Euro coins held for transaction purposes in Germany

According to estimates using the seasonal method, the volume of euro coins held for transaction purposes in Germany in 2011 stood at €2.3 billion; this corresponds to around 36% of the total volume of German (ie issued by the Deutsche Bundesbank) euro coins in circulation. €1 and €2 coins accounted for 76% of the total volume of coins by value held for transaction purposes. In recent years, the volumes of coins held for transaction purposes of almost all denominations have remained the same. Only the volume of €2 coins held for transaction purposes has increased significantly, which has made a notable contribution to growth in the circulation of this denomination. Unlike the other motives behind the demand for coins, it is comparatively easy to model the transaction motive empirically (via cash consumption). Structural models are therefore the most suitable method of determining the demand for €2 coins. At less than 30%, the transaction balance shares of small denomination coins (1 and 2 cent coins) are comparatively low. This is because larger volumes of them are lost or people hoard them in order to lighten their wallet or purse. On balance, German euro coins in circulation abroad are probably only to be found in countries outside the euro area where they are being hoarded on a permanent basis. Owing to insufficient data, the volumes of coins held for domestic transaction purposes by sector cannot be fully captured. Households and credit institutions accounted for the largest share.

Background information

Reasons for large volume of coins in circulation

Since the introduction of euro banknotes and coins, there has been a marked upward trend in the demand for euro coins issued in Germany.[1] At the start of 2002, there were only €3.8 billion worth of coins in circulation (11.1 billion coins); however, by the end of 2014, this figure had risen steadily to €7.4 billion (32.5 billion coins). In statistical terms, this recently worked out at 403 coins with a value of €92 euro for each person living in Germany. Growth in 1 and 2 cent coins has been particularly pronounced. In Germany, 208 coins of these denominations are held *per capita*.

Coins in circulation are used for the following purposes: first, the (domestic) transaction balance for purchases; second, (domestic) hoarding; and third, foreign demand. Coins may be hoarded permanently or temporarily. Based on the broad definition applied here, this not only comprises classic hoarding as a store of value and the regular setting aside of coins to be used as small change, eg for vending machines (temporary hoarding), it also includes leakages in the form of coins that are part of a collection, as well as coins that are lost or damaged (permanent hoarding). The breakdown of German coins in circulation into the various categories of use has not yet been examined in more detail. However, it is clear from the figures provided that the rise in the number of these coins cannot be explained simply by the increase in the transaction balance, especially since the decrease in the proportion of households' expenditure in cash does not exactly suggest sharp growth in the volume of coins held for domestic transaction purposes. In this article, we seek to estimate the level and patterns over time of these transaction balances.[2] The remainder of the total volume of coins in circulation is accounted for by the domestic hoarding balances and the foreign demand for German euro coins.

Contributions to seigniorage

The volume of euro coins held for transaction purposes in Germany is of interest for the following reasons. First, it is relevant to seigniorage. Responsibility for minting euro coins lies with the national governments of the euro-area countries. In Germany, while the Federal Ministry of Finance is responsible for minting coins, it is the Bundesbank's task to bring them into circulation. In order to do so, it purchases them from the Federal Ministry of Finance at their face value. The difference between the face value and the minting costs is known as seigniorage. Unlike the issuance of banknotes, the seigniorage generated from the issuance of coins is collected directly by the Federal Ministry of Finance. The total value of all the coins to be brought into circulation every year has to be approved by the Governing Council of the ECB.

If the overall demand for coins is broken down into the categories "transaction balance", "hoarding" and "foreign demand", the sources of seigniorage from the coins in circulation can be determined. While coins held for transaction purposes circulate comparatively quickly, coins that are hoarded and coins that are held abroad circulate slowly. The latter two categories thus result in a higher volume of coins in circulation. It is therefore beneficial to the government budget if a large proportion of coins are hoarded and in circulation abroad.

Use of small denomination coins

The volume of German 1 and 2 cent coins (known as small denomination coins) in circulation has risen sharply over the past few years and a large number of small denomination deutsche Mark coins have not yet been returned to the Bundesbank.[3] This raises the

1 The (statistical) circulation of euro coins issued in Germany corresponds to the accumulated net issuance of euro coins by the Bundesbank. In this article, these coins will also be referred to as "German" euro coins in circulation and the circulation of "German" euro coins. According to this definition, these coins do not necessarily have to have a "German" national reverse side, since the Bundesbank also (re)circulates coins with foreign national reverse sides.
2 The results presented here are taken from the following paper: M Altmann and N Bartzsch, The volume of euro coins held for transaction purposes in Germany, ROME Discussion paper, No 14-06e, August 2014.
3 At the end of 2014, 23.5 billion DM coins were still in circulation. At just over 13 billion coins, more than half of these were 1 and 2 pfennig coins.

question as to how often small denomination coins are actually used in cash transactions, ie held for transaction purposes. Because of their low face value, they are not very useful as a store of value for the purpose of savings. Moreover, if the main reason for using small denomination coins in transactions is to provide exact change, then phasing out these coins could help make payment transactions slightly more efficient. This is why, up to now, the euro-area countries Belgium, Finland and the Netherlands have introduced a rounding rule, according to which the payment amount is rounded up or down to the nearest five cents at the point of sale. The findings of a survey on payment behaviour conducted by the Bundesbank indicate that Germans are not especially interested in the introduction of a rounding rule at the moment.[4] However, no clear trend can be derived from the responses. Another factor to consider here is the cost of producing small denomination coins, which is less than their face value.

Forecasting demand for coins

Ultimately, determining the transaction balance also plays a role in forecasting coin circulation. The Bundesbank forecasts the change in circulation for each denomination every January and September as part of its cash requirement planning for the Federal Ministry of Finance.[5] It does so using time series models. In principle, forecasts using structural models which map the individual motives of the demand for cash, such as transactions and hoarding, can be used as an alternative. However, it is difficult to find suitable variables for this. It is more or less possible to capture the transaction motive using a proxy variable for consumption paid for using coins ("cash consumption"). It is much more difficult to find an opportunity cost variable for the hoarding motive. Therefore, the greater the extent to which developments in the circulation of coins are driven by the transaction balance, the more suitable structural models are for creating forecasts.

Seasonal method

The aim of the seasonal method is to filter out information about the volume of coins held for transaction purposes in Germany from the seasonal structure of coins in circulation.[6] This is based on the assumption that holdings of coins for transaction purposes have a more pronounced seasonal structure than the total volume of coins in circulation. The latter ultimately also includes hoarding balances and foreign demand. Neither is likely to have much to do with seasonal developments in Germany. The calculation formula for the share of the domestic transaction balance in the volume of coins in circulation is derived and described in the box entitled "Seasonal method" on pages 64 and 65.

Shares of German euro coins in circulation held for domestic transaction purposes

Share of the transaction balance in the total volume of coins in circulation is 36%

The share of coins held for domestic transaction purposes in the total volume of coins in circulation is determined both for total circulation by value (total for all denominations) of German euro coins (ie those issued by the Bundesbank) as well as for the circulation of these coins by denomination. Based on the calculation formula, the transaction balance shares can only be determined up to and including 2011, even though the database covers 2002 to 2012. The years 2002 and 2003 were not taken into consideration on account of the distortions to coin circulation following the introduction of euro banknotes and coins. The share of the total value of German euro coins in cir-

4 See Deutsche Bundesbank, Payment behaviour in Germany in 2011 – An empirical study of the utilisation of cash and cashless payment instruments, October 2012.
5 See Deutsche Bundesbank, Current and projected development of coin circulation in Germany, Monthly Report, January 2013, pp 33-35.
6 This idea comes from Sumner, who applied this approach to determine domestic hoarding balances for US currency. See S B Sumner (1990), The transactions and hoarding demand for currency, Quarterly Review of Economics and Business, 30 (1), pp 75-89.

Seasonal method

The seasonal model is based on the assumption that the time series of the cumulative value-based net issuance of euro coins by the Bundesbank (volume of "German" euro coins in circulation in terms of value) consists of three parts: a trend component T_t, a seasonal term S_t and an irregular component. These are to be linked together on a multiplicative basis (multiplicative seasonal model). Assigning the irregular component to the trend for the sake of simplicity and taking into account the fact that some of the coins are in domestic hoards or abroad, it follows that

(1) $T_t S_t = T_t^d S_t^d + T_t^a S_t^a$,

where t represents the time index, d denotes the domestic transaction balance and a stands for domestic hoards and euro coins circulating outside the country (foreign demand). If β_t now captures the share of the total trend to be found in the domestic transaction balance and, consequently, $(1-\beta_t)$ is the corresponding share of domestic hoards and of foreign demand, it follows that

(2) $S_t = \beta_t S_t^d + (1-\beta_t) S_t^a$.

On the assumption that there is not any season in the domestic hoards and in foreign demand, ie $S^a = 1$ for all t, Equation (2) can be further simplified to

(3) $S_t = \beta_t S_t^d + (1-\beta_t)$.

Given the values for the seasonal terms S and S^d, an equation is produced for the unknown value β_t, the domestic transaction balance share of German euro coins

(4) $\beta_t = \dfrac{S_t - 1}{S_t^d - 1}$.

S_t corresponds to the seasonal figure of the value-based German euro coins in circulation and can be determined by applying the usual methods of seasonal adjustment (eg X12-ARIMA, Tramo/Seats). S^d, on the other hand, the season of the domestic transaction balance, is unknown. This has to be approximated. Equation (4) does not always deliver meaningful results, however. If, for example, there is no seasonal adjustment in any given period, ie $S_t = S_t^d = 1$, β_t tends to infinity and/or every value of β_t is compatible with Equation (4). It is then not possible to identify β_t unambiguously. Problems may also arise if the seasonality of the total value-based coins in circulation is not more weakly pronounced in every period than that of the domestic transaction balance.[1] This method thus produces plausible results for some, but not for all periods.

Therefore, further modifications are needed to allow for such cases and to be able to apply this method. It is often the case that meaningful estimation results are obtained only for certain frequencies within a year.[2] With regard to the total value-based German euro coins in circulation, the seasonal high lies in December, for example, but the seasonal low is in January. This is therefore an instance of a one-month frequency. In order to factor this into the equation, we replace the time index t with m,j, where m denotes the mth month and j stands for the jth year. If Equation (3) for January is subtracted from the corresponding equation

1 If the seasonality of the domestic transaction balance is more pronounced than that in the domestic hoards and in foreign demand, the following applies to values greater than 1: $S_t < S_t^d$, for values smaller than 1: $S_t > S_t^d$.
2 See Federal Reserve System, The location of U.S. currency: How much is abroad?, Bulletin, October 1996, pp 883-903.

for the preceding December, the share of the domestic transaction balance β_j is given as

$$(5)\ \beta_j = \frac{S_{dec,j} - S_{jan,j+1}}{S^d_{dec,j} - S^d_{jan,j+1}}.$$

The next thing to do is to approximate the unknown seasonal amplitude of the domestic transaction balance in the denominator of Equation (5). To do this, the seasonal amplitude of a transaction variable tr, $\Delta \mathrm{S}(tr)$, is used, ie the difference between the seasonal high and the seasonal low of this transaction variable. The selected transaction variable should capture the domestic transaction demand for coins as accurately as possible. Here, real cash consumption is used as the transaction variable. This corresponds to those components of real private consumption that are usually (also) paid for with coins.[3] Furthermore, the seasonal amplitude of the transaction variable and/or real cash consumption still has to be multiplied by the transaction and/or income elasticity in order to convert the "transaction variable" unit into the "value of coins in circulation" unit. A value of 0.5 is set for the transaction elasticity. This derives from cash management theory for notes and coins that are used for the payment of regular transactions.[4] Equation (5) thus becomes

$$(6)\ \beta_j = \frac{S_{dec,j} - S_{jan,j+1}}{S^d_{dec,j} - S^d_{jan,j+1}} \approx \frac{S_{dec,j} - S_{jan,j+1}}{0,5 \cdot \Delta S(tr)}.$$

Finally, owing to the availability of data on cash consumption, there also has to be a changeover from monthly data to quarterly data (q). The seasonal amplitude of the total value-based *quarterly* volume of German euro coins in circulation (in the numerator) corresponds to the difference between the seasonal factor of coins in circulation in the second quarter of the year j and the seasonal factor of coins in circulation in the first quarter of the following year $j+1$.[5] The seasonal amplitude of cash consumption (in the denominator) is equal to the difference between the seasonal factor of cash consumption in the fourth quarter and its seasonal factor in the first quarter of the following year. The calculation formula for the domestic transaction balance's share of the total volume of German euro coins in circulation is thus

$$(7)\ \beta_j \approx \frac{S_{q2,j} - S_{q1,j+1}}{0,5 \cdot \Delta_{q4,j;q1,j+1} S(tr)},$$

where $\Delta \mathrm{S}(tr)$ stands for the difference between the seasonal high and the seasonal low of real cash consumption.

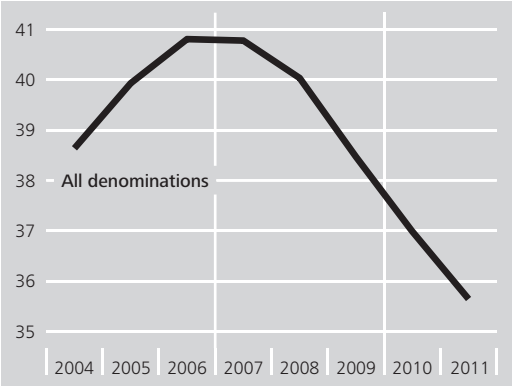
3 For details, see M Altmann and N Bartzsch (2014), The volume of euro coins held for transaction purposes in Germany, ROME Discussion paper, No 14-06e, August 2014, section 3.2.

4 See W J Baumol (1952), The transactions demand for cash: An inventory theoretic approach, Quarterly Journal of Economics, 66 (4), pp 545-556.

5 In line with Equation (6), it might be expected that the seasonal high of the total volume of German coins in circulation lies in the fourth quarter. However, it falls in the second quarter for the following reasons. With regard to monthly seasonal factors, those in December are indeed the greatest, but are immediately followed by seasonal factors in June and May, which can be explained by public holidays and the start of the holiday period. Furthermore, seasonal factors in November are low-level.

Percentage share of all the German euro coins in circulation (by value) accounted for by the domestic transaction balance

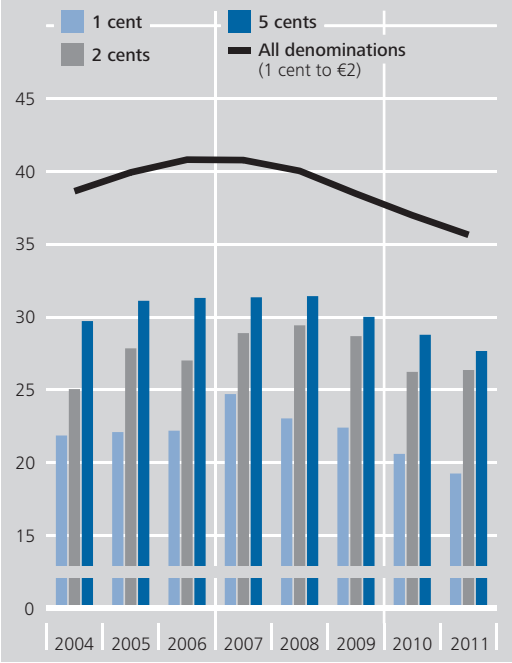
As a percentage



Deutsche Bundesbank

Percentage share of the German euro coins in circulation (by value) accounted for by the domestic transaction balance in the case of small denomination coins

As a percentage



Deutsche Bundesbank

culation accounted for by the transaction balance was just under 36% in 2011, its lowest level during the period under review. The highest level was reached in 2006 and 2007 at just under 41%. The declining trend since 2008 could be attributable to the drop in the share of cash payments made in retail outlets. In addition, the share of coins in circulation accounted for by the transaction balance automatically shrinks over time due to the accrual of coins that are lost or form part of a permanent collection. However, this argument applies mainly to older coins in circulation.[7]

Transaction balance shares of small denomination coins between 20% and 30%

Applying the seasonal method, the percentage shares accounted for by the domestic transaction balance can also be estimated for the individual coin denominations. The domestic transaction balance shares by denomination refer here to the circulation of the denomination in question and not to total circulation by value (circulation of all denominations). The domestic transaction balances shares of small denomination coins (1, 2 and 5 cent coins) are between about 20% and 30%, well below the share of the total volume of German euro coins in circulation by value accounted for by the domestic transaction balance. The transaction balance shares of small denomination coins are particularly low. A likely explanation is that people put more of them to one side in order to lighten their wallet or purse. Just under 30% of respondents in the Bundesbank's study on payment behaviour agreed with the following statement: "I prefer not to use small coins as a form of payment and tend to put them to one side".[8] What is more, for the most part, it is not possible to use small change at vending machines. Furthermore, a relatively large proportion of small denomination coins are likely to be lost.[9] They thus account for correspondingly low shares of the transaction balance. These shares rise as the denomination size increases. As with total circulation, the small denominations have accounted for decreasing shares of the domestic transaction balance in recent years.

7 For instance, the share of the entire volume of DM coins in circulation accounted for by the volume of DM coins held for domestic transaction purposes in 2000 was estimated to be just slightly less than 15%. See M Altmann and N Bartzsch (2014), op cit, section 4.
8 See Deutsche Bundesbank (2012), op cit, p 26.
9 See Deutsche Bundesbank, Münzgeldentwicklung in Deutschland – Eine empirische Studie über den Münzgeld- und Banknotenumlauf in der Bundesrepublik Deutschland mit einer Prognose der Münzgeldnachfrage bis 2007, March 2003, p 142.

Transaction balance shares of medium denomination coins around 50%

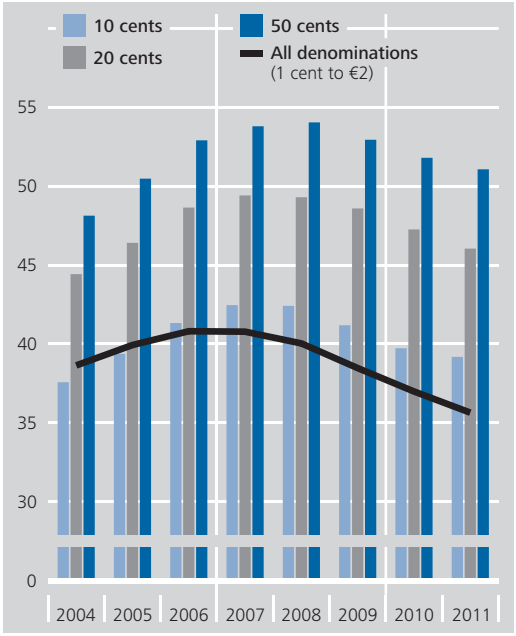
The domestic transaction balance shares of medium denomination coins (10, 20 and 50 cent coins) are higher than those of the total volume of coins in circulation.[10] The German transaction balance shares for 20 and 50 cent coins are particularly high. They were 46% and 51%, respectively, in 2011. These two denominations can be classed as typical transaction denominations. Unlike small denomination coins, people rarely put them to one side in order to lighten their wallet or purse. Given their low face value, they are also not as suitable as a store of value as the two large denomination euro coins. Just like small denomination coins, the domestic transaction balance share for medium denomination coins has fallen in recent years, and rises as the denomination size increases.

Transaction balance shares of large denomination coins between 35% and 45%

The domestic transaction balance shares of large denomination coins (€1 and €2 coins) are fairly different.[11] At 45%, the €1 coin's share of the transaction balance is significantly higher than its corresponding share of the total circulation by value. However, it is lower than the shares for 20 and 50 cent coins, which are typical transaction denominations. This could be due to the fact that €1 coins are more suitable as a store of value because of their comparatively high face value and are therefore hoarded to a greater extent. This assumption is supported by the share of the circulation of the €2 coin accounted for by the domestic transaction balance, which, over the entire period under review, is lower than the share of the transaction balance in the total volume of coins in circulation by value. In 2011, it was 35%. Be-

Percentage share of the German euro coins in circulation (by value) accounted for by the domestic transaction balance in the case of medium denomination coins

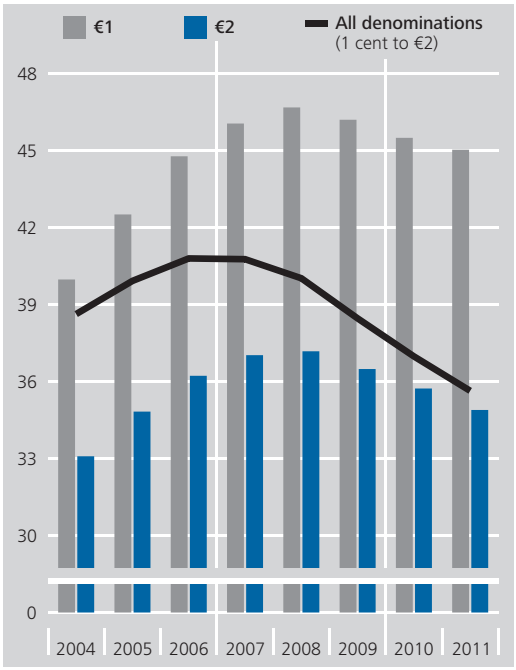
As a percentage



Deutsche Bundesbank

Percentage share of the German euro coins in circulation (by value) accounted for by the domestic transaction balance in the case of large denomination coins

As a percentage



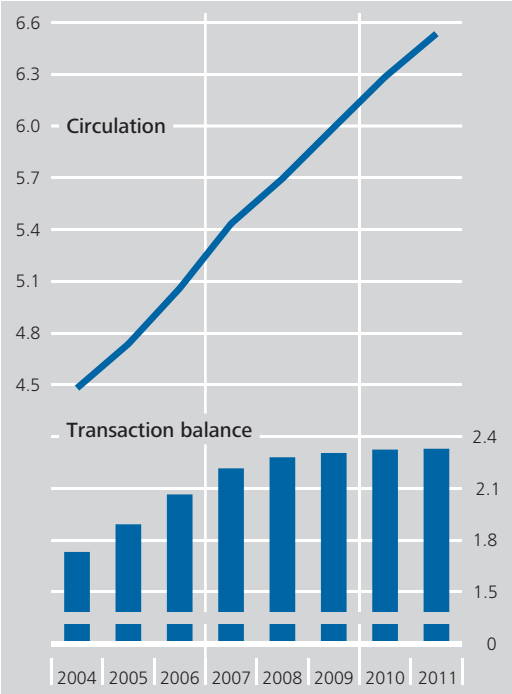
Deutsche Bundesbank

10 As is the case for the small denominations, the seasonal high for the medium denominations occurs in the third quarter and not in the second quarter as for the total volume of coins in circulation. The calculation formula (see box on pp 64-65) has been adapted accordingly.

11 As with the small and medium denominations, the seasonal high in the circulation of the €1 coin also takes place in the third quarter. This may be connected to the holiday period. By contrast, the seasonal high in the circulation of the €2 coin falls in the second quarter. Given the large weighting of €2 coins in the total volume of all German euro coins in circulation by value (about 50% at the end of 2011), the seasonal high for total circulation by value is also found in the second quarter.

Total circulation and domestic transaction balance of German euro coins

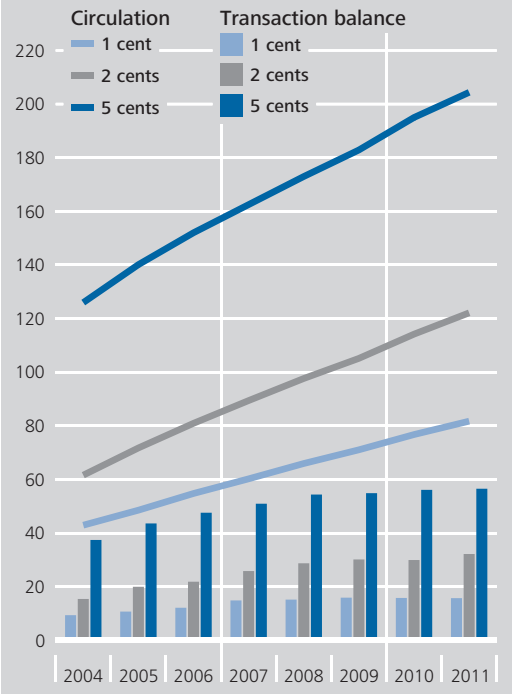
€ billion



Deutsche Bundesbank

Domestic transaction balance and German euro coins in circulation in the case of small denomination coins

€ million



Deutsche Bundesbank

cause of its high face value, the €2 coin is particularly good for hoarding as a store of value because relatively few of these coins need to be put to one side in order to save larger sums or amounts suitable for transactions. However, it is also in demand as a collectible item in the form of commemorative €2 coins, which also include the Federal States series.

Volumes of German euro coins held for domestic transaction purposes

Total volume of coins held for transaction purposes amounts to €2.3 billion

The domestic transaction balances (in €) are calculated by multiplying the shares of the transaction balance by the denomination-specific or total circulation of German euro coins by value. The share of the total circulation of German euro coins accounted for by the domestic transaction balance rose from just over €1.7 billion in 2004 to just over €2.3 billion in 2011.[12] During the same period, the total value of German coins in circulation rose from almost €4.5 billion to just over €6.5 billion. Consequently, around 30% of this rise is accounted for by the German transaction balance. However, while the total volume of coins in circulation has shown marked linear growth during the period under review, the time series for the German transaction balance has flattened out noticeably since 2008 and barely makes any contribution towards growth of total circulation. As described above, the share of the domestic transaction balance in total circulation of German euro coins by value has therefore fallen since 2008.

12 This estimate is confirmed by another estimate based on information relating to the introduction of euro banknotes and coins. See M Altmann and N Bartzsch (2014), op cit, section 4. According to this, the domestic transaction balance of euro coins was just over €2.3 billion (transaction balance share of just under 41%) in 2008 and €2.5 billion (transaction balance share of just over 38%) in 2011. These estimates are very similar to the results presented here for the domestic transaction balance, which are €2.3 billion (transaction balance share of 40%) in 2008 and €2.3 billion (transaction balance share of just under 36%) in 2011.

Volumes of small denomination coins held for transaction purposes very low

The domestic transaction balances and circulation volumes of small denomination coins increase with the denomination size. Reflecting the low value of the circulation of small denomination coins by value, the transaction balances are quite low at under €60 million. While the shares of the transaction balances by denomination have been declining since 2008, the transaction balances themselves have remained more or less the same over this period. Because of sharp growth in the circulation of small denomination coins, the transaction balances have not fallen despite the decline in the transaction balance shares. The significant increase in the circulation of small denomination coins is not attributable to the domestic transaction motive because the corresponding transaction balances have remained more or less constant for a number of years. By contrast, hoarding saw (net) inflows.

Volumes of medium denomination coins held for transaction purposes between €100 million and €350 million

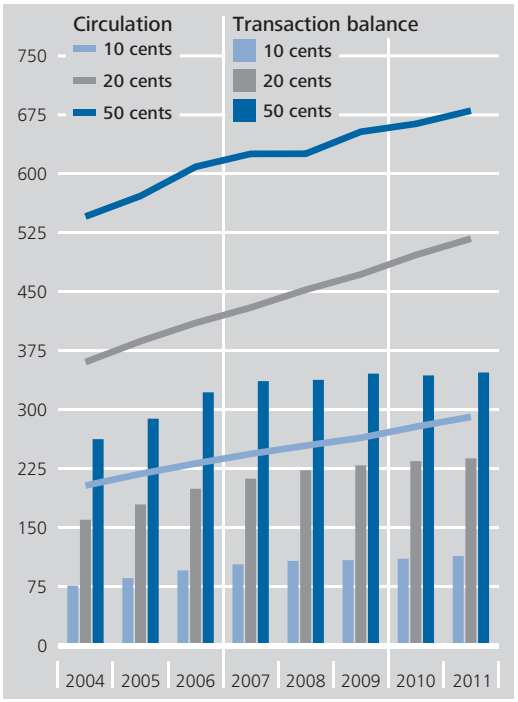
The domestic transaction balances and circulation volumes of medium denomination coins also increase with denomination size. The former have remained more or less the same since 2008 at between €100 million and €350 million. They are thus considerably higher than for small denomination coins. As for small denomination coins, despite the declining transaction balance shares, holdings remained stable thanks to the rise in circulation. In the case of medium denomination coins, too, growth in circulation is not attributable to the domestic transaction motive, but rather to hoarding at home and abroad.

Volumes of large denomination coins held for transaction purposes between €600 million and €1.1 billion

For the large denominations, the most recent domestic transaction balances of just over €600 million for the €1 coin and just over €1.1 billion for the €2 coin are well above those of the small and medium denominations, as might be expected. As with the latter, the declining transaction balance shares in the large denominations are offset by growth in circulation (by denomination). While the domestic transaction balance for €1 coins as well as for small and medium denomination coins has remained constant since 2008, the domestic transaction

Domestic transaction balance and German euro coins in circulation in the case of medium denomination coins

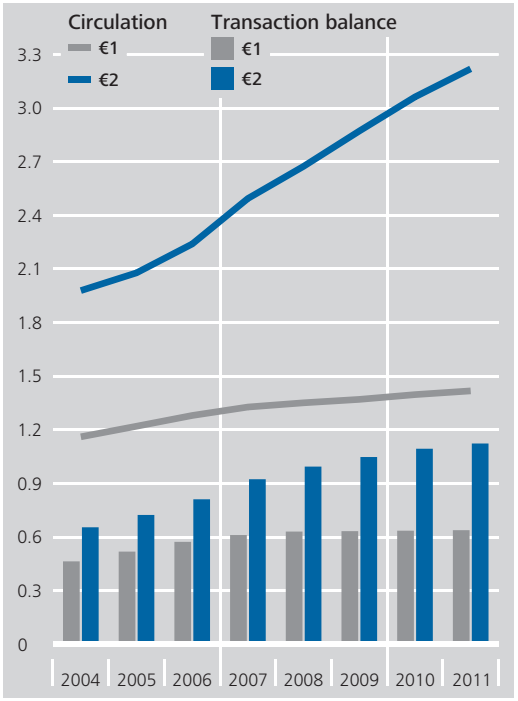
€ million



Deutsche Bundesbank

Domestic transaction balance and German euro coins in circulation in the case of large denomination coins

€ billion



Deutsche Bundesbank

balance for €2 coins has shown marked growth since 2004. The share of this denomination in the total circulation of German euro coins by value had risen from just over 44% at the end of 2004 to just under 50% by the end of 2011. The circulation of German euro coins by value is clearly determined by the two large denominations. During the period under review, they consistently accounted for a share of about 70% of the total volume of coins in circulation by value. During the same period, the transaction balance share of the two large denominations in all German euro coins rose from 65% to 76%. As with the small and medium denominations, the transaction balance for €1 coins in Germany also makes no contribution towards growth in the circulation of that denomination. This is different in the case of the €2 coin. Here, the rise in the domestic transaction balance from 2004 to 2011 amounts to almost 38% of the corresponding rise in the circulation of this denomination.

Volumes of euro coins held for domestic transaction purposes by sector

In the text which follows, we seek to estimate the volumes of euro coins held for domestic transaction purposes, broken down by sector. In addition to the volume of coins held in the wallets or purses of households (consumers), this also includes the change kept at points of sale in retail outlets and the stock of coins in amusement and vending machines, as well as the volume of coins held by credit institutions. While households use coins for actively effecting transactions, retailers need coins to provide customers with change. The cash contained in vending machines derives from turnover and part of this income re-enters circulation as change dispensed to customers. On balance, turnover income exceeds the amount disbursed again as change; consequently, the stocks of coins in the machines have to be emptied on a regular basis. Credit institutions maintain holdings of coins for the purpose of facilitating withdrawals by retailers and households. In addition, coins are paid in at banks by vending machine operators and households. For their part, credit institutions dispose of whatever surplus coins they have by submitting these to the Bundesbank, from which they also obtain new stocks of coins.

Volume of coins held by consumers for transaction purposes totals €410 million

The Deutsche Bundesbank conducted a survey of payment behaviour in Germany in 2008, 2011 and 2014.[13] Among other things, these surveys ascertained how much cash people had in their wallet or purse during the recording period. In 2008, the respondents were found to carry an average of €118 on their person, €6.70 of which was accounted for by coins. This contrasts with 2011 when the figure in question declined slightly to an average of €103. Of this amount, €5.90 was in the form of coins. The cash people carry around on them is generally used for making payments. Therefore, this amount can be wholly allocated to the transaction balance. If the average volume of coins carried on an individual's person is then extrapolated for Germany's entire adult population, this results in a volume of around €440 million worth of euro coins held for transaction purposes on the part of households in 2008, and a total of approximately €410 million for 2011.

Volume of coins held by credit institutions ranges from €120 million to €370 million

The volume of coins kept by other users (ie sectors) for effecting transactions can only be gauged on the basis of assumptions of greater or lesser reliability due to the lack of relevant statistics. The average volume of cash held by credit institutions in Germany is known but there are no data on how this breaks down in terms of banknotes and coins. However, this information can be roughly calculated by study-

13 See Deutsche Bundesbank, Payment behaviour in Germany – An empirical study of the selection and utilisation of payment instruments in the Federal Republic of Germany, June 2009; Deutsche Bundesbank (2012), op cit; Deutsche Bundesbank, Zahlungsverhalten in Deutschland 2014 – Dritte Studie über die Verwendung von Bargeld und unbaren Zahlungsinstrumenten, März 2015 (translation not yet available). Time constraints prevented inclusion of the most recently conducted survey.

ing credit institutions' inpayments and outpayments to and from the Bundesbank. To this end, the share of coins in the total volume of inpayments made by credit institutions to the Bundesbank in the course of a year is allotted to the average volume of cash held. Alternatively, the above calculation can also be made using the outpayment data. On balance, this estimation method provides a rough approximate value of the volumes of coins held by credit institutions for transaction purposes. Estimates for 2011 put these at between €120 million and €370 million.

Volume of change held by retailers stands at €130 million

Another share of the volume of coins held for transaction purposes is kept at points of sale in retail outlets. These outlets require coins to give shoppers change. According to an interview with an expert in the field, retailers are generally replenished with coins twice a week. Assuming that the volume of coins diminishes at a steady rate, the amount of cash held as change is calculated as the supply of coins needed to cover three days of sales activity, divided by two. Using turnover figures and the shares of cash payments in these sales, the volume of cash needed as change can be extrapolated for all retailers operating in Germany. This presupposes a need for coins in individual business sectors that is proportionately equal to the share of cash payments and to turnover figures. Based on this model, retailers in Germany hold around €130 million worth of coins in their cash registers on average.

Coins held in vending machines between €30 million and €100 million

In addition to retail outlets that need to provide coins as change, there are also points of sale where coins are the main method of payment, primarily vending machines (eg for travel and parking tickets, cigarettes and gaming activities). The stocks of coins accumulated in vending machines as a result of the above sales are wholly allocable to the transaction balance. In order to determine the volume of coins held in vending machines, it is necessary to make an additional calculation. An approximate value for the daily turnover in cash at vending machines in Germany can be calculated on the basis of turnover figures provided by the German Industry Association for coin-operated Amusement and Vending Machines (VDAI) and the share of cash payments conducted at vending machines according to the Bundesbank study on payment behaviour.[14] Making an assumption about the frequency at which vending machines are emptied, this works out at an average stock of coins of between €30 million and €100 million. Unfortunately, the data from the vending machine industry do not include all vending machine sales transactions. They omit transactions at machines selling parking or travel tickets. Consequently, the values shown here are likely to represent lower limits. In addition, no distinction can be made between banknote and coin payments on the basis of the cash payment share. The turnover in coins is presumably lower than the cash turnover shown here. Moreover, vending machines redistribute coins as change, thus further depleting the stock of coins kept in vending machines. No information is available about the precise influence of the various determining factors.

To summarise, the volume of coins held for domestic transaction purposes in 2011 was estimated at between €690 million and €1.0

Overview of estimation results

€ million

Item	2011	2012
Volume of coins carried in wallets or purses	410	–
Volume of coins held by credit institutions	120–370	140–350
Volume of coins held as change by retail outlets	130	130
Volume of coins held in vending machines	30–100	30–100
Total	690–1,010	–

Deutsche Bundesbank

14 See Deutsche Bundesbank (2012), op cit, p 54.

Foreign demand for German euro coins

The purposes of coin usage are generally broken down into the following three categories: transaction balance, hoarding and foreign demand. The foreign share of DM coins in circulation is unlikely to have played a major role.[1] Little is known to date about the hoarding of and foreign demand for euro coins issued in Germany ("German" euro coins).

In a first step, the number of coins in circulation in each country as a share of the total euro coins in circulation can be compared with the ECB capital shares of the member states.[2] A country's ECB capital share is calculated on the basis of its population and its economic output and, thus, upon important factors for determining the transaction balance of cash in that country. While the volume of coins in circulation in some countries deviates from the calculated value based on the ECB capital share, the deviations are by far not as pronounced as in the case of euro banknotes, for which there is a significant migration, also within the euro area.[3] In contrast to banknotes in circulation, tourism does not therefore appear to lead to any significant cross-border net flows of coins within the euro area.[4]

German euro coins make their way into countries outside the euro area via three channels: first, via the euro coins taken by German tourists and business travellers to certain holiday destinations (such as Turkey) for transaction purposes; second, through countries outside the euro area which have introduced the euro unilaterally as legal tender and, third, via tourists and business travellers from outside the euro area who take euro coins back home following a trip to the euro area. In the case of the first channel, we assume, as with coin migration within the euro area, that households and business travellers take just as many coins with them to countries outside the euro area as they take from these countries back to Germany. Consequently, there is no (net) export of German euro coins. The second channel concerns Kosovo and Montenegro. Euro coins are in circulation in these countries for transaction and hoarding purposes. However, the balances concerned can be disregarded as these countries are so small. The third channel is the most important of the three. It concerns tourists from countries outside the euro area who take euro coins back home with them. Unlike euro banknotes, these coins cannot generally be exchanged and therefore end up being hoarded. A large share of these coins never return to the euro area and can therefore be regarded as being permanently hoarded.[5] This form of seepage loss is probably more significant because Germany attracts visitors from all over the world.

Consequently, the active volume of German euro coins circulating abroad (excluding permanent hoarding) probably plays only a minor role. The difference between the overall value of German euro coins in circulation and the cash balance held in German euro coins for domestic transactions is therefore likely to consist principally of domestic and permanent hoards outside the euro area. The division into these two types of hoards and the composition of the domestic hoards (temporary and permanent hoards, collector holdings and lost coins) goes beyond the scope of this study and merits future research.

---

1 See Deutsche Bundesbank, Münzgeldentwicklung in Deutschland – Eine empirische Studie über den Münzgeld- und Banknotenumlauf in der Bundesrepublik Deutschland mit einer Prognose der Münzgeldnachfrage bis 2007, March 2003, p 161.
2 See M Altmann and N Bartzsch, The volume of euro coins held for transaction purposes in Germany, ROME Discussion paper, No 14-06e, August 2014, Table 6 on page 36.
3 See Deutsche Bundesbank, Foreign demand for euro banknotes issued in Germany, Monthly Report, January 2011, pp 29-41.
4 Using a random sample, the Bundesbank examined the share of euro coins with a foreign reverse side among all the euro coins in circulation in Germany for the year 2012; see Deutsche Bundesbank, Current and projected development of coin circulation in Germany, Monthly Report, January 2013, pp 36-37. Only cumulated flows to Germany are captured, however. Information about the outflow of euro coins with a national German reverse side to other euro-area countries would also be required in order to determine (cumulated) cross-border net flows of coins. No such data are available.
5 See J W D Bos (1994), The demand for coins in the Netherlands, De Nederlandsche Bank, Quarterly Bulletin, June 1994, pp 67-90.

billion. At around €410 million, the single largest value was recorded for the volume of coins carried in households' wallets or purses. This was followed by credit institutions, retail outlets and vending machine operators.

As a result, the total volume of coins held for domestic transaction purposes by sector lies well below the volume of coins held for transaction purposes in Germany in 2011 calculated using the seasonal method, which came to about €2.3 billion. Owing to insufficient data, the volumes of coins held for domestic transaction purposes by sector cannot be fully captured. It is doubly difficult to estimate the foreign demand for German euro coins (measured in terms of net exports). A majority of these coins are likely to be found circulating in countries outside the euro area. For further details, refer to the box entitled "Foreign demand for German euro coins" on page 72.

Summary and conclusions

Transaction balance makes next to no contribution towards elevating the volume of coins in circulation

According to estimates based on the seasonal method, the volume of euro coins held in Germany rose from just over €1.7 billion in 2004 to around €2.3 billion in 2011. During the same period, the total circulation of euro coins issued by the Bundesbank ("German" euro coins in circulation) rose from just under €4.5 billion to just over €6.5 billion. Consequently, 30% of this rise is attributable to the volume of coins held for domestic transaction purposes. However, while the total volume of German euro coins in circulation has grown at a steady and marked pace during the period under review, the time series for domestic transaction balances has flattened out noticeably since 2008 and barely makes any contribution towards the growth in the volume of German euro coins in circulation. The share of the total volume of German euro coins in circulation by value accounted for by the volume of coins held for domestic transaction purposes has therefore dropped since 2008 and stood at just under 36% in 2011. One reason for this downward trend in recent years could be the dwindling share of cash payments in the retail sector. In addition, the share of coins in circulation accounted for by the transaction balance automatically shrinks over time due to the accrual of coins that are lost or part of a collection.

Volumes of coins held for transaction purposes increase in line with denomination size

The volumes of coins held in small denominations (1 to 5 cent coins) for domestic transaction purposes was quite low at less than €60 million in each case in 2011, which corresponded with the low circulation of these denominations by value. The largest volumes of coins held for domestic transaction purposes were accounted for by the €1 coin (€600 million of late) and the €2 coin (at just over €1.1 billion). According to the estimates cited here, the €2 coin is the only denomination in which the volume of coins held for transaction purposes is still expanding significantly in Germany, unlike the other denominations which have been stagnating since 2008.[15] The circulation of German euro coins by value is clearly dominated by the two large denominations.

Low transaction balance shares of small denomination coins

The domestic transaction balance shares of small denomination coins in the volume of small denomination German euro coins in circulation ranged between 20% and 30% in 2011; well below the figure for total circulation by value (36%). This can partially be explained by the fact that small denomination coins are hoarded to a greater extent to lighten the weight of wallets and purses, or are lost. Moreover, except for a few cases, they cannot be used for making payments at vending machines. The domestic transaction balance shares of 20 and 50 cent coins turn out to be above average (46% and 51% respectively in 2011). These two coins can be classed as typical transaction denominations. Unlike small denomination coins, people rarely hoard them to make

15 To derive an economic explanation for this result as well as to verify its accuracy, it would be necessary to identify the extent to which consumption is paid for using coins (cash consumption), broken down by denomination. However, no such figures are at hand and it would be extremely difficult to make an estimate.

their wallet or purse lighter. Given their low face value, they are also not as good as a store of value as large denomination coins.

In the main, small denomination coins are kept to be used as change

Households hold highest volume of coins for transaction purposes

In addition, surveys and statistics were used to arrive at an estimate of the volumes of coins held for domestic transaction purposes by sector. Due to a lack of data, it was not possible to fully capture Germany's transaction balance using the stated approach. Hence, in 2011 the total volume of coins held for domestic transaction purposes by sector was estimated as lying between €690 million and €1.0 billion. At around €410 million, the single largest value was recorded for the volume of coins carried in the wallets or purses of households. This was followed by credit institutions, retail outlets and vending machine operators. German euro coins (in net terms) are only likely to be kept in significant quantities outside the euro area, where they are hoarded on a permanent basis.

The estimates specified here allow the following conclusions to be drawn.

Firstly, as a rule, small denomination coins (ie 1 and 2 cent coins) seem to be used to issue customers with the exact amount of change when settling a transaction. Owing to their modest transaction balance shares, relatively little use is made of such coins to pay for goods and services. In all likelihood, the bulk of them are either permanently lost or hoarded to lighten the weight of wallets and purses.

Coin circulation forecasts best achieved using time series models

Secondly, the results are of interest for estimating demand functions for German euro coins as well as the expected circulation of German euro coins. The demand for coins essentially depends on a transaction variable (for the transaction motive) and an opportunity cost variable (for the hoarding motive to use them as a store of value).[16] Real cash consumption can be used as one such transaction variable in structural models. It is more difficult to find a suitable proxy variable for opportunity costs. Structural models are therefore the most suitable method of determining the demand for German €2 coins. This is the only denomination in which the transaction balance makes a significant contribution towards boosting circulation. Hoarding balances play a greater role in other denominations. Time series models appear to be more suitable for this purpose.

16 See Deutsche Bundesbank (2013), op cit, pp 33-35.