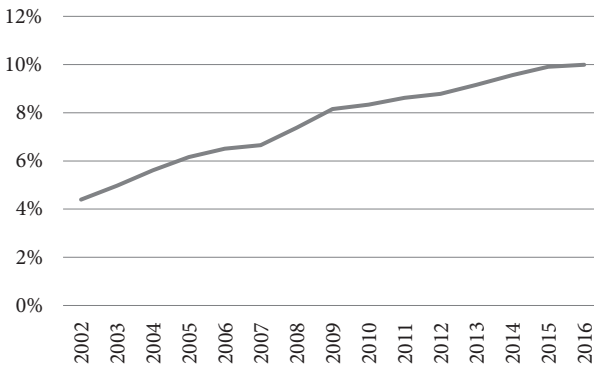
Below, we will take up some of the issues that figure prominently in the discussion.² In section 3 we will evaluate the arguments against cash. Subsequently, we will analyse some of the benefits of cash and some of the problems that might arise if cash were to be abolished (section 4). At first, however, we will present some data regarding the use of cash and cashless payments instruments as well as results of cost studies (section 2).

² See for a more extensive coverage of the microeconomic, macroeconomic and societal benefits of cash *Krueger/Seitz* (2017).

II. Some Data

Since the introduction of the euro, the amount of currency in circulation has trended strongly upward. The ratio of cash-to-GDP has risen from a low of around 3% just after the introduction of the euro to around 10% at the end of 2016.

A rising cash-to-GDP ratio is not just a euro phenomenon. For example, the US, Switzerland and Japan are also experiencing strong increases in the demand for cash. In 2015, these ratios amounted to around 8%, 12% and 20%, respectively. Even in the UK, where cashless payments are widespread, the demand for banknotes increased more than GDP in the last decade.



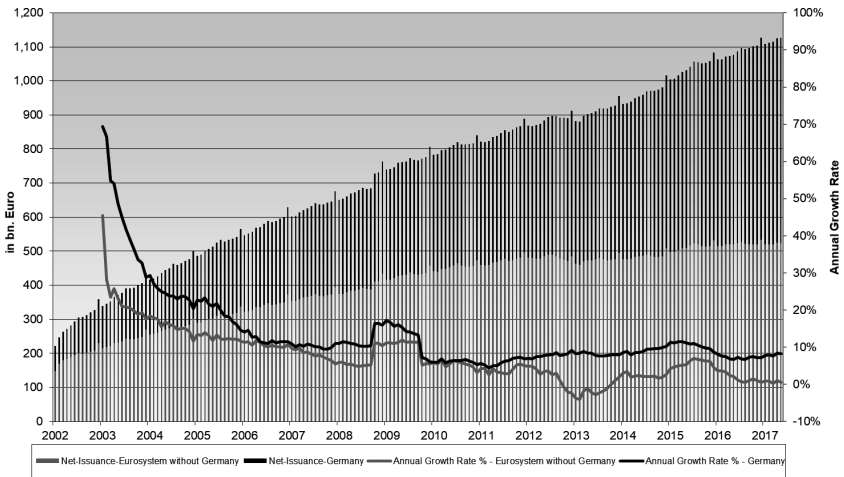
Source: ECB SDW and own calculations.

Figure 1: The Cash-to-GDP Ratio in the Euro Area

Looking at the euro area, a striking feature since the introduction of the euro is the very dynamic upward trend since 2002 (see Figure 2). This trend is especially pronounced in Germany.³ The growth rates were in double figures up to the end of 2009 and thus differ significantly from the days of the Deutsche Mark prior to the introduction of euro cash (Bartzsch et al. 2011b). If cash holdings in 2012 were divided purely mathematically by the number of German residents, this would yield a figure of around € 5,000 per capita. This is not in line with experience, however.

The chart clearly shows how the insolvency of Lehman Brothers in October 2008 triggered a surge in the demand for cash. The German situation differs significantly, on the whole, from that in other countries both within and outside

³ The net issues are not to be confused with cash in circulation in Germany, which can no longer be determined precisely within the framework of a monetary union.

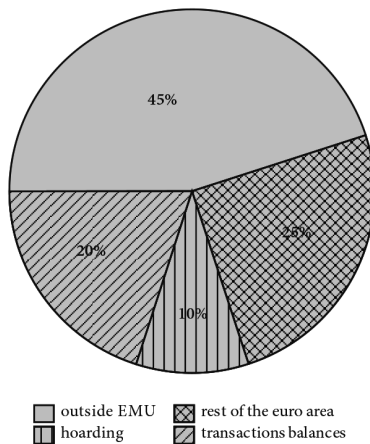


Notes: Annual rate of growth compared with the previous year.

Source: Deutsche Bundesbank, European Central Bank.

Figure 2: Euro Banknotes in Circulation

the euro area. The reason for the high levels of cash holdings is that all of the motives that create demand for cash are present in the case of Germany (see Figure 3). Cash is used for transaction and hoarding purposes, and considerable proportions of the notes issued in Germany are held in other euro-area member



Source: Update of Bartzsch et al. (2011a, b).

Figure 3: Cash Motives and German Net Issues

countries, as well as outside the euro area (see also *Bartzsch et al. 2011a, b* for a detailed account of this). Due to transaction and hoarding reasons, 70 % of those notes are held outside the country, with the majority outside the euro area. Only a small portion of at most 10 % is required in Germany for transaction purposes. Hoarding for various reasons accounts for around 20 %.

Even if most of the cash issued in Germany is held abroad or is hoarded, this does not imply that cash is little used. Obviously, the nature of cash payments makes collecting statistics on the value and number of cash transactions difficult. Cash is an “offline” method of payment, and a cash transaction is not separately recorded. Therefore, the value of cash payments can only be estimated with indirect methods or on the basis of data collected by means of surveys. In principle, there are three possibilities:

1. Estimation of purchases that are generally settled in cash. As payment cards are also used for these transactions, card transactions are deducted from the total volume and the remainder represents the volume of cash transactions.
2. Estimation of the amount of cash withdrawn from automated teller machines (ATMs) and over the counter. As cash is essentially withdrawn to be used to make subsequent payments,⁴ this variable can be used as the upper limit for the volume of payments effected in cash.
3. Surveys on the payment and cash procurement habits of the population.

Table 1

**Estimated Value of Cash Payments:
Comparison Between Different Approaches**

€ bn	2008	2009	2010	2011	2012	2013	2014	2015
National accounts	530	517	500	505	498	475	487	490
VAT	603	572	578	589	566	553	569	585
Withdrawals	664	660	625	636	626	614	570	600
Survey (expenditure)	637			538			468	
Survey (withdrawals)	558							
Average	598	583	568	567	563	547	523	558

Source: Deutsche Bundesbank, *Bartzsch et al. (2011a, b)*, Federal Statistical Office and own calculations. For more information on these estimates see *Krueger/Seitz (2014)*.

⁴ For example, the findings on the share of cash in payments using data from payments diaries (e.g., Deutsche Bundesbank, 2009a, Chap. IV) according to which the main determinants are transaction-driven could be interpreted in this sense.

Table 1 provides a summary of the different estimates. The findings based on VAT statistics and on the withdrawals reported by the banking industry are relatively high and suggest that the value of cash payments in 2015 is around €600 billion. The other two estimates (based on data on aggregate consumption and on survey data) are below €500 billion. Most estimates display a small downward trend in cash payments. Only the findings based on the payments study conducted by the Deutsche Bundesbank suggest that there was a more rapid decline of cash payments. In 2015, the average of the different estimates was equal to € 558 billion. This is equal to about € 6,800 per person.

III. The Arguments Against Cash

1. *The Shadow Economy*

A serious argument against cash is that it facilitates transactions in the shadow economy. In doing so, cash may have several harmful effects:

- distortion of the structure of production,
- decrease of tax and social security revenue (possibly leading to higher tax rates),
- reduction of employment in the legal part of the economy,
- facilitation of crime.

When evaluating the activities in the shadow economy, one has to distinguish between activities that are, in principle, legal but which are moved into the black economy in order to evade taxes etc (plumbing, construction work, child care, hair dressing, ...) and outright criminal activities (drug dealing, smuggling, extortion, ...). In the first case, there is a clear damage to society if shadow market activity replaces legal activities. Law-abiding companies that pay taxes may have to go out of business because they cannot compete against companies from the black economy – even if the latter are less productive. Consequently, the structure of production is distorted and tax and social security income is reduced. However, if the service could only be supplied in the shadow economy because high taxes would have otherwise made it unprofitable, the case looks different. Many countries have high taxes and social security contributions.⁵ These put a wedge between the amount a customer pays and the amount the supplier earns. If the wedge becomes very large, shadow market activity may also be an important “safety valve”. In such a case, the black market allows to maintain a high level of production in spite of excessive taxation and regulation (see also *Schnei-*

⁵ On the role of taxation and regulation as causes of shadow market activities see *Schneider* (2002) and *Schneider/Enste* (2000).

der/Enste 2000). Consequently, the role of cash as a facilitator of black market transactions does not necessarily cause welfare losses. Or, to put it differently, by providing an anonymous means of payment such as cash, governments restrain their ability to “overtax” an economy.⁶

As far as criminal activities are concerned, it seems to be undisputed that cash is used by criminals for transactions and – possibly – as a store of value. However, the argument that abolishing cash (or high denomination notes) might be an effective means to reduce crime seems overly optimistic. First of all, criminals do not just use cash but also bank money and digital currencies like Bitcoins. Using complicated chains of transactions including transfers from and to foreign countries, criminals seem to be remarkably apt to hide the sources and destinations of their funds.⁷ Second, if cash were to be abolished, this would have to be on a global scale. Thus, it would not help to move in this direction, say, in the euro area alone. In this case, criminals would simply increase the use of US-dollars. Third, even if cash were no longer available, criminals could use substitutes to facilitate criminal transactions (for instance gold, diamonds, pre-paid phone cards). Fourth, the use of cash for criminal purposes seems to be strongly exaggerated. Empirical results indicating that only a small fraction of cash is required to carry out legal transactions are often interpreted to imply that the rest is used for criminal activities. For instance, *Buiter* (2009) states “The only domestic beneficiaries from the existence of anonymity-providing currency are the underground economy – the criminal community”.⁸

However, this statement lacks any empirical basis. Even if some economists think that hoarding does not make sense, the large increase of cash in circulation after the Lehman insolvency shows that cash is not just used as a means of payment but also used as a store of value at home and abroad. In this respect it is also instructive to look at the results of the “Indian experiment”. It was meant to provide a blow to the black economy, especially corruption and tax evasion. However, of the 15.4 trillion rupees outstanding in cancelled notes, 99 per cent were returned (*The Economist* 2017). This suggests that cash receipts originat-

⁶ In this sense, cash may also be interpreted as a “signal” that a government will not try to overtax. This argument was proposed by Kai Konrad in a discussion of *Drehmann/Goodhart/Krueger* (2002).

⁷ Therefore, it does not come as a surprise that large parts of anti-money laundering regulations are addressing non-cash payment instruments. See the proposals of the Financial Action Task Force (FATF) (www.fatf-gavi.org).

⁸ Others have cited the finding that almost all bank notes have traces of cocaine on them. However, as police have been pointing out, this can be easily explained by the fact that bank notes are usually going through sorting machines. If a few bank notes with traces of cocaine pass through these sorting machines, the machines will be ‘contaminated’ and all notes passing through them will have traces of cocaine on them (see *Drexler* 2003).

ing from the black economy are quickly laundered or that there are less cash-financed illegal activities than expected.

To sum up: Cash is probably not used as widely for criminal activities as is often thought and its abolition would not be as effective in preventing crime as is hoped (see also *Schneider/Linsbauer 2016*).

2. Monetary Policy Arguments (Zero Lower Bound)

Economic crisis periods may necessitate negative policy and market interest rates. According to some estimates for the US, as low as -5% or even -10% (*Rogoff 2016*). Japan has battled since the 1990s with a mild deflation and is incapable to return to an inflation rate in significantly positive territory. Therefore, Japan may also be viewed as a case requiring negative rates.

As a consequence, more and more economists are contemplating drastic action to make negative rates possible. (*Rogoff 2016; Buiter 2009; Haldane 2015*, sceptical: *McAndrews 2015*). The main problem on the road to negative rates is cash. Cash has a nominal return of zero and a real return (taking carrying costs into account) that is mildly negative.

$$i_C^{real} = i_C^{nom} - k = -k$$

i_C^{real} is the real return on cash, i_C^{nom} is the nominal return on cash (equal to zero) and k represents carrying costs (storage, risk of theft, insurance...)

Once a negative rate on short-term instruments such as bank deposits, money market funds etc. has been introduced, there comes a point when it will be profitable to take cash out of the bank and store it in a safe place. Likewise, the incentives of banks to increase their cash holdings will be higher the more negative policy rates are. Thus, an attempt to get interest rates significantly into negative territory (below $-k$) requires a mechanism to interfere with such hoarding behavior.

However, abolishing cash would constitute a fundamental institutional change. Whether or not to undertake such a drastic measure depends on two questions:

- Do we really need negative rates?
- Are there alternatives that might be preferable?

While some economists seem to take it for granted that we need negative rates, others do not agree. For instance, the German Council of Economic Experts (*Sachverständigenrat 2014*) has calculated Taylor rates for the euro area. Only very briefly, in 2009, one of the estimates dipped below zero. For the rest of the post-crisis period, Taylor rates have been positive and most of the time also above the main refinancing rate (*Sachverständigenrat 2014*). For the US,

Laubach/Williams (2015) estimate a natural rate of interest that falls only slightly below zero in the years after the crisis. Such estimates do not lend support to the view that significantly negative policy rates would have been required.

Much of the discussion about negative interest rates has been about getting *the* interest rate below zero. However, if the aim is not only to discourage saving⁹ but also to encourage investment, it is important to get the costs of capital down. Costs of capital consist of the riskless rate plus a risk premium. If central banks think that getting the riskless rate down to zero is not enough they can work on the risk premium. This could be done via granting credit to the corporate sector, buying corporate bonds, discounting bills of exchange (a time-honoured central bank practice) or accepting private securities as collateral. The Eurosystem has moved already a little into this direction but in order to yield a significant effect on private investment, more is in order.¹⁰

Central banks seem to be reluctant to move into this direction because it entails taking on more risks on their balance sheets. But, historically, they often have taken large risks on board, for instance by piling up huge stocks of foreign currency reserves which often involved high losses (*Krueger* 2013). Moreover, as *Hellwig* (2015) reminds us, central banks are, after all, banks. So, it should not be their prime concern to minimize risks. Indeed, it is somewhat strange that the very institution that has the lowest default risk is so keen to limit its exposure to risk.¹¹

Proponents of the monetary policy argument believe that economic activity would be stimulated in a sustainable manner. However, this raises the issue of whether the measure is commensurate to the problem, particularly in the euro area, and what side effects it might have (*Borio/Zabai* 2016; *Jobst/Lin* 2016). For instance, the problems in the euro area appear to be of a structural, rather than a cyclical, nature. In addition, there are alternative transmission channels at work around the lower bound on interest rates. What comes to mind in this context are the signalling, exchange rate, trust and portfolio channels (*Ulbrich* 2016).

In any case, the impact of negative rates would be relatively minor, not least because there would be considerable evasive shifts towards other currencies whenever cash was abolished in one currency area only. Moreover, the public would attempt to use alternative transaction mediums and stores of value which are not subject to negative interest rates. For example, there is always the option

⁹ Whether savings are, indeed, negatively influenced by negative interest rates is open to debate. A lower return on savings might also entice people to save more. Thus, it seems crucial that there really is a positive effect on investment.

¹⁰ *Krueger* (2013) makes a case for monetising private debt rather than public debt.

¹¹ Also in this respect, the crisis has been instructive. We could witness central banks with negative equity. For instance, the Czech Central Bank had negative equity over an extended period – and nobody seemed to worry!

to switch to vouchers, use cheques without depositing them immediately, make advance tax payments or early repayments of loans (*McAndrews* 2015). Furthermore, it is not implausible that the demand for gold and other precious metals would rise considerably. Real estate, too, would probably be in high demand. These markets might experience significant price bubbles, resulting in financial instabilities and imbalances. To circumvent the restrictions, behavioural changes and arbitrage activities would result. They would also create incentives for “financial innovation” to guarantee an interest rate of at least zero. These incentives would be greater, the longer the negative interest period lasts and the more pronounced it was. This is consistent with *Bech/Malkhozov* (2016) who argue that if rates were to remain negative for a prolonged period, at some point the effective lower bound would increase as economic agents adapt to the new environment and as innovations will prevail, which reduce the costs associated with holding cash. This is supported by the fact that most of the costs of cash holdings are of a fixed nature. Ultimately, the level of the lower bound on interest rates would depend on whether and how banks succeed in pushing deposit rates, too, into negative territory (*Alsterlind et al.* 2015).

Finally and under the realistic assumption that the zero or negative interest rate policy is but a temporary phenomenon in exceptional situations and with ambivalent effects, the response to it ought not to be an absolute and, in principle, irreversible measure in the form of a permanent abolition of cash.¹²

3. *The Efficiency Argument (Speed, Costs)*

In the past 20–30 years there have been numerous studies on the relative costs of payments instruments. However, even though some of the papers derived clear-cut results, these should be interpreted with caution. First, “costs of payments” is a complex issue. There are the “pure” costs of production, such as printing cash, manufacturing cards, sorting cash, processing card payments, customer service, fraud management etc. In addition, there are costs involving resources of the payment users, such as the time it takes to carry out a payment or the time it takes to go to an ATM and get cash. Finally, there may be external costs such as facilitating criminal activities.

For a long time, there has been little interest in the costs of the payment system. However, during the past 20 years the number of cost studies has been rising.

A widely cited estimate of the costs of cash payments is the EPC (European Payments Council) estimate of EUR 50bn for the EU as a whole (EPC 2003). This impressive estimate covers the costs of banks (incl. central banks) and mer-

¹² Possible alternatives to monetary policy as crisis tool are discussed, inter alia, by *Summers* (2014) or *von Weizsäcker* (2015) who make a case for more public spending.

chants. But the EPC also came up with an estimate of the number of cash transactions: 360 billion. Putting the two figures together yields average costs per cash transaction of 15 cents. This is not too high for an all-purpose means of payment that can be used under various circumstances (P2P, P2B, B2P and B2B) for small- as well as large-value payments. Unfortunately, the EPC did not come up with a comparable figure for card payments. There are, however, several studies that attempt to provide comparative estimates.

One of the most ambitious cost studies has been the study of the Dutch National Forum on the Payment System (National Forum on the Payment System 2004). The Forum does not simply try to estimate costs. Rather it attempts to derive cost functions for the different payment instruments. The main result of the study was that cash is relatively cheaper for low-value payments whereas debit cards are relatively cheap for payment values above a time-varying threshold. Credit cards had the highest costs and e-purses had the lowest costs.¹³ The Dutch study has influenced numerous other studies such as the cost study of the Belgian Central Bank (Banque Nationale de Belgique 2005) and the cost study of the Eurosystem (*Schmiedel/Kostova/Ruttenberg* 2012).

Overall, it is difficult to draw straight-forward conclusions from the cost studies.¹⁴ But when looking at their results (see Table 2), it can be concluded that cash does not seem to be an expensive outlier.¹⁵ This is also confirmed by a recent study on Canada based on merchants' and consumers' surveys (*Fung/Huyuh/Kosse* 2017).

Table 2

Costs of Payments – International Overview (Cost per Transaction)

	Cash	Cards	Debit	Credit
US 2003 \$54	2.18		1.07	1.16
US 2003 \$11	0.90		1.00	0.95
Austr. 2005 \$A50	1.64		0.80	0.99
Austr. 2005 \$A10	0.96		0.80	0.99
Australia 2007 (\$A)	0.37		0.80	1.22

(Continue next page)

¹³ The fact that e-purse payments had the lowest costs has never been followed up by regulators. Rather, in the Dutch policy debate the main issue has been cash versus debit cards.

¹⁴ For a more detailed and critical overview, see *Krueger/Seitz* (2014).

¹⁵ A completely different interpretation of the data can be found in *van Hove* (2007).

(Table 2: Continued)

	Cash	Cards	Debit	Credit
Germany 2004 (€)	0.36		0.82	2.73
Belgium 1998 (€)	0.56	0.64		
Sweden 2009 (€)	0.78		0.42	1.15
Norway 2007 (€)	1.53	0.74		
Denmark 2009 (€)	0.78		0.36	3.86
Hungary 2009 (€)	0.39		0.33	3.59
Netherlands 2002 (€)	0.30		0.49	3.59
Netherlands 2009 (€)	0.39		0.32	
Italy 2009	0.33		0.74	1.91
EU13 2009 (€)	0.42	0.99	0.70	2.39

Notes: US: Calculation for transactions of 54 and 11 US dollars, respectively; Australia 2005: Calculation for transactions of 50 and 10 Australian dollars, respectively. The annual number refers to the data upon which the study is based.

Source: Krueger/Seitz (2014).

A related argument against cash is the claim that cash payments are relatively slow and therefore more expensive (e.g., Der Spiegel 2015). If this were correct, a switch to cashless payment instruments could help to reduce the average time it takes out to carry a payment and thus the costs of payment.

In the first payment survey carried out by the Deutsche Bundesbank for the year 2008, 90% of respondents viewed cash as convenient and fast means of payment (Deutsche Bundesbank 2009b). In the most recent payment survey (Deutsche Bundesbank 2015) those who only paid by cash and those who only paid by card were analysed separately. In the first group, 33% characterised cash as secure and 29% as fast. The respective values in the second group were 26% and 27% – only marginally lower than in the first group.

According to a study carried out to estimate the time it takes to complete a payment by the EHI Retail Institute in Germany (Siedenbiedel 2016), cash payments are still faster than card payments (see also Fung 2015 for Canada and Jonker 2016, 39 for the Netherlands). According to Denmark's Nationalbank (2012), in Denmark there are no significant differences with respect to the time it takes to carry out a cash or a card payment.

To conclude, there is little evidence that cash is systematically slower as a means of payment at the POS than other payments media.

4. *The Security Argument*

Obviously, when trying to evaluate payment instruments, security is a crucial issue. Payment instrument users can react very sensitively to changes in actual or perceived security of payment instruments (Kosse 2013). In this respect, the security problems arising from a complete elimination of cash are often underestimated (Krueger/Seitz 2015). To understand why this is the case, one has to be aware how intensive and how diverse the use of cash still is. Eliminating cash implies that cashless payments have to be universally used and accepted – by anybody without any restrictions. “Anybody” includes people with reduced cognitive capabilities as well as criminals. Except for small children and legally incapable persons really everybody needs to be able to make and receive cash payments. To achieve this goal, those electronic means of payment that are meant to substitute for cash must be very easy to use. Preferably, they would have to be usable also in offline mode (without an online connection to a bank or payment service provider). Offline usability is a necessary fall-back solution for situations when communication lines are not functioning. Moreover, it is indispensable as long as online coverage is not 100 %. To date, the only payment medium able to combine ease of use, offline availability, anonymity and convenience is cash. There have been repeated attempts to provide cashless systems of this kind, but accomplishing the above-mentioned combination has shown only limited success. Bitcoins, for example, are neither particularly easy to use nor are they convenient (the payee must wait several minutes until the authenticity of the bitcoins is confirmed).

Experience has also shown that not only the security of the Bitcoin technology is an issue. Owners of Bitcoin may also be subject to theft. Bitcoin owners have to trust their own hardware (PC, notebook, tablet, smart phone and the software installed on these devices) and/or the service providers that store Bitcoins. Of course there may be innovations that will help to contain security problems. But it is a pipe dream to think that digital payment systems can simply grow out of existing security problems. After all, the incentives for fraudsters to attack a particular payment system are increasing with the size of the system. For instance, data of the ECB (2015) demonstrate that card fraud is highest in the largest European card markets, England and France. The fraud rates in these countries are much higher than in countries such as Germany or Italy in which cards are used much less.

Thus, it seems likely that a generally used electronic means of payment that serves as a substitute for cash will face intensive attacks by criminals. Such a system is particularly vulnerable because, once cash has been eliminated, fraudsters could not be excluded from using it. Access to electronic payment systems would almost be a “human right”.

IV. The Benefits of Cash

1. Privacy

Focussing only on costs presupposes that all payments are alike – or, put more technically, that payments are homogenous goods. However, numerous studies show that from the point of view of users (not just criminals) it makes a difference (beyond costs) which payment instrument is used. In fact, a cashless world in which all payments are electronic would provide the state (and possibly also criminals) with a frightening potential to control ordinary citizens. In the words of *Goodhart/Krueger* (2001) it would be a complete “Orwellian nightmare”.

It may be argued that a move towards a cashless world would not make such a difference. In the modern computerised and interlinked world citizens already leave a digital trail that covers a large part of their activities. This concerns their activities on the internet, video surveillance in the “real” world, use of mobile phones, and an already existing use of electronic payments. In other words, privacy has already been largely compromised.¹⁶ However, payment data are far from complete because people still use cash intensively. In many cases, they may choose which instrument to use and if they wish to preserve privacy they can use cash. Such payments do not leave any trail. Given the large number of cash payments, this matters. For Germany, *Krueger/Seitz* (2014) estimate a volume of 32 bn cash transactions (2011). That implies that the average German conducted 400 cash transactions per year.¹⁷ If all these transactions were carried out electronically, the potential amount of control would be increased considerably. There would be no more privacy to speak of.

Kahn et al. (2005) argue that “cash is privacy” and that the loss of privacy and anonymity would make transactors worse off. There would be less legal (!) transactions and correspondingly a deadweight loss – as in the case of distorting taxes. The importance of privacy for many people can also be inferred from the fact that cash is even used in e-commerce. The model “order on the net – pay in store” is widely used.

In 2002, *Drehmann/Goodhart/Krueger* (2002) wrote: “There are many reasons why people may prefer anonymity – many of which are connected with ‘bad’ behaviour.” But “bad” does not necessarily mean “illegal”. It also refers to the little weaknesses of human nature. Moreover, it should also be considered that governments may also misbehave.

¹⁶ *Birch* (2014) makes the disturbing argument that, in the future, it may well be possible to preserve privacy in the virtual world but *not* in the real world.

¹⁷ This figure should be interpreted as a lower bound. In the same period (2011) the number of card transactions per person amounted to 36.

Another important advantage of cash is that it provides people with an easy way of budgeting. If somebody wants to spend only 50 dollars in a certain period using cash may be the simplest means to achieve this. As *Hernandez et al.* (2016) report, this aspect is important for many cash users.

Of course, it is conceivable that an anonymous electronic means of payment could be created. Currently, Bitcoin receives a lot of attention. But Bitcoin is far from being an electronic equivalent of cash. From the point of view of users, products like Bitcoin are complex and it is difficult to ascertain, how well anonymity is protected. According to *Böhme et al.* (2015) Bitcoin is not as anonymous as cash: “Bitcoin raises certain privacy risks, most notably the risk that transactions can be linked back to the people who made them. Bitcoin transactions are not truly anonymous: instead, they are pseudonymous, ...” (see also *Koshy et al.* 2014).

From the point of view of governments, such products would be worse than cash: Criminals, terrorists, etc. could send around millions across the globe with one click. For instance, according to press reports, there have already been cases in which blackmailers have demanded ransom to be paid in Bitcoin (*ThePAYpers* 2015). As a consequence, governments are increasingly regulating Bitcoin-related services.¹⁸

2. Payment Inclusion

Cash allows all parts of society to make payments using a straightforward means of payment. These include children, people with cognitive impairments, those with limited or poor education, and refugees. The availability of cash as a method of payment therefore ensures, at least at present and in the near future, that everyone can participate adequately in economic life (*Lepecq* 2015). In the words of *Erkki Liikanen*, the Governor of the Bank of Finland (2016): “But the payment system is a utility which must be accessible to everybody, not only the majority of people. It must be inclusive. So that raises the issue of how social groups with special needs can cope without the option of using cash.” In this sense, cash is “successfully implemented social policy” and helps achieve payment inclusion (*Committee on Payments and Market Infrastructures* 2016). In light of these considerations, *Sveriges Riskbank* (2016) issued a press release in March 2016 warning of the risks of switching over too rapidly to a cashless society, highlighting situations in which there are no alternatives to cash and calling on banks to continue supplying cash to the general public.

¹⁸ Examples are Switzerland (see *FINMA* 2014) or the state of New York where a new BitLicense law has been passed. See also *EBA* (2014).

Based on payment diaries as well as surveys, irrespective of the country, it is evident that cash holdings increase in line with lower levels of education and income (see, for example, Deutsche Bundesbank 2015; *Bagnall et al.* 2016; *Wang/Wolman* 2014). In Germany, the share of payments made in cash by people with low incomes has actually risen over time and, based on the last payment behaviour study in 2014, stood at 75 % for households with an income of less than €1,500 (Deutsche Bundesbank 2015, 35). In an international study, *Bagnall et al.* (2016) find clear confirmation of the education effect, in particular, in all seven countries analysed (Australia, Austria, Canada, France, Germany, the Netherlands and the United States). *Wang/Wolman* (2014) use the largest dataset, consisting of two billion retail transactions of a large discounter in the United States. They confirm the existence of the above-mentioned effects and show additionally that cash usage reacts to variables related to income and education. For example, they find that a higher cash share is associated with renters in comparison to property owners and with the Afro-American and Hispanic population compared to the “white” benchmark group. The effects are reinforced as the transaction volume increases.

In Sweden, by no means everyone has turned their back on cash, either. According to a representative survey by the Riksbank on payment behaviour, the share of people who view the decline in cash usage negatively rose from 24 % to 31 % between 2014 and 2016 (www.riksbank.se/en/Statistics/Payment-statistics/). The Swedish National Pensioners’ Organisation (PRO) is also calling on the Swedish government to ensure continued access to cash, and 140,000 Swedes have signed its petition. The Swedish association of retailers and small businesses (Småföretagernas Riksförbund) is also critical of current developments and fears that a further deterioration in the cash supply could endanger many small enterprises (*Betz* 2016). Other critical voices maintain that the decline in cash reflects not so much customer preference as the interests of the banks (*Eriksson* 2014). Thus, Sweden, which is cited time and again as an example of an economy that is on its way to becoming cashless, shows that moving away from cash also causes many problems.

In this sense, we should be wary of limiting cash usage too far in the absence of universal, widely used and accepted alternatives to cash.

3. Systemic Relevance

What if the electronic payment system is down? What if its security is compromised? Paper works without infrastructure (to a certain extent). An instructive example is provided by the bank strikes in Ireland in 1970 (Central Bank of Ireland 1971; *Krueger* 2017). People and businesses did not have access to bank accounts for a protracted period of time. Consequently, there was a heavy use of

cash, checks and foreign cash. In this way, it was possible to keep the economy running.

Today, such a bank strike might have more serious problems. In many countries, checks are on the way out. Even if they are still used, the relationship between payer and payee has changed. In 1970, a lot of the transactions were between people who knew each other. Thus, they could form some kind of expectation regarding the likelihood that a check would not bounce. In today's environment, it would be much more difficult to use checks as substitutes for other payment instruments.

Cash allows market participants to carry out transactions without the help of any intermediary. Thus, it also works when intermediaries are shut down or cannot be reached. However, access to cash is relying on payment cards and central switching points. Thus, cash provision is vulnerable in exactly the same way as card payments. Still, by keeping some cash reserves people can prepare for such a contingency. Thus, cash still provides a limited fall-back in times of disruption. But what are the fall-back solutions in a cashless world?

4. *Bank Runs with and without Cash*

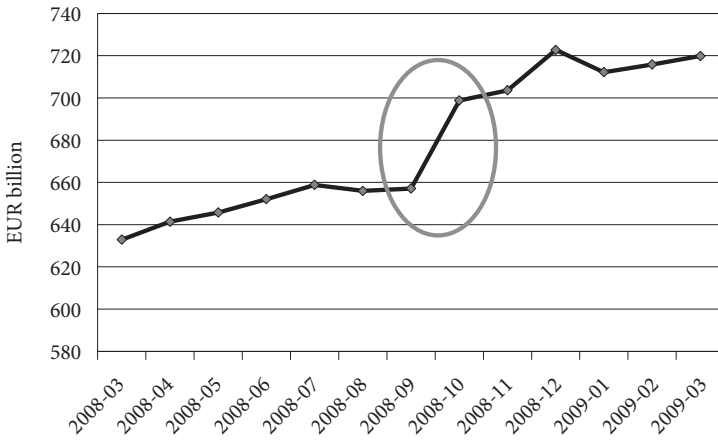
An important aspect that has received little attention, so far, is the role of cash in times of financial crisis and general lack of trust in the financial system. During such periods the demand for cash is usually rising. Thus, the Bundesbank alone paid out EUR 11.4b. in cash in October 2008, the month of the Lehman bankruptcy (see Figure 4). A large part of the notes delivered to the public were high denomination notes (Deutsche Bundesbank 2009a).¹⁹

Such a “run” on the banking system is usually seen as a serious threat that may lead to a collapse of the banking system. However, experience shows that the ability to withdraw cash from the banks may also calm the nerves of the public. As soon as people realise that “their money” is still in the bank, trust is restored.²⁰ So, the ability to get “money” out of the system may serve as a safety valve (Negueruela 2014) – a safety valve that would be missing in a cashless world.²¹

¹⁹ See also Negueruela (2014) and Cusbert/Rohling (2014) who analyse the Lehman effect for Spain and Australia.

²⁰ Of course, other factors were at work, too. The German government, for instance, declared deposits as safe – a statement that the public immediately interpreted as a guarantee of the government.

²¹ One may object that cash is a liability of the central bank and that the holder of cash would still be tied “in the system”. But this is not the way people see it – and rightly so, one should add. For the value of money the structure of the balance sheet of the central



Source: ECB SDW.

Figure 4: The Lehman Effect

In a system based entirely on electronic means of payment, it is in principle impossible for non-banks as a whole to withdraw funds from the banking system. As a result, there may be frantic buying and selling which only moves claims against the banking system from one non-bank to the other. Such a process is unlikely to restore trust into the banking system and may considerably distort financial market prices. This situation resembles hyperinflation in which everybody tries to get rid of money as fast as possible but all money holders together are unable to reduce their (nominal) money holdings.

5. Cash and Banking

In terms of the value of payments cash accounts for only a trifle of the payment market (Krueger/Seitz 2014). Therefore, abolishing cash may seem to be a matter of minor importance – a little detail of the payment system. However, such a view neglects the crucial role of cash in the current two-tier banking system. Cash is the only “direct access to central bank money” (Mersch 2017) for the general public. If cash ceased to exist, private non-banks would no longer have access to central bank money, effectively rendering them “captive” in the commercial banking system. If, say, the private non-banks were to lose confidence in the commercial banks, the conversion of deposits into cash would no

bank is relatively unimportant. For money holders, it is important that others will accept money against goods and assets.

longer be possible. For the general public, this would hardly be acceptable. There would be mounting pressure to consider the following options:

- Bank deposits covered by central bank money (“narrow banking”).
- Deposits in central bank accounts available to everyone.
- Digital central bank money (e-euro).

In some countries, enterprises and households have already voiced their demand for such a fundamental change to the system. For instance, Talanx Insurance tried (in vain) to secure the right to hold a Bundesbank account by taking the matter to court (Süddeutsche.de 2010). In Switzerland, a narrow banking initiative has been set up, its aim being to amend the Swiss constitution so as to make it mandatory for deposits held at banks to be wholly covered by central bank money.²²

But central banks, themselves, are likewise turning their attention to this matter. In the light of the dwindling use of cash, the Swedish Riksbank is already considering whether it should start issuing electronic money (e-krona) (*Skingsley* 2016; Sveriges Riksbank 2017). Meanwhile, the Bank of England, too, has been intensely involved in this topic (*Broadbent* 2016; Bank of England 2015).

At this juncture, it is difficult to foresee where these deliberations will lead, not least because cash is still used intensively and concrete plans to actually abolish it completely are not on anyone’s agenda at present. The Swedish Riksbank is keen to emphasize that e-krona should not be viewed as a substitute for cash but as a complement (*Skingsley* 2016). The same is true for the Bank of England. Governor Carney has stressed that there are no plans to do away with cash (*Broadbent* 2016).

Nevertheless, it is possible and useful in this context to assess the consequences of a drastic decline in the use of cash, and perhaps its complete abolition. Surprisingly, central banks’ importance as the agents that issue cash would not necessarily decrease but, under certain circumstances, actually increase. This applies irrespective of which “replacement products” might be offered in the event of cash being abolished, be it deposits in narrow banks, deposits in central bank accounts for everyone or digital central bank money.

It is reasonable to assume that the size of the central bank’s balance sheet would increase significantly in all three scenarios (*Koohs* 2016a, b). If narrow money were chosen as the solution, banks’ reserves would increase sharply. If central bank accounts were also made accessible to non-banks, then deposits

²² For more information on this, please consult www.vollgeld-initiative.ch/ The Swiss Federal Council spoke out against this initiative in 2016, but there will be a referendum on the subject in 2018. As regards the standpoint of the Swiss National Bank, see *Jordan* (2016).

held at the central bank would compete with deposits at commercial banks. Especially in times of uncertainty, non-banks would undoubtedly make extensive use of the option of keeping their money safe at the central bank. If e-euro were offered by central banks, then cash would be replaced by central bank e-money, though probably not on a one-to-one basis. Central bank e-money might therefore compete with cash and commercial banks' overnight deposits as well (*Broadbent* 2016).

The exact degree of such competition would depend heavily on the specific design of the new central bank products. Depending on the design of the new system (i. e. its conditions, including the interest rates applied and its ease and scope of use), it could lead to a wide-scale substitution of bank deposits. It is even conceivable that the ability of the commercial banking system to create credit would be seriously impeded (*Broadbent* 2016; *Skingsley* 2016; *Tolle* 2016).

It is hard to gauge the extent to which non-banks would make use of this facility. Supposing overnight deposits in the euro area were subject to a 100 % reserve rule, this would oblige the banks to hold reserves of €6.2 trillion, based on today's volumes (see Table 3). To achieve this, banks would have to sell assets, while the Eurosystem would be obliged to purchase assets. Alternatively, the Eurosystem could furnish the banks with loans. The magnitude of these transactions would be equivalent to the value of about one half of all assets held by the commercial banks. Such effects could also be incurred if the non-banks were to decide in favour of central bank accounts or central bank e-money.

Table 3
Deposit Liabilities of Euro Area Banks (EUR Billion)

Overnight deposits	6.156
Deposits of euro area residents	12.195
<i>In comparison: Liabilities of the Eurosystem</i>	
<i>Banknotes in circulation</i>	<i>1.109</i>
<i>Liabilities to euro area credit institutions</i>	<i>1.387</i>
<i>Liabilities to other euro area residents denominated in euro</i>	<i>305</i>

Notes: End of January 2017.

Source: Deutsche Bundesbank.

Abolishing cash could therefore ultimately mean that the Eurosystem's balance sheet would enlarge considerably. The question of how the assets side of the balance sheet is to be arranged would then be of enormous macroeconomic importance. Consequently, it is not by chance that the President of the Swiss Na-

tional Bank, in the event that the narrow banking resolution is passed, warned of a looming “politicization of monetary policy” (Jordan 2016). The same may be said regarding the other two options (central bank accounts for non-banks, digital central bank money).

The consequences for the commercial banking sector would be just as serious. The commercial banks’ balance sheets would possibly contract massively and the ability to generate credit would be limited – in the worst case scenario, it would disappear entirely. This could have painful ramifications for the real economy. Against this background, the solely cost-driven arguments of banks with respect to cash are not convincing.

Even if the balance sheets of commercial banks were to suffer less, there is still another reason why abolishing cash could have wide-ranging consequences for the banking system. Banks frequently view cash as a burden because issuing and collecting cash is associated with considerable costs and the process only generates minimal directly attributable income. However, it is frequently overlooked that the role of banks in the cash cycle is one of the essential features that sets banks apart from other financial service providers in the eyes of their customers. The infamous US bank robber Willie Sutton expressed this fact pithily when he said,

“A bank is where the money is.” (Sutton’s law) (Wikipedia 2015).

For him, “money” means “cash”. This view is shared by most people. They think of cash when they talk about “money”.²³ If cash were actually abolished, there would not be any “money” in the bank any more. This raises the question:

“If there is no more money in the bank, is the ‘bank’ still a bank?”

In this case, what would become of the nice business model of issuing non-interest-bearing liabilities (“sight deposits”)? Competition would increase on the liability side of a bank’s business. From the customer’s perspective, branch banks, direct banks and other financial intermediaries would be offering investment products that differ little from each other.

V. Summary, Conclusions

Cash is an ancient institution that has served mankind well. The reasons for this lie in the many advantages that cash offers, which are related to its unique features. The breadth of issues that are related to cash and its potential abolition serves as a testimony of its importance. Abolishing cash is not just a technical matter that can be decided with the help of a relatively simple cost analysis. A

²³ The “Hofgarten” beer garden in Aschaffenburg is a good example. Until recently, the menu stated: “We only accept money payments – no plastic!”

world without cash might differ more radically from today's world than we think. Therefore, we should not decide such a move with undue haste. Maybe, there should be no "decision" at all.²⁴ If we really can do without cash, sooner or later, it will disappear.

When considering the case against cash, one is reminded of *Hayek's* (1978) critique of "constructivism": "the innocent sounding formula that, since man has himself created the institutions of society and civilisation, he must also be able to alter them at will so as to satisfy his desires and wishes" (*Hayek* 1978). Of course, Hayek was highly skeptical of this approach because he viewed human institutions as product "of human action but not human design" (*Hayek* 1978).

References

- Alsterlind, J./Armelius, H./Forsman, D./Jönsson, B./Wretman, A.-L.* (2015): How far can the repo rate be cut?, Sveriges Riksbank, Economic Commentaries, No 11.
- Bagnall, J./Bounie, D./Huynh, K. P./Kosse, A./Schmidt, T./Schuh, S./Stix, H.* (2016): Consumer cash usage: a cross-country comparison with payment diary survey data, *International Journal of Central Banking* 12(4), pp. 1–61.
- Bank of England* (2015): One bank research agenda, Discussion Paper, February.
- Banque Nationale de Belgique* (2005): Costs, advantages and disadvantages of different payment methods, December.
- Bartzsch, N./Rösl, G./Seitz, F.* (2011a): The circulation of German euro banknotes abroad: estimates applying direct methods, Deutsche Bundesbank, discussion paper, series 1, No. 20/2011.
- (2011b): The circulation of German euro banknotes abroad: estimates applying indirect methods), Deutsche Bundesbank, discussion paper, series 1, No. 21/2011.
- Bech, M./Malkhozov, A.* (2016): How have central banks implemented negative policy rates?, *BIS Quarterly Review*, March, pp. 31–44.
- Berentsen, A./Schär, F.* (2016): The fallacy of a cashless society, in Beer, C, E Gnan & U. W. Birchler (eds), *Cash on trial*, SUEF Conference Proceedings 2016/1, Larcier, pp. 14–19.
- Betz, K.* (2016): Schweden. Bargeldloses Bezahlen entzweit die Gesellschaft, *Deutschlandfunk*, 15 August.
- Birch, D.* (2014): *Identity is the new money*, London Publishing Partnership, London.
- Böhme, R./Christin, N./Edelman, B./Moore, T.* (2015): Bitcoin: Economics, Technology, and Governance, *Journal of Economic Perspectives* 29, pp. 213–238.

²⁴ *Rösl et al.* (2017) calculate that in the case of the euro area and Germany, the welfare costs of abolishing cash would be substantial.

- Borio, C./Zabai, A.* (2016): Unconventional monetary policies: a re-appraisal, BIS Working Papers No 570, July.
- Broadbent, B.* (2016): Central banks and digital currencies, speech given by Ben Broadbent, Deputy Governor for Monetary Policy, Bank of England, London School of Economics, 2 March.
- Buiter, W. M.* (2009): Negative nominal interest rates: Three ways to overcome the zero lower bound, NBER Working Paper 15118, June.
- Cards International* (2016): India demonetises high denomination currency notes to weed out black money, Published: 9 Nov 2016.
- Central Bank of Ireland* (1971): Survey of the economic effects of bank dispute 1970, Dublin.
- Committee on Payments and Market Infrastructures, World Bank Group* (2016): Payment aspects of financial inclusion, April.
- Cusbert, T./Rohling, T.* (2014): Currency demand during the global financial crisis: Evidence from Australia, in: Deutsche Bundesbank (ed), The usage, costs and benefits of cash – Conference Volume, pp. 178–221.
- Danmarks Nationalbank* (2012): Costs of payments in Denmark.
- Der Spiegel* (2015): Bargeld ist ein Anachronismus, interview with Peter Bofinger, No 21, 16 May.
- Deutsche Bundesbank* (2009a), The development and determinants of euro currency in circulation in Germany, Monthly Report, June, pp. 49–62.
- Payment behaviour in Germany – an empirical study of the selection and utilisation of payment instruments in the Federal Republic of Germany, Frankfurt am Main.
 - Payment behaviour in Germany in 2014 – third study of the utilisation of cash and cashless payment instruments, Frankfurt am Main.
- Drehmann, M./Goodhart, C./Krueger, M.* (2002): The challenges facing currency usage: will the traditional transactions medium be able to resist competition from the new technologies?, *Economic Policy* 34, Spring, pp. 195–227.
- Drexler, M.* (2003): Kokain an Geldscheinen: Polizei bezweifelt Aussagekraft der Studie, *Kieler Nachrichten*, p. 13, 9 July.
- Eriksson, B.* (2014): Cards on the table: the reasons why banks want to eliminate cash, authorized translation funded by Currency Research, 2014.
- European Central Bank* (2015): Fourth report on card fraud, Frankfurt am Main, July.
- European Payments Council (EPC)* (2003): Cash Working Group. Summary of Findings & Recommendations, 28 March 2003.
- FINMA* (2014): Fact Sheet. Bitcoins, 25 June.
- Fung, B./Huyuh, K. P./Kosse, A.* (2017): Acceptance and use of payments at the point of sale in Canada, *Bank of Canada Review*, Autumn, pp. 14–26.
- Fung, B.* (2015): Cashless society: is it the future? Speech at Suomen Pankki’s “Going Cashless” conference, Helsinki, 14 June.

- Goodhart, C./Krueger, M.* (2001): The impact of technology on cash usage, Financial Markets Group, London School of Economics, Discussion Paper 374.
- Haldane, A. G.* (2015): How low can you go?, 18 September.
- Häring, N.* (2015): Das Barzahlungsexperiment. Mit Münzen und Scheinen gegen den Rundfunkbeitrag, Handelsblatt, 05.06.2015.
- Hayek, F. A.* (1978): The errors of constructivism, in: *New Studies in Philosophy, Politics, Economics, and the History of Ideas*, London 1978.
- Hellwig, M.* (2015): Jens Weidmanns gefährliche Argumente, Frankfurter Allgemeine Sonntagszeitung, 4 January.
- Hernandez, L./Jonker, N./Kosse, A.* (2016): Cash versus debit card: The role of budget control, *Journal of Consumer Affairs* 51, pp. 91–112.
- Jobst, C./Stix, H.* (2017): Doomed to Disappear: The surprising return of cash across time and across countries, CEPR Discussion Paper DP12327, September.
- Jobst, A./Lin, H.* (2016): Negative interest rate policy (NIRP): implications for monetary transmission and bank profitability in the euro area, IMF Working Paper WP/16/172, August.
- Jonker, N.* (2016): Cash as a budget control device, in Beer, C., E. Gnan and U. W. Birchler (eds), *Cash on trial*, SUERF Conference Proceedings 2016/1, Larcier, pp. 37–44.
- Jordan, T. J.* (2016): Erläuterungen zur Schweizer Geldpolitik, 108th ordinary general assembly of the shareholders of the Schweizerische Nationalbank, Bern, 29 April 2016.
- Kahn, C. M./McAndrews, J./Roberds, W.* (2005): Money is privacy, *International Economic Review* 46, pp. 377–399.
- Kooths, S.* (2016a): Scheindebatte: Währung ohne Bargeld, *IfW Fokus* 185, 26 March.
- Schein oder nicht Schein, *Wirtschaftswoche*, p 35, 11 March.
- Koshy, P./Koshy, D./McDaniel, P.* (2014): An analysis of anonymity in Bitcoin using P2P network traffic, *Lecture Notes in Computer Science* 8437, pp. 469–485.
- Kosse, A.* (2013): The safety of cash and debit cards: a study on the perception and behavior of Dutch consumers, *International Journal of Central Banking* 9, pp. 77–98.
- Krueger, M.* (2013): Ein Drei-Punkte-Plan zur Reformierung der Geldpolitik, *Credit and Capital Markets* 46-4, pp. 425–441.
- (2017): Money and credit: lessons of the Irish bank strike of 1970, *ROME Discussion Paper Series*.
- Krueger, M./Seitz, F.* (2014): Costs and benefits of cash and cashless payment instruments in Germany. Module 1, Overview and initial estimates, Study commissioned by the Deutsche Bundesbank, Frankfurt.
- (2015): Bargeldlos oder bar jeglichen Verstands? Was die Abschaffung des Bargeldes bringt oder eben gerade nicht, *ifo Schnelldienst* 13/2015, Vol 68, pp. 9–12.
- (2017): The benefits of cash, Module 2, Study commissioned by the Deutsche Bundesbank Fritz Knapp Verlag, Frankfurt.

- Laubach, T./Williams, J. C.* (2015): Measuring the natural rate of interest redux, Federal Reserve Bank of San Francisco Working Paper 2015–16.
- Leinonen, H.* (2016): Developing future payment instruments? When is the time to move from cash and cards to new generation instruments? in Beer, C., E. Gnan and U. W. Birchler (eds): Birchler (eds), Cash on trial, SUERF Conference Proceedings 2016/1, Larcier, pp. 20–36.
- Lepecq, G.* (2015): Cash essentials beyond payments, AGIS Consulting.
- Liikanen, E.* (2016): Cash and the central bank, speech at Suomen Pankki's "Going Cashless" conference, Helsinki, 14 June.
- McAndrews, J.* (2015): Negative nominal central bank policy rates: Where Is the lower bound? Remarks at the University of Wisconsin, May 8, 2015.
- Mersch, Y.* (2017): Monetary policy challenges for Europe: banking on the recovery, Speech at the 2017 IIF Spring Membership Meeting, Tokyo, 8 May 2017.
- National Forum on the Payment System* (2004): The costs of payments. Survey on the costs involved in POS payment products, Working Group on Costs of POS Payment Products, March.
- Negueraela, D.* (2014): Cash and the financial crisis, in: Deutsche Bundesbank (ed.), The usage, costs and benefits of cash – Conference Volume, pp. 75–152.
- Reißmann, O.* (2014): Verdacht auf Diebstahl. Bitcoin-Börse Mt. Gox ist offline, Spiegel-Online, 25. February.
- Rogoff, K. S.* (2016): The curse of cash, Princeton University Press, Princeton and Oxford.
- Rösl, G./Tödter, K.-H./Seitz, F.* (2017): Doing away with cash? The welfare costs of abolishing cash, Institute for Monetary and Financial Stability (IMFS) Working Paper No. 112, April.
- Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung* (2014): Jahresgutachten 2014/15, Wiesbaden.
- Salmony, M.* (2011): Why is use of cash persisting? Critical success factors for overcoming vested interests, Journal of Payments Strategy & Systems 5, No. 3, pp. 246–272.
- Sands, P.* (2016): Making it harder for the bad guys: the case for eliminating high denomination notes, M-RCBG Associate Working Paper Series No 52, February.
- Schmiedel, H./Kostova, G./Ruttenberg, W.* (2012): The social and private costs of retail payment instruments: A European perspective, ECB Occasional Paper Series No. 137, September.
- Schneider, F.* (2002): The size and development of the shadow economies of 22 transition and 21 OECD countries, IZA Discussion Paper No. 514, June 2002.
- Schneider, F./Enste, D.* (2000): Shadow economies: Size, causes, and consequences, Journal of Economic Literature 38, pp. 77–114.
- Schneider, F./Linsbauer, K.* (2016): The financial flows of transnational crime and tax fraud. How much cash is used and what do we (not) know?, in Beer, C., E. Gnan and U. W. Birchler (eds): Birchler (eds), Cash on trial, SUERF Conference Proceedings 2016/1, Larcier, pp. 83–107.

- Siedenbiedel, C.* (2016): Geldirrtümer: Bargeld oder Karte: Was geht schneller?, FAZ.net, 27 November.
- Skingsley, C.* (2016): Should the Riksbank issue e-krona? Speech at FinTech Stockholm, 16 November.
- Sueddeutsche.de* (2010): Talanx verklagt Bundesbank. Spektakulärer Streit um ein Konto, 17 May.
- Summers, L. H.* (2014): Idle workers+low interest rates=time to rebuild infrastructure, Boston Globe, April 11.
- Sveriges Riksbank* (2016): The Riksbank's e-krona project. Report 1, September 2017.
- (2016): Introduce a legal requirement for the banks' cash service, press release, 16 March.
- The Economist* (2017): Paint it white. Of Indian banknotes cancelled last year, 99 % are accounted for, Sep 2, 2017.
- The Paypers* (2015): Hacker leaks UAE bank data demands Bitcoin ransom, Monday 30 November 2015. <http://www.thepayers.com/digital-identity-security-online-fraud/hacker-leaks-uae-bank-data-demands-bitcoin-ransom/762274-26>.
- Tolle, M.* (2016): Central bank digital currency: the end of monetary policy as we know it?, Bank of England, Bank Underground, 25 July.
- Ulbrich, J.* (2016): Getting rid of cash? Some monetary policy considerations, in Beer, C., E. Gnan and U. W. Birchler (eds), Cash on trial, SUERF Conference Proceedings 2016/1, Larcier, pp. 108–111.
- van Hove, L.* (2007): Central banks and payment instruments: A serious case of schizophrenia, *Communications & Strategies* 66:2, pp. 19–46.
- Wang, Z./ Wolman, A. L.* (2014): Payment choice and the future of currency: insights from two billion retail transactions, Federal Reserve Bank of Richmond, Working Paper 14-09R, October.
- Weizsäcker, C. C. von* (2015): Das Ende der Kapitalknappheit und sein Verhältnis zur Keyneschen Theorie, Keynote Lecture auf der Jahrestagung der Keynes Gesellschaft 2015, Graz, 24. February.
- Wikipedia* (2015): Willie Sutton, https://en.wikipedia.org/wiki/Willie_Sutton, last accessed 9 December 2015.