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Abstract

The period from the 1950s to the late 1970s saw an almost uniform decline of cash-to-GDP ratios in industrial countries. A closer look at the German payment system suggests that the factor causing such a change has been the shift towards cashless wage payments. In this period, in Germany, the branch network of the banks expanded significantly and at the end of the period almost all economically active persons had a current account. This change was triggered by rising wages and incomes. Rising wages increased the burden of weekly wage payments in cash, and rising incomes made the average earner more interesting for banks. Moreover, regulation and de-regulation, triggering both, price and non-price competition, may also have played a role. Technological change has not been an independent driver. The introduction of cashless wage payments has not only affected the payment behavior but also the savings behaviour of households. These changes were evolutionary rather than revolutionary, however. So, even though the cash-to-GDP ratio declined in this period, absolute amounts of real cash per capita were still rising.

1 Introduction: the post-World War Two evolution of cash-to-GDP ratios

Since the 1980s there has been a rapid spread of non-cash payment instruments that have competed with cash.[1] First and foremost, there has been the spread of debit and credit cards that have become an almost universal payment instrument in many countries. Second, in the 1990s, electronic purses were introduced, however with limited success. After a first wave of mobile payments around the year 2000, we are now witnessing the second wave, which seems to be more successful (Krueger 2016). Third, technology is making cards more convenient, in particular through the implementation of contactless payments. Finally, the rise of the internet has shifted an increasing share of retail sales into the web and thus made it more likely that cashless means of payment would be used. In some countries, cards are the main internet payment instruments, in others credit transfers or direct debits. Increasingly, online shoppers also use dedicated internet payment systems like PayPal, iDeal, Sofortüberweisung or recently Bitcoin and other virtual currencies.[2]

Figure 1 Cash-to-GDP ratios since the 1980s (1)
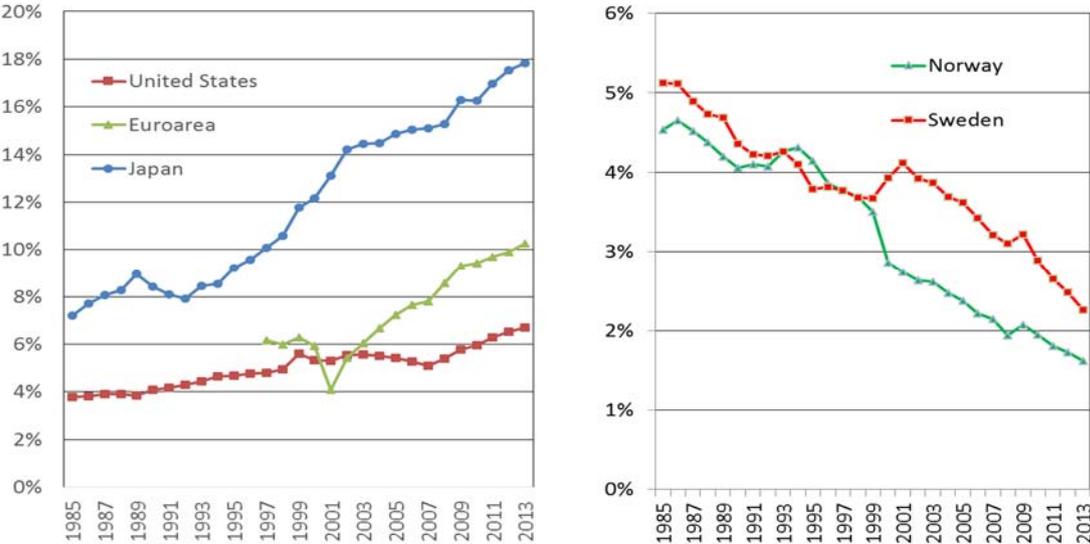
Source: IMF, International Financial Statistics; Norges Bank and own calculations

One should have expected that this wave of innovations would leave its mark on the demand for cash. However, in most countries the amount of cash in circulation is far from declining. When looking at cash-to-GDP ratios, even a rise of cash can be observed in some countries (Figure 1). In others, this ratio has been fairly stable over the past 30 years (Figure 2). Only in some countries there has been a prolonged decline since the mid-1980s (Figure 1).

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[1] Overviews of changes in the area of retail payments are provided by Cronin and McGuinness (2010), Deutsche Bundesbank (2015) and Harasim (2016).

[2] E-commerce payments are not entirely cashless, though. Payment models such as "cash upon delivery" are still frequently used, even in advanced economies.

Figure 2 Cash-to-GDP ratios since the 1980s (2)
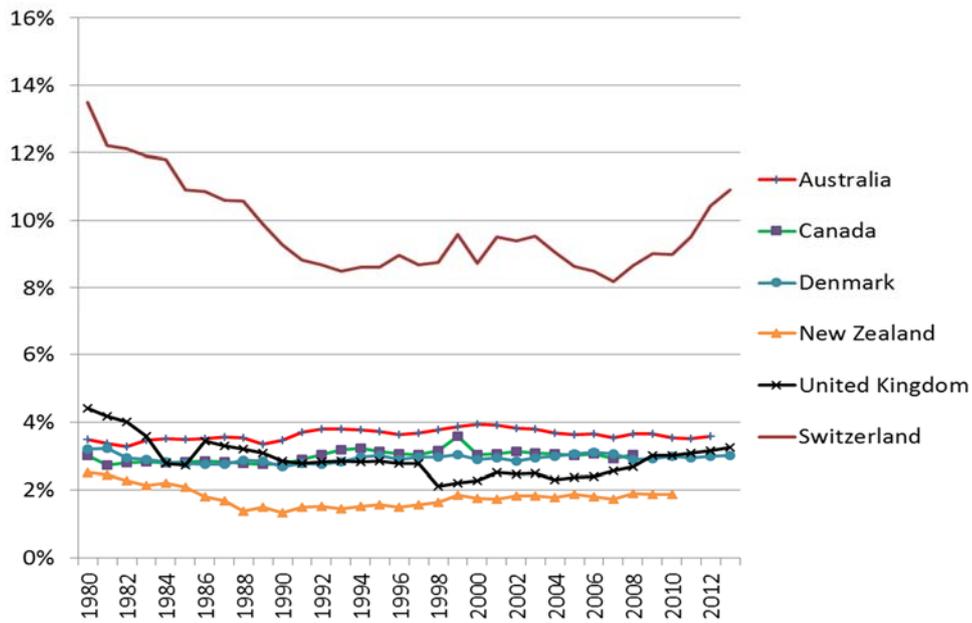
Source: IMF, International Financial Statistics and own calculations

Looking at some of the Eurozone countries, up to 1998, the same picture emerges. There are countries such as Spain and Germany with rising cash-to-GDP ratios, and others with relatively stable ratios (such as Finland) or falling ratios, like Belgium and France (Figure 3).

Figure 3 Cash-to-GDP ratios since the 1980s (3)
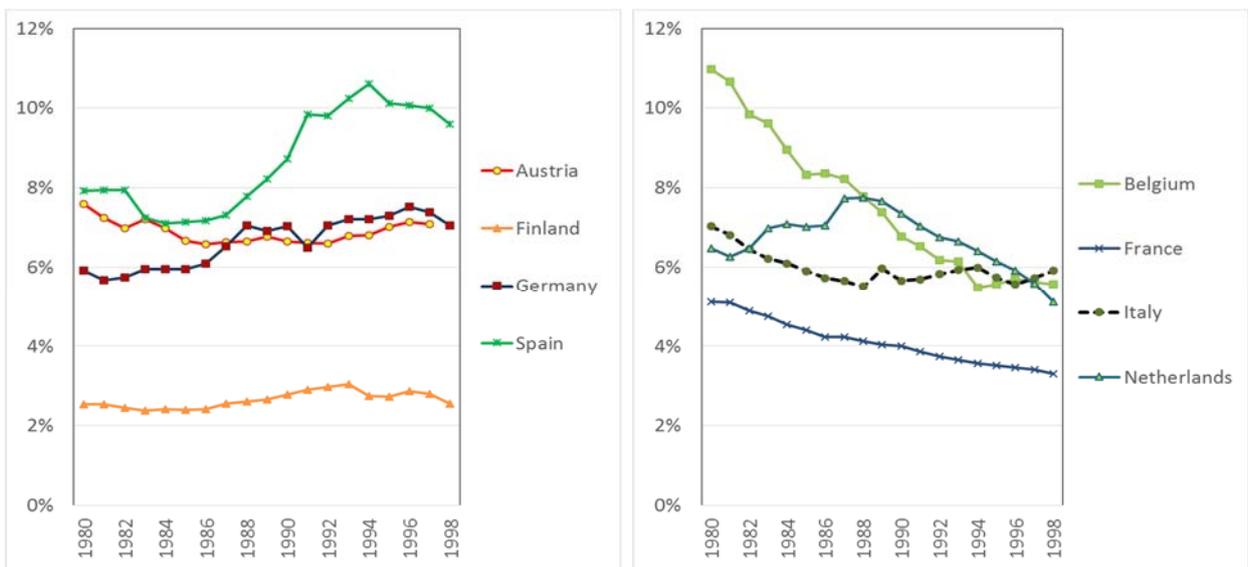
Source: IMF, International Financial Statistics and own calculations

A number of factors may explain this remarkable resilience of cash. First, cash is not only held for transaction purposes but also as a store of value (it is hoarded).[3] Second, in some currency

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[3] For Euro bank notes issued in Germany, Bartzsch, Rösl and Seitz (2011a and b) provide estimates of the share of hoarded balances.

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areas "cash in circulation" does not necessarily mean that the entire stock of cash is held within this area. Empirical estimates are showing that the US Dollar and the Euro, in particular, are also held abroad.[4] Finally, rising cash-to-GDP figures have also been interpreted as indicators of a rising shadow economy.[5]

Figure 4 Cash-to-GDP ratios 1948 to 1980
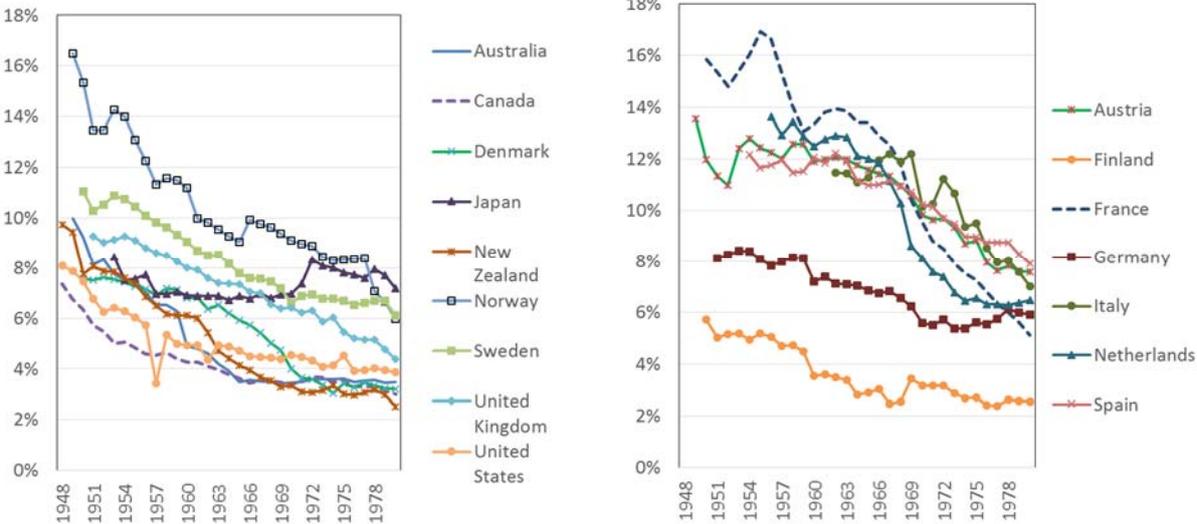
Source: IMF, International Financial Statistics and own calculations

The validity of all of these factors shall not be disputed. However, there may be another factor at work. Although it has become fashionable to see "disruptive" new technologies in all corners of the payment universe, the innovations of the last 20-30 years may not have been as profound as many think. In fact, Paul Volcker once quipped that the „only thing useful banks have invented in 20 years is the ATM" (nypost.com 2009).

Even if Volcker's remark may strike some payment experts (and some financial engineers) as extreme, it has to be admitted that current payment innovations are often technology-driven: chip cards, asymmetric cryptography, the internet, smart phones, near field communication and distributed ledger technologies are some of the developments that have had an impact on payments. No doubt, some of these technologies have been useful. Moreover, the internet has created new markets with new market needs. But sometimes new technologies are received enthusiastically although there is no clear market need (and business case). As Michael Salmony put it with respect to blockchain/distributed ledgers: "Blockchain is currently a solution looking for a problem." (EPC 2016, 2) This may also have been true for other innovations.

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[4] See Bartzsch, Rösl and Seitz (2011a and b) and Judson (2012).
[5] The so-called "currency demand approach" is discussed in Schneider and Enste (2000).

The same cannot be said about the changes in the payment system that took place in the period from the 1950s to the 1970s. As the analysis below shows, these changes were mainly market driven. Incomes were rising fast and the wider population became an interesting customer group for banks. Moreover, with rising wages, the costs of paying employees in cash were felt more acutely by companies.

A case can be made that the period from the 1950s to the 1970s has seen much more radical change of the payment system than the decades afterwards. These innovations not only deeply affected the way payments were made but also the way people were saving. This explains why, in this period, there was, indeed, a strong decline of cash-to-GDP ratios throughout the developed world (Figure 4).

Below, an in-depth analysis of the introduction of cashless wage payments in Germany will be provided in order to identify the main drivers of change (section 2).[6] In section 3, the effects of payment innovations on the payment and saving behaviour of non-banks will be analysed. Section 4 summarises the results, draws some conclusions for current developments and points to some open questions.

2   Introducing Cashless Wage Payments: Germany 1958-1975

The period from the late 1950s to the early 1970s is characterised by substantial change in the way ordinary people carried out payments and held their wealth. In this period, companies started paying wages by credit transfers and the number of current accounts or 'giro accounts' grew rapidly.[7] These developments are interesting for at least two reasons. First, just like today's innovations (card payments, mobile payments) these innovations promised to substitute non-cash payments for cash payments on a large scale. Second, they lowered the transactions costs of switching funds between money and interest-bearing assets.

2.1   Revolutionary at First: Retail Banking in Germany[8]

In the 1950s, Germany was basically a cash-society. Wages were mainly paid in cash and few households had an account with a bank. Banking services were mostly reserved for firms and rich individuals. Even though many small savers held savings accounts with the savings banks,

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[6] It would have been desirable, to include more countries in this analysis. This is beyond the scope of this study, however.
[7] Similar developments could be observed, for instance, in Finland, in the Netherlands and in Sweden. See Lelieveldt (2000), Snellman (2000) and Bátiz-Lazo, Karlsson and Thodenius (2009).
[8] This phrase has been borrowed from Büschgen (1995, 697). It aptly describes the changes that took place in German banking starting in the late 1950s. A brief overview can be found in Deutsche Bundesbank (2002).

it is likely that a large portion of the population used cash not only as a medium of payments but also as a store of wealth. If it was necessary to transfer cash to more distant recipients, households used the transfer system of the German postal service, in those days a government agency (Schubert and Schneider 1980).

However, since the late 1950s there have been numerous and wide ranging changes in the payments system:

- introduction of cashless wage payments
- extension of the bank branch network
- improvements in the use of cheques
- increased use of credit transfers and direct debits
- increased use of paperless methods in the payments system
- introduction of cheque and bank cards

Whereas in the late 1950s the possession of a giro account (checking account) was largely confined to firms and wealthy individuals (Terrahe 1983, 352), by 1977 there were 37 million private (i.e. non-business) giro accounts in a population of 61 million (of which 26 million were employed). This suggests that about every economically active person had a giro account by this time.

Figure 5: The Number of Accounts at Savings Banks: 1959-1968[9]
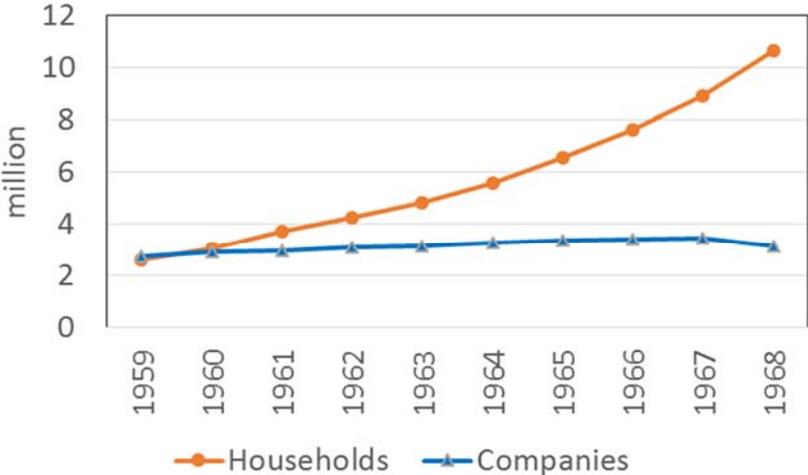
Source: Deutscher Sparkassen- und Giroverband and Trurnit (1969)

The main driver behind this development was the shift from wage payments in cash to cashless wage payments. This shift did not only affect payment methods used in Germany but also the

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[9] For this period, numbers of accounts have only been published for the savings banks. However, since the savings banks are the largest banking group in the retail banking sector in Germany, these numbers are fairly representative for the overall development.

savings behaviour of private households. Once they had giro accounts they were also prepared to invest more in savings products offered by the banks. The transition to cashless wage payments stretched out over a long period ranging from the late 1950s to the mid-1970s. It has changed the banking and payments system more fundamentally than any of the newer innovations such as credit cards and EFTPOS-systems, not to mention mobile payments or Bitcoin.

To a certain extent, cashless wage payments existed already in the 1950s - mainly for public sector employees (Röthel 1960, 299). The share of 'wage and salary accounts' (also referred to as 'private accounts')[10] relative to total accounts was still small, however. In particular, wages were nearly exclusively paid out in cash. This changed in the late 1950s. Up to the mid-1970s the number of wage and salary accounts and bank branches increased strongly (see Figures 5 and 6).[11] Already in 1960 the number of wage and salary accounts surpassed the number of giro accounts of firms. 90 per cent of the following increase of giro accounts with savings banks was due to new wage and salary accounts. In nearly all cases, the switch to giro transfers of wages was immediately followed by a switch to monthly payments (Röthel 1960, 300). The latter may also have been an important source of efficiency gains for firms.

Figure 6: The Number of Banks and Bank Branches (1960-1980)[12]
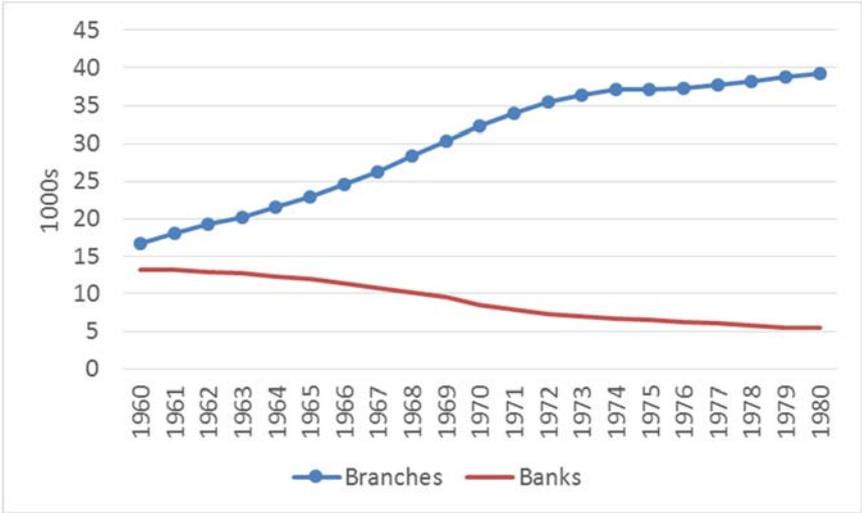
Source: Deutsche Bundesbank

The switch to cashless payments required large-scale investments and technical and organisational improvements of payment processing.[13] The banks had to enlarge their branch network considerably. Up to the mid-1970s the number of bank branches steadily rose while

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[10] Including accounts of pensioners, apprentices etc.
[11] See also Chart 5.12 in Büschgen (1995, 710).
[12] Data of Aschauer (1983, 313) suggest that before 1960 numbers were fairly static.
[13] In the Netherlands, this process was strongly driven by the activities of the Postal Giro Service (Lelieveldt 2000).

the number of banks declined (see Figure 6). At the same time, there were many technical and organisational improvements (Büschgen 1995, 714; Terrahe 1983, 353, Strohmayr 1995, 58).

The transformation of the payment system would not have been possible without co-operation – in particular with respect to new payment standards.[14] In 1960, the banks agreed on a standard form for giro-transfers, in 1963 there was an agreement on 'direct debits' (giro-transfers initiated by the payee) and in 1967 the banks started to emit cheque cards (Lipfert 1970). The introduction of cheque cards enhanced the acceptance of cheques because the issuer of the card guaranteed that cheques would be honoured up to DM200 (later DM300). Finally, in early 1968, more flexible overdraft facilities were introduced (Ashauer 1983, 327; Büschgen 1995, 704).

In the 1970s the in-house processing of cashless payments as well as the clearing between different banks was improved. Optical-mechanical machines were introduced to read and process vouchers and also the first steps were taken on the way towards paperless payments (Terrahe 1983, 353).[15] With the introduction of the 'eurocheque' in 1972 cheques were standardised and gained a larger significance for retail payments and for tourists travelling within Europe.[16] The eurocheque was introduced without charge - neither for households nor for retailers – a 'blemish' the banks were not able to remedy in subsequent years (Strohmayr 1995, 61).

2.2 The Drivers of Payment Innovation 1958-1975

What were the factors that drove payment innovation? In order to answer this question, the incentives of the various groups (banks, firms, wage earners) will be analysed. The focus will be on 'regime change' – not on incremental change.

- Reluctant Wage Earners
For wage earners it was not a question whether they wanted to hold slightly larger or smaller balances on their giro accounts. It was a question whether they wanted an account, at all. In order to decide this question they had to compare the expected costs and benefits of the new regime with the old cash regime. The old cash regime had the advantage for wage earners that they saved trips to the bank since wages were paid out at the firm. But the new regime promised

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[14] Thus, it can be interpreted as an example of successful "co-opetition", a term coined by Nalebuff and Brandenburger (1996).

[15] A short outline of the process of automation of payments can be found in Zügel (1993, 635).

[16] Unlike in the US and Canada they were not used for wage payments, though. Since the banks were aiming for a voucher free processing of payments, cheques were (and are even more so today) an oddity in the system (Büschgen 1995, 712) and their share in total non-cash customer transactions declined. See, for instance, Deutscher Sparkassen- und Giroverband (1980, 35) and e-card business (1998, 6).

a certain gain because some payments can be made easier via transfers of deposits. Interest on deposits has rarely been paid in the past and is still not common in Germany. In this respect, deposits did not promise any gains over cash. Trips to the bank were likely to increase, especially for those households which neither had a giro account nor a savings account, before. If wage payments took place during working hours there were no fixed costs involved for households. In the case of a bank account, however, there might be periodic charges and set-up costs. Furthermore, it had to be taken into account that the shift was going hand in hand with a shift towards monthly wage payments, which basically meant that workers had to grant half a one-month loan to their employers instead of half a one-week loan. For families with tight budget and borrowing constraints this outlook may not have looked advantageous. Even when taking into account that the introduction of consumer credits for account holders made an account more attractive,[17] from the point of view of households, a regime switch from cash to deposits did not necessarily look promising.

On the whole, there does not seem to have been a strong demand for banking services by wage earners.[18] Rather, it took some effort to persuade them to change. To overcome the resistance of private households wage accounts were initially free of charge for employees.[19] Only in 1972 were account charges introduced by most of the banks (Büschgen 1995, 710; Strohmayr 1995, 56).

- Hopeful Firms

Weekly cash payments of wages were quite costly for firms. With rising employment and rising wages the weekly cash payments became more and more of a burden for them. The costs of workers leaving their work places in order to receive cash were rising, especially for firms with a widely dispersed workforce (Juchter 1960, 90). Cashless wage payments held the promise to eliminate these costs. Moreover, since it was understood that cashless wages would be paid out on a monthly basis, there was another benefit for firms. Basically, under monthly payments, workers are granting a 2 week credit to employers whereas under weekly payments it is only a half-week credit.

Using a back-of-the-envelope calculation shows that relatives sizes of benefits. In 1970, the difference in costs between weekly cash payments and monthly non-cash payments would be

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[17] Deutsche Bank introduced the 'small personal loan' in 1959 that helped acquire 700,000 new customers (Büschgen 1995, 697 and 704).

[18] See Schaefer (1961) who describes the reservations of workers and provides a list of conditions that the unions wanted to see fulfilled in order to agree to a regime change.

[19] In some cases employers paid a fee to the bank (Marx 1961, 19).

equal to DM1,200 million, about 0.17% of GDP.[20] Looked at from a different perspective, monthly wage payments imply an implicit employee credit to firms in the range of 6% to 8% of external finance. Thus, for companies the shift to monthly cashless wage payments definitely had benefits. However, most of these benefits could have been reaped even if cash payments had been maintained.

Figure 7: Cost savings for firms
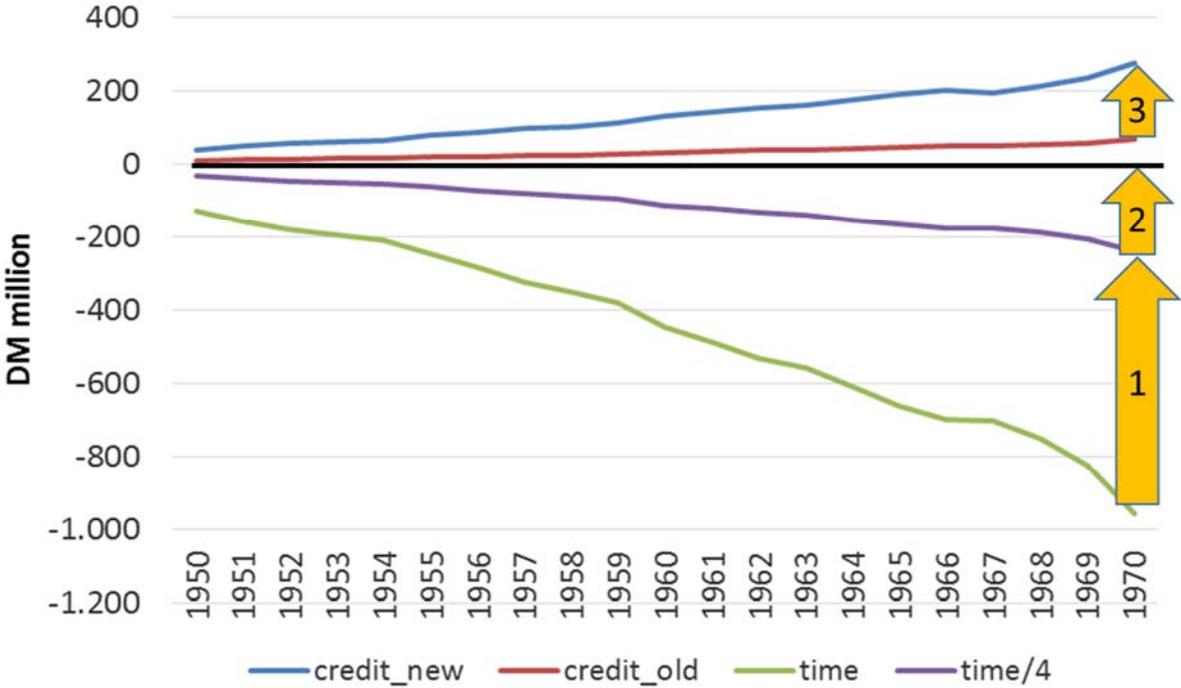
credit-new: interest saved due to implicit credit to firms when wages are paid monthly; Credit-old: interest saved due to implicit credit to firms when wages are paid weekly; time: costs of paying out wages in cash every week, time/4: costs of paying out wages in cash every month. Arrows are explained in the text. Sources: see appendix

Interestingly, from the point of view of companies, most benefits of a shift towards cashless wage payments could also have been achieved by a shift towards monthly wage payments in cash. Such a shift would have affected the saving on the time lost when workers were collecting their cash payments (arrow 1 in Figure 7) and the increase of the implicit credit that came with monthly payments (arrow 3 in Figure 7). The only additional benefit that came with cashless payments consisted of the complete elimination of wage payment costs (arrow 1 and 2 in Figure 7).

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[20] According to one estimate of the 1950s these costs amounted to 0.22-0.41 per cent of the wages paid out (Juchter 1960, 90).

- Deregulation and Expanding Market Size: Intensified Competition in the Banking Sector

Banks have to consider large investments that will only pay off, if they correctly predict the demand for payments and their situation vis-à-vis their competitors. Following Baltensperger (1980, 35) the decision problem of the banks can be analysed with the help of the following profit function:

(1) $$\Pi_B = r_c A - r_d D - r_e E - AMC - \lambda_I I - \varepsilon P - F - L - S$$

The banks are trying to maximise profits Π_B that consist of

- the interest income on earning assets ($r_c A$),
- interest payments on 'deposits' (non-equity liabilities) and equity ($r_d D$ and $r_e E$),
- asset management costs (AMC),
- the cost of running the payment system which consist of the cost of capital (basically a leasing rate where λ_I = interest + depreciation on the investment 'I') and variable costs (εP) which can be either proportional to the amount of payments (P) or falling with P,
- other costs (F) such as advertising,[21]
- liquidity costs (L) and
- insolvency costs (S).

The question for the banks is not simply whether the customers are prepared to pay enough for the services of the payment system in order to finance large investments and pay for variable costs. They must also take into account that via the provision of payments services

- new customers can be acquired and
- other services can be sold to customers ('cross selling').

Better services may also permit to keep the interest rate spread wider. A larger customer base may reduce the variability of net outflows and therefore liquidity costs (L).[22] Furthermore, other costs, like advertising, may be reduced. Thus, other costs (F), liquidity costs (L), the spread (r_c-r_d) and the size of earning assets and deposits (A and D) are all functions of the investment into the payment system (I). Finally, each bank must have an idea as to the prospective size of the payments system because there are network externalities in the provision of payments services and the process of clearing. Thus, the banks need to form expectations about the growth of the market as a whole and about the development of individual market shares.

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[21] Asset management costs, the costs of running the payments system and 'other costs' may be combined to what Baltensperger (1980) calls 'real resource costs of banking'.

[22] Of course, the cost of capital and the cost of insolvency may also be affected but it is harder to predict in what way.

At first, German banks were hesitant. Given the huge necessary investments in a larger branch network and the high running costs they feared that the additional earnings might be too low. The calculations made by some banks confirmed that the earnings stemming from interest free deposits would not be enough to cover the costs of the payment system. Even though gaining new customers with giro accounts opened the possibility to sell them other financial products (Röthel 1960, 300; Brune 1968). Thus, from a static point of view, the outlook was mixed, at best.

But there were two important factors that induced the banks to go ahead and expand. First, 1958 brought a kind of 'big bang' for branch banking in Germany. Until 1956 the banks had successfully managed to dismantle all the restrictions of the allied powers which allowed banks only to operate on a provincial scale (Pohl 1983, 231-239). However, the expansion of the branch network still required an official permit by German authorities ('Bedürfnisprüfung'). This requirement was scrapped by a federal court in 1958 (Deutsche Bundesbank 1961, 13). This was the end of the 'truce' which had prevailed between German banks earlier in the 1950s (Ashauer 1983, 317). At the same time, interest rates remained regulated (until March 1967), just like in other countries. As a consequence, competition via interest rate changes was not possible. The spread was fixed. Since the spread was relatively wide it was profitable for banks to look for other means to attract customers.[23] Thus, in the late 1950s there was a mix of regulation and deregulation that intensified competition and channelled it mostly into non-price competition.

Table 1: Income and Wealth: Major Trends in Germany 1950-1990

	Population (million)	GDP (DM billion)	Real GDP (1990 prices)	Net Liq. A. (DM billion)	Cash (DM billion)
1950	47	98	439	21	8
1960	55	302	1000	130	22
1970	61	676	1545	462	39
1980	62	1477	2026	1318	84
1990	63	2449	2544	2632	159
1950-70	+30%	+590%	+252%	+2100%	+388%
1970-90	+3%	+262%	+65%	+470%	+308%

Net Liq. A.: net liquid assets of households
Source: Deutsche Bundesbank, Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, own calculations

The second factor at work was the increase in real incomes. The 1950s and 1960s saw a spectacular rise of income and wealth of the broad population (see Table1). Whereas bankers

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[23] Most banks were opposed to the abolition of interest rate regulation, which shows that the spread must have been 'generous' (Büschgen 1995, 703). After the abolition of interest rate controls the spread between loan rates and time deposit rates declined falling below 4 per cent in the early 1970s. See Figure 9. The subsequent rise of the spread can be explained with increased inflation and interest rate volatility.

had previously looked down on the retail business the rise in real incomes and wealth of the broad population promised a big new market (Büschgen 1983, 402). This caused a change in attitudes even of those banks which had traditionally only catered to wealthy individuals[24].

So, while in the late 1950s the costs of offering payments services to the population seemed to outstrip the short-term benefits, the long-run prospects looked quite different. Indeed, it seems to have been the prospect of attracting more savings from the small savers that led the banks to undertake the massive investments into the branch network. The subsequent evolution proved them right. The expansion of the branch network had the desired effect: savings and time deposits grew strongly. Net liquid assets of households grew 21-fold between 1950 and 1970 (see Table1).

Figure 8: Liquid assets 1950-1975
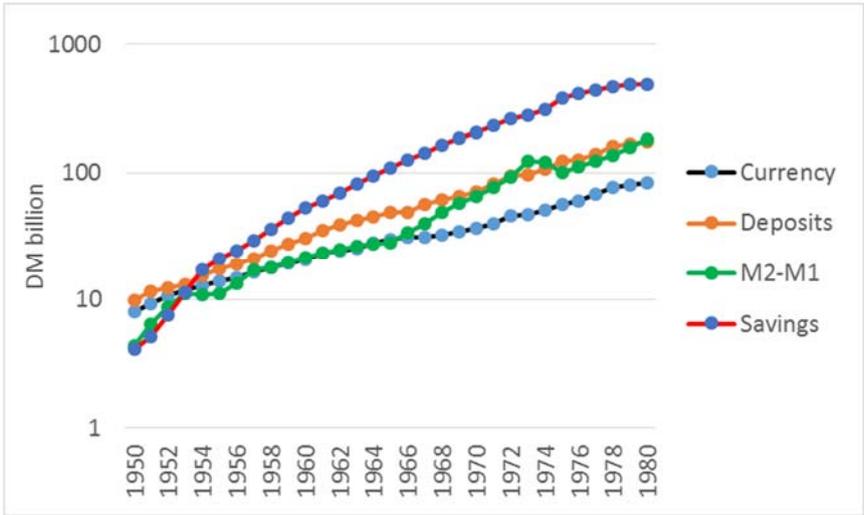
Deposits: sight deposits; Savings: all types of savings deposits; M2-M1: time deposits with a maturity under 4 years (included in M2); Source: Deutsche Bundesbank

In the 1950s and early 1960s savings deposits were growing faster than time deposits or sight deposits. This changed in 1965 when the first steps to liberalise interest rates were undertaken. By 1967 interest rates were completely liberalised (see Deutsche Bundesbank 1967). This mainly affected time deposits that increasingly offered better rates than savings deposits. Consequently from 1965 to 1973 time deposits grew strongly whereas the growth of savings deposits was somewhat subdued.

As the market was expanding, competition became stiffer and the number of banks was considerably reduced. In 1960, there were still more than 13,000 banks in Germany - many of which did not survive the 'retail banking revolution' - and by 1977 the number was reduced to

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[24] As Büschgen (1995, 698) notes H. J. Abs, the speaker of Deutsche, 'was openly dismissive in his stated attitude towards broad retail business'.

6,000 (see Figure 6). The number of co-operative banks fell from 12,000 (1948) to 4,600 (1978) and the number of private banks was reduced from 233 (1951) to 92 (1978) (Wolf 1980, 122, 132). Since the market was vigorously expanding, there were not many banks that actually went out of business. Rather, competition and rationalisation led to take-overs and mergers. In particular, small co-operative banks in the country-side experienced a wave of mergers.

Competition in the banking sector received another boost when interest regulations were abolished in 1967.[25] At the same time, restrictions regarding the advertising activities of banks were abolished (see Büschgen 1983, 401-2)[26]. Stronger interest rate competition together with the success of the giro account which had become the centre of the payment system (Ashauer 1983, 326) were probably the two factors which led to the introduction of service charges for giro accounts in the early 1970s.[27] .

Figure 9: The Spread Between Debit and Credit Interest Rates
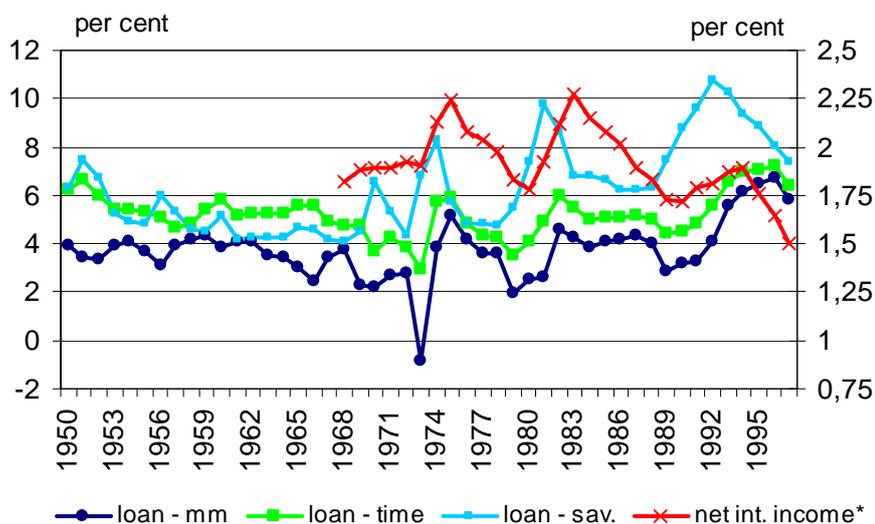
*: right-hand scale; Loan: loan rate on bank loans under DM1 million; mm: three months money market rate; Time: rate on time deposits under DM1 million, one to three months; sav.: rate on savings deposits with three months notice[28]; net int. income: net interest income as percentage of total assets; Source: Deutsche Bundesbank, own calculations

Thus, at the end of the 1950s, two of the three groups involved in the payment of wages had an incentive to consider a change in the method of payment. At the same time, there existed

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[25] It was, in fact, a stepwise process starting 1965 with the deregulation of interest rates on time deposits with a maturity over 2.5 years and ending with the complete liberalisation of interest rates in 1967. See Deutsche Bundesbank (1967).

[26] Another change that took place in 1967 was the partial reduction of tax preferences granted to savings banks. Further steps to equalise the tax treatment of all banks were undertaken in 1975 and 1981 (Ashauer 1983, 323).

[27] Another factor may have been the determined monetary tightening of the Bundesbank after the end of system of Bretton Woods that drove up money markets rates. See Krueger (1996).

[28] Due to the appearance of 'special savings forms' the interest on 'savings balances with three months notice' became less and less indicative of the average interest on savings.

three of the principle elements that may trigger innovation: regulation/de-regulation, competition and growing markets. Regulation diverted competition away from price competition to non-price competition. De-regulation, competitive forces and the vigorously growing markets gave the incentive to make large-scale investments into the payments system (basically branches, people and processing technology). As a driving force, technology played a minor role, at first. However, once the branch network and the payments system had been installed there was a constant struggle to keep costs down and employ new technologies in order to make the processing of vouchers more efficient. So there was a kind of induced technological progress. As an independent force, technology became important only in the 1970s.[29]

3   Slow change of payment behaviour

While the changes of the payments system envisioned in the late 1950s were clearly *revolutionary*, implementation was rather *evolutionary* - conforming historical experience with changes in payment systems (see White 1997). Not only did the banks need time to expand the branch network,[30] also new customers needed time to adopt the opportunities provided by the new payments methods.

Figure 10: The Number of Bank Offices and the Cash to Deposit Ratio
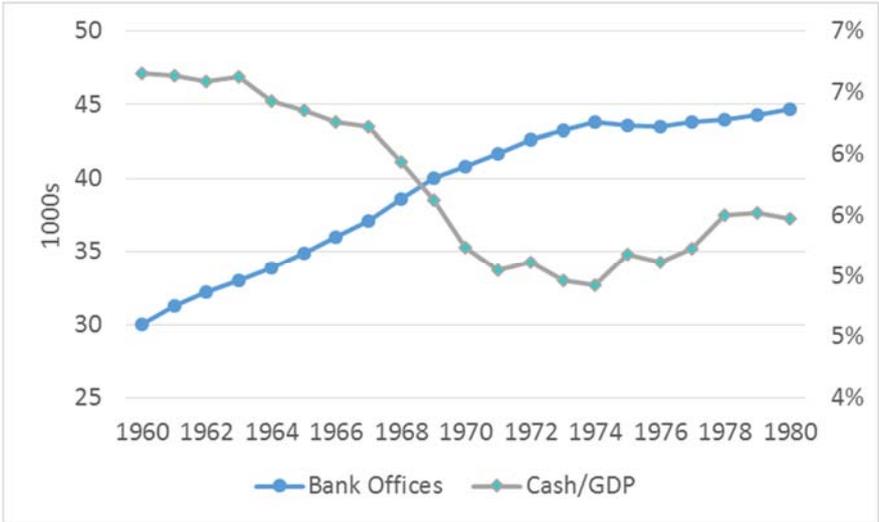
Deposits: Sight deposits; Source: Deutsche Bundesbank, own calculations

The transition was a continuous process of approximately 15 years. In this period the behaviour of people changed only slowly. For instance, the change from weekly cash payments to monthly

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[29] The increasing automation of payments is described in Harmsen, Weiß and Georgieff (1991).
[30] In order to speed up the development some banks would even use mobile outlets. See Büschgen (1995, 704).

transfers of deposits had, at first, only little impact on the demand for cash because in many cases blue collar workers would go to the bank four times a month and take out cash – regarding the bank as something like a pay office (Ashauer 1983, 326).[31] This is documented by the statistics on transactions per account. In 1959 blue collar workers would use the account on average four times per month whereas white collar workers already made 6.42 transactions per account per month (Röthel 1960, 300). Only after a certain adjustment period were cashless payments used more often (giro transfers, standing orders, direct debits) and the giro account was supplemented by a savings account (Köster 1967, 389). Thus, cashless wage payments only gradually led to further substitution of cash payments.[32] By 1965, only half of the accounts of white-collar workers and a third of the accounts of blue-collar workers at savings banks were used for standing orders (Pfisterer 1967, 385). The average number of transactions per account in this year was 61. This is equal to 5 per month. Such a figure shows that the overwhelming amount of transactions still must have been made in cash (see also Harmsen, Weiß and Georgieff 1991, 231-233).

Figure 11: Real per capita balances of cash and deposits
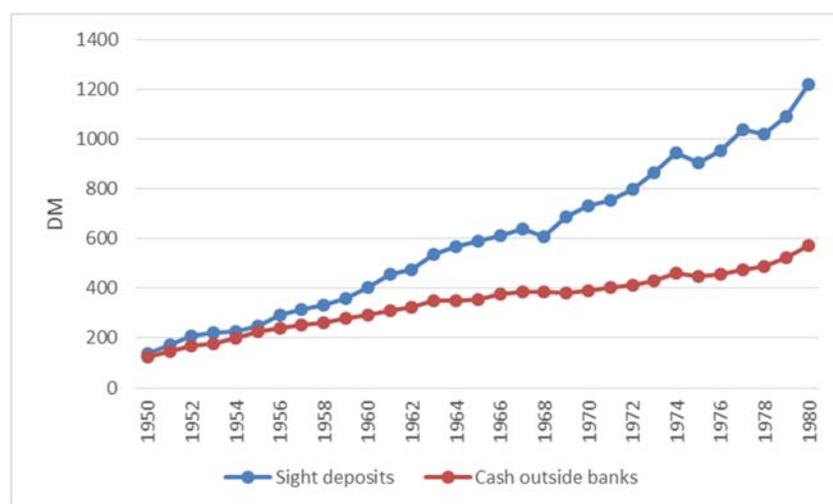
Source: Deutsche Bundesbank, Statistisches Bundesamt and own calculations

The average amount of sight deposits on private accounts was DM432. Seventy per cent of transactions were debits and nearly half of the debits were cash withdrawals (Reyher 1967, 401). The average size of yearly 'automatic debits' (standing orders and direct debits) per

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[31] From a sociological viewpoint this change may have been quite far-reaching though. Given the banks opening hours, in many cases it would no longer be the - usually male - income earner who collected the cash but his spouse. See Schaefer (1961), 61: '*The husband assumes that he will have problems with his family, especially his wife, regarding his pocket money.*' (my translation)

[32] Still, the utilisation of the new accounts was higher than had been expected. Consequently costs rose faster than anticipated by the banks (Büschgen 1995, 710).

account was DM824. This is equal to DM5.4 billion. Of this amount DM3.4 billion were credited to accounts of third parties and DM2.0 billion to own accounts or accounts of family members (Köster 1967, 388). This compares to private consumption expenditures to the order of DM260 billion.

The increased use of cashless payments led to a gradual decline of the cash-to-GDP ratio and the cash-to-deposits ratio. However, real per capita cash holdings have been rising during almost the entire period under observation. So, the shift towards cashless means of payment did not lead to a fall in the real demand for cash balances (Figure 11).

Not surprisingly, per capita deposit balances rose faster than per capita cash balances. However, the deposits-to-GDP ratio rose only very slowly. Thus, in spite of the increased use of cashless payments instruments, the volume of deposits increased only slightly faster than GDP – the commonly used scale variable.

Figure 12: The Cash to GDP and the Deposits to GDP Ratio
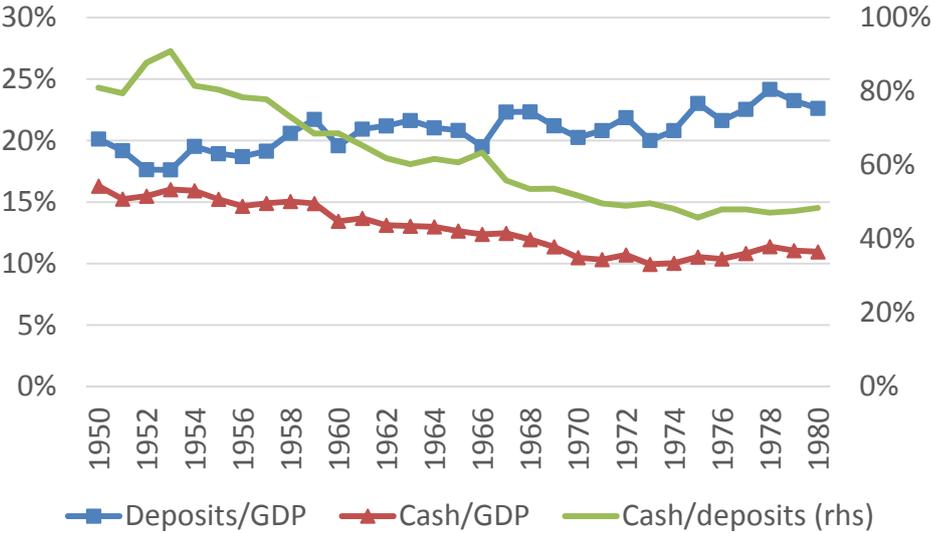
Deposits: Sight deposits; Source: Deutsche Bundesbank, Statistisches Bundesamt

The fact that the increased use of deposits as a means of payment did not lead to a rise in the deposits to GDP ratio may be due to intensified deposit management. The spread of the branch network reduced the costs of transferring funds from sight deposits into interest bearing accounts. As a consequence, the (sight-) deposit to M3 ratio declined slightly from 31% (1955) to 23% (1973).[33]

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[33] In the late 1970s and throughout the 1980s this ratio stayed close to 23%. Source: Deutsche Bundesbank and own calculations.

4 Conclusions

In spite of its profound impact, the process of change was evolutionary and steady rather than revolutionary and erratic. Money users changed their habits only slowly. Thus, throughout the period, the demand for cash was rising – in spite of the growing use of deposits as a means of payment.

The process of payment innovation did not lead to a complete replacement of the traditional means of payment (bank notes and coins). In terms of the number of transactions, cash remained the dominating means of payment. The new means of payment such as credit transfers, direct debits or standing orders were (and are) mainly used for larger payments and for recurring payments. Smaller payments in face-to-face transactions continued to be made mainly in cash.[34] The main findings regarding the process of innovation can be summarised as follows:

- Competition was a driving force – interacting with regulation and deregulation. Unlike today, non-banks were not active. The main driver of the process were banks.[35]

- Initially, non-price competition in the banking sector was important because regulation limited the extent of price competition.

- The introduction of the new payment system required some non-market co-ordination. Banks had to agree on standards regarding technology, design of forms and common procedures. These joint activities were tolerated or even welcomed by the authorities.

- Some of the gains produced by the shift towards cashless wage payments were caused by organisational changes rather than by new technologies.

- To speed up the acceptance of new payments instruments, these instruments were usually under-priced (the price often being zero). This strategy helped to overcome initial resistance and quickly gain critical mass. However, the approach also had its drawbacks. While in some cases user charges could be levied after the introductory period had passed (e.g. giro accounts); in other cases this was not the case (e.g. eurocheques).[36]

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[34] Unfortunately, there are no data on the volume of cash payments in this period. However, payment cards were hardly used and cheques also did not play a significant role in retail transactions. Thus, purchases in the retail sector were predominantly carried out in cash. Even today, there are only a few estimates of the volume of cash payments. For the retail sector, the EHI Retail Institute carries out an annual survey (Rüter 2016). An estimate of the overall use of cash in Germany can be found in Krueger and Seitz (2014).

[35] In Holland, were giro payments were almost exclusively going through the postal network, the situation was a little different.

[36] At the moment, Swedish banks wishing to introduce transaction charges for the new real-time P2P payment service "Swish" are facing the same problem. See Arvidsson (2015, 206).

As has been shown, the decline of the German cash-to-GDP ratio over a period of approximate 20 years can be explained with the help of payment innovations. It is likely that similar factors were at work in other countries, some of which experienced an even steeper decline.

While the introduction of cashless wage payments can explain the decline of the cash-to-GDP ratio, the absolute value of per capita cash holdings remain a puzzle. On average, people held far more than an entire gross monthly income. The cash/income ratio declined somewhat in the 1960s. However, in the 1970s it stabilised at around 1.6. This seems to be a multiple of what is required by transactions.

Figure 13: Cash per capita and monthly income per capita
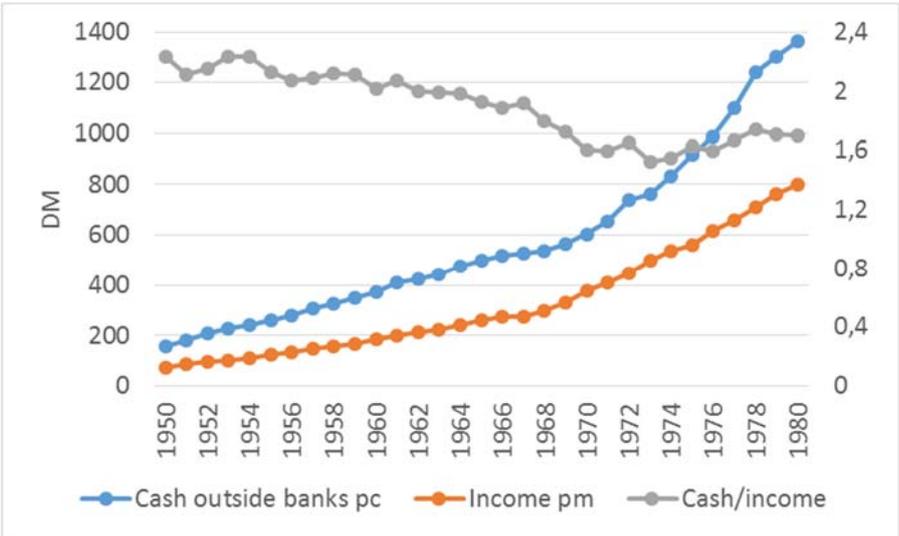
Pc: per capita,, income pm: monthly per capita net national income at factor costs; Source: Deutsche Bundesbank, Statistisches Bundesamt and own calculations

Another puzzle consists of the observed rise in cash-to-GDP ratios that has taken place since the 1980s in some countries. Often, long-term trends in cash balances or cash-to-GDP ratios are used as indicators of activities in the black economy.[37] However, the analysis above suggests that such trends can be strongly influenced by institutional changes in the payment system. Therefore, results that do not take such changes into account should be interpreted with care.

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[37] The "classical" contributions are Gutmann (1977), Feige (1979) and Tanzi (1983).

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Appendix:

The switch to monthly cashless wage payments: Potential cost savings for firms

A. Estimate of the value of one hour of work time

	NNP pc	ALI pc	ALI pc pm	ALI pc pw	Employed mn.	Hours pw	ALI ph
1950	1 674	1.172	98	24,4	20,4	48,2	0,507
1951	2 011	1.407	117	29,3	20,9	47,6	0,616
1952	2 269	1.588	132	33,1	21,3	47,7	0,694
1953	2 406	1.684	140	35,1	21,8	47,9	0,732
1954	2 545	1.781	148	37,1	22,4	48,5	0,765
1955	2 889	2.022	169	42,1	23,2	48,7	0,865
1956	3 170	2.219	185	46,2	23,8	48,0	0,963
1957	3 431	2.401	200	50,0	24,3	46,3	1,081
1958	3 628	2.540	212	52,9	24,5	45,5	1,163
1959	3 904	2.733	228	56,9	24,8	45,4	1,254
1960	4 332	3.033	253	63,2	26,2	45,4	1,392
1961	4 641	3.249	271	67,7	26,6	45,3	1,494
1962	4 964	3.475	290	72,4	26,7	44,7	1,619
1963	5 189	3.632	303	75,7	26,7	44,5	1,700
1964	5 645	3.951	329	82,3	26,8	44,2	1,862
1965	6 116	4.281	357	89,2	26,9	44,4	2,009
1966	6 421	4.495	375	93,6	26,8	44,0	2,128
1967	6 423	4.496	375	93,7	26,0	42,4	2,209
1968	7 027	4.919	410	102,5	26,0	43,4	2,361
1969	7 708	5.396	450	112,4	26,4	44,1	2,549
1970	8 859	6.201	517	129,2	26,7	44,1	2,929

NNP pc: Net national product per capita (in DM)

ALI pc: Average labour income per capita (in DM). Calculated as 70% of NNP pc (based on values of Hoffmann (1965) for the 1950s.

ALI pc pm: Average labour income per capita per month (in DM).

ALI pc pw: Average labour income per capita per week (in DM).

Employed mn. Employed persons (in millions).

ALI ph: Average labour income per hour (in DM).

Sources:

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B. Value of working hours lost due to wage payments in cash

Assumptions: 15 minutes lpst per worker per payment, 49 weeks per year.

	weekly payment		monthly payment
	mn hours	DM million	DM million
1950	250	126	31,6
1951	256	158	39,4
1952	261	181	45,2
1953	267	196	48,9
1954	274	210	52,5
1955	285	246	61,5
1956	292	281	70,3
1957	298	322	80,5
1958	300	349	87,3
1959	304	381	95,2
1960	322	447	111,9
1961	326	487	121,7
1962	327	529	132,4
1963	328	557	139,3
1964	328	610	152,6
1965	329	662	165,4
1966	328	699	174,7
1967	318	702	175,6
1968	318	751	187,8
1969	323	823	205,7
1970	327	957	239,3

C. Value of implicit workers' credit to firms

workers' credit				workers' credit	
credit a.	credit b.	ext. fin.	net invest.	in % of ex.fin.	net invest.
497,5	124,4	6.454	16.722	7,7%	3,0%
612,7	153,2	5.926	20.184	10,3%	3,0%
704,7	176,2	10.366	24.252	6,8%	2,9%
765,2	191,3	12.498	20.732	6,1%	3,7%
831,0	207,8	12.791	25.719	6,5%	3,2%
978,6	244,7	16.175	38.510	6,1%	2,5%
1101,8	275,4	15.392	38.236	7,2%	2,9%
1217,6	304,4	14.219	39.606	8,6%	3,1%
1297,5	324,4	9.192	38.295	14,1%	3,4%
1411,0	352,7	12.165	43.537	11,6%	3,2%
1658,2	414,6	22.101	64.190	7,5%	2,6%
1799,8	449,9	31.489	65.344	5,7%	2,8%
1932,1	483,0	24.037	65.990	8,0%	2,9%
2023,7	505,9	24.898	55.682	8,1%	3,6%
2202,2	550,5	31.195	68.317	7,1%	3,2%
2398,0	599,5	42.305	80.893	5,7%	3,0%
2509,6	627,4	31.821	65.794	7,9%	3,8%
2430,7	607,7	1.545	36.946	157,3%	6,6%
2661,2	665,3	16.683	57.912	16,0%	4,6%
2962,6	740,7	50.363	91.533	5,9%	3,2%
3445,2	861,3	64.132	109.350	5,4%	3,2%

Credit a.: implicit workers' credit to firms (DM million) when wages are paid out on a monthly basis (calculated as half a monthly wage).
Credit b.: implicit workers' credit to firms (DM million) when wages are paid out on a weekly basis (calculated as half a weekly wage).
Ext. fin.: external finance of companies (DM million)
Net invest.: Net investment of companies (DM million)
Source:
Deutsche Bundesbank, (1998 [005.]) 50 Jahre Deutsche Mark. Monetäre Statistiken von 1948 bis 1997. GESIS Köln, Deutschland ZA8186 Datenfile Version 1.0.0 (E2_14_Produktionsunternehmen__Sachvermögensbildung_und_Ersparnis).

D. Finance costs saved due to implicit workers' credit
Assumption: interest rate = 8%

	finance costs saved (DM million)	
	monthly pay.	weekly pay,
1950	39,80	9,95
1951	49,01	12,25
1952	56,38	14,09
1953	61,21	15,30
1954	66,48	16,62
1955	78,29	19,57
1956	88,14	22,04
1957	97,41	24,35
1958	103,80	25,95
1959	112,88	28,22
1960	132,66	33,16
1961	143,98	36,00
1962	154,57	38,64
1963	161,90	40,47
1964	176,18	44,04
1965	191,84	47,96
1966	200,77	50,19
1967	194,45	48,61
1968	212,90	53,22
1969	237,01	59,25
1970	275,62	68,90

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