No. 11-05 – November 2011

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Research On Money in the Economy

Discussion Paper Series
ISSN 1865-7052

No 2011-05, November 2011

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Abstract

In this paper, we analyze the volume of euro banknotes issued by Germany within the euro area with several seasonal methods. We draw a distinction between movements within Germany, circulation outside Germany but within the euro area and demand from non-euro-area countries. Our approach suggests that only about 20% of euro notes issued by Germany are used for transactions in Germany. The rest is hoarded (10%), circulates in other euro area countries (25%) or is held outside the euro area (45%).

Currency Movements Within and Outside a Currency Union: The case of Germany and the euro area[*]

"Where did all the money go?,
Where did all the cash flow?"

(Neil Young, 2011)

1 Introduction

In principle, all euro-area *national* central banks, but not the European Central Bank, issue euro banknotes. Following the introduction of euro cash at the start of 2002, the volume of banknotes issued by the Deutsche Bundesbank increased from an initial €73 billion to €367 billion at the end of 2010. Figure 1 shows that the volume of these "German" euro banknotes outstanding has grown much faster than could have been expected on the basis of earlier growth rates for D-Mark currency. Moreover, for each of the seven euro denominations (euro 5, 10, 20, 50, 100, 200, 500), the Bundesbank's share in the net issuance is higher than its share in the capital of the European Central Bank (ECB) of about 27%. The latter is calculated according to the euro countries' population and GDP shares.

These developments cannot be explained solely by an increased holding of transaction balances in cash as German private consumption since the introduction of euro cash in 2002 was weak and there was a steady decline in the percentage of cash payments in German retail sales (EHI Retail Institute 2010). The huge surge is therefore likely to be due to domestic hoarding and especially to foreign demand for euro banknotes. This foreign demand may originate from other euro area countries or from non-euro area countries.

In addition to helping to explain the increase in circulation, determining the volume of Bundesbank-issued euro banknotes in circulation outside Germany (and in hoards) is important for a number of other reasons. First, banknotes in circulation outside Germany have no impact on domestic demand, or at least a much smaller impact than those circulating in Germany. This has to be taken into account when analyzing the development of monetary aggregates. Second, foreign demand for banknotes influences the central banks' money market management. The value of banknotes outstanding is the largest autonomous liquidity factor and is also relatively difficult to forecast. Third, banknotes in circulation outside

Germany are not returned to the Bundesbank for processing as quickly as domestic transaction balances in cash. This is relevant when measuring the Bundesbank's participation in cash processing (Deutsche Bundesbank 2011). Fourth, foreign demand also has an impact on the Bundesbank's monetary income (before it is reallocated within the Eurosystem). As, with the exception of the liabilities item "banknotes in circulation", all items that are included in the calculation of monetary income are generally remunerated at the (average) interest rate for the Eurosystem's main refinancing operations, monetary income broadly corresponds to the seigniorage from banknotes in circulation (Rösl & Schäfer 2000). Fifth, during the latest financial market crisis, currency demand in Germany increased dramatically after the insolvency of Lehman Brothers (Deutsche Bundesbank 2009). As future crisis cannot be ruled out, a further buffer for such an unexpected surge in banknote demand is required for logistical reasons. Sixth, currently, there is an intensive discussion of the settlement of cross-border payment flows in the euro area, the so-called TARGET2 balances (see Sinn & Wollmershäuser 2011; Bindseil & König 2011).[1] Especially, the related large claims of the Deutsche Bundesbank against the Eurosystem are a point of criticism. However, it might be argued that the German issue of banknotes which exceeds its capital share and which constitute liabilities against the Eurosystem, have to be subtracted from the TARGET2 claims to get the net position of Germany. And last, but not least, euro banknotes held outside the euro area are an indication of the role of the euro as an international reserve currency.

As in other countries, there are no statistics that directly record the volume of cash in circulation outside Germany. There are, however other primary statistics (e.g., on net shipments of currency abroad) and surveys on cash from which inferences might be drawn. These have proven to provide only lower boundaries on the actual foreign holdings (see, e.g., Seitz 1995; Porter & Judson 1996). Therefore, one usually has to rely on indirect methods which make use of the different characteristics of domestic and foreign demand or particular events, such as the euro cash changeover.[2] In this paper, we concentrate on several variants of the so-called seasonal method. It makes use of different seasonal patterns of domestic and foreign demand. The different variants not only allow to derive results on the two different

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[1] TARGET2 stands for "Trans-European Automated Real-time Gross settlement Express Transfer system". All national central banks in the euro area are connected to TARGET2. There are no constraints on the size of their balances vis-à-vis the European Central Bank that emerge from the cross-border flow of interbank payment flows. As a result of payment flows between the Federal Reserve districts in the US, surpluses or deficits also emerge in interdistrict balances. These balances enter the Interdistrict Settlement Accounts, which are settled once a year.

[2] See on an overview of different direct and indirect approaches Feige (1997). An application to Germany (with extensions) can be found in Bartzsch et al (2011a, 2011b).

foreign sources (intra euro area outside Germany and extra euro area), but also on transaction balances and the amount of hoarding in Germany.

Figure 1: German banknotes in circulation in €billion
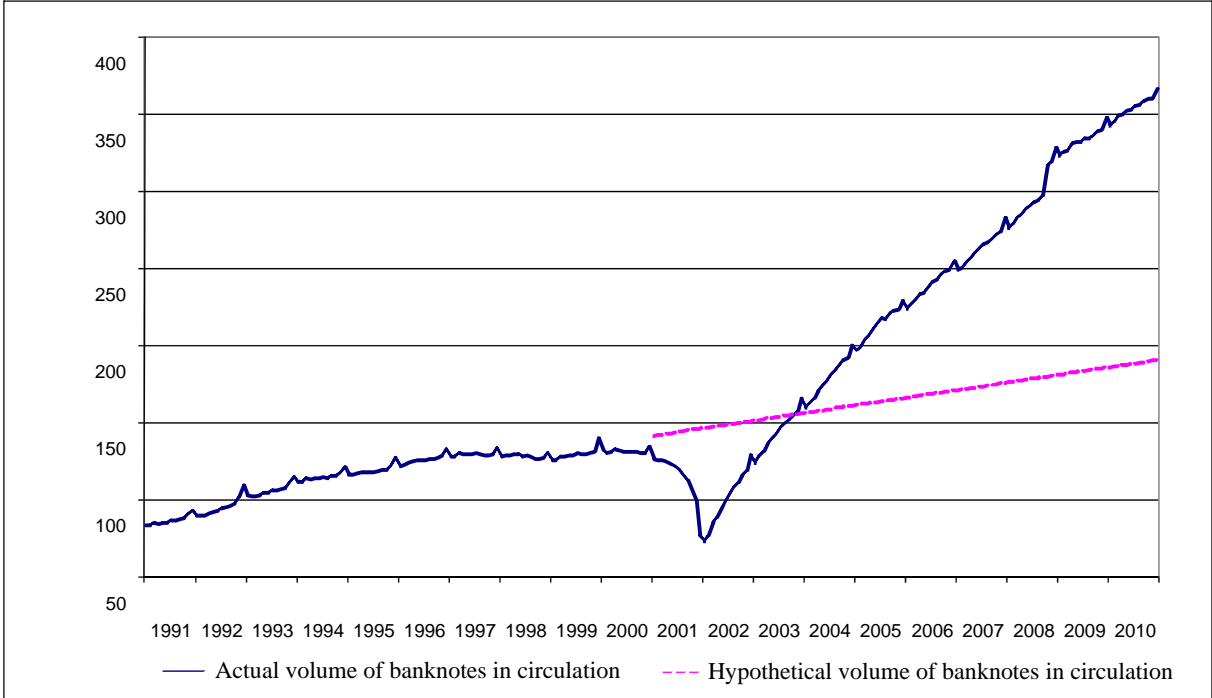
Note: The actual volume of banknotes in circulation in the period from January 1991 to December 2001 corresponds to the volume of D-Mark banknotes outstanding and, as of the introduction of euro cash in January 2002, the volume of Bundesbank-issued euro banknotes outstanding. For the purpose of simplicity, the volume of D-Mark banknotes outstanding in the period from January 1991 to December 2000 extrapolated using its linear trend is taken as the hypothetical volume of banknotes in circulation since January 2001.

The majority of studies on foreign demand for cash examine the US dollar and the Hong Kong dollar.[3] According to analyses conducted by the Federal Reserve, 60% to 70% of the US currency stock is held outside the US (Porter & Judson 1996; Anderson & Rasche 2000; US Treasury Department 2006).[4] Foreign demand as a percentage of the total volume of Hong Kong dollar currency in circulation in 2009 is estimated to be similarly high at between 50% and 70%. This figure has grown considerably over time (Leung et al. 2010).

There are only very few studies on foreign demand for cash in Europe. Seitz (1995) uses various estimation approaches and concludes that in the mid-1990s 30% to 40% of the total volume of DM cash was in circulation outside Germany.[5] Fischer et al. (2004) estimate that between 8% and 13% of the total volume of outstanding euro legacy currencies in 2000 was circulating abroad. As yet, however, there are no detailed papers that examine the (total)

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[3] For countries importing foreign cash, see Feige (2003).

[4] However, estimates in literature fluctuate between 20% and 70% (Feige 2009). A critique of the argument that most of the "missing" US dollar currency is probably abroad may be found in Haughton (1995).

[5] Doyle (2000) uses econometric methods and even arrives at a figure of almost 70%. However, this figure contradicts empirical evidence of banknotes returned following the introduction of euro cash.

foreign demand for euro cash either for the euro area as a whole or for individual euro-area countries. Deutsche Bundesbank (2009, pp. 49-51) uses the total known volume of euro banknotes shipped by banks from Germany to non-euro-area countries and an additional blanket amount for probable positive net exports of euro banknotes via other channels (eg tourism or money sent home by foreign workers) to estimate that foreign demand outside the euro area at the end of 2008 had accounted for between 25% and 35% of the total demand for Bundesbank-issued euro banknotes. The ECB (2011, p. 31) states that "taking into account a range of different estimates suggests that around 20%-25% (potentially a figure closer to the upper end of the range) of euro currency was circulating outside the euro area at the end of 2010". However, it does not specify these "different estimates" in more detail. Since 2007 the Austrian central bank has conducted a semi-annual survey on the foreign holdings of euro cash in central, eastern and south-eastern Europe. According to this survey, in 2008, households in these countries held approximately €12 billion in euro cash (Scheiber & Stix 2009).The present paper on developments in Germany since the euro cash changeover until the end of 2009 thus fills a gap in the research. This is all the more important, as it derives estimates for foreign demand from both non-euro-area countries and other euro-area countries.[6] As a by-product, we will also obtain domestic transaction balances and the amount of cash hoarded.

The paper is structured as follows. Section 2 describes the seasonal method. The results of three variants of it are presented in section 3. Section 4 concludes and summarizes.

2 The seasonal method

The general problem can be formulated as follows (Feige 1997, p 184):[7]

The shares β_1 and β_2 of two subpopulations C_1 and C_2, which together produce the total population C, are to be estimated. Let X_1 and X_2 denote the observed and recorded characteristics of subpopulations C_1 and C_2. The average feature X is then a weighted average of both characteristics, with the weights being the unknown shares β_1 and β_2.

(1) $X = \beta_1 X_1 + \beta_2 X_2$

As $\beta_1 = 1 - \beta_2$, the shares can be estimated by means of the observed and measured properties.

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[6] Analyses of cash movements within a currency area are relatively rare. For a country-specific perspective within the euro area, see Schneeberger & Süß (2007). For the situation in the United States, see Judson & Porter (2004).

[7] Initially, we do not distinguish between demand for German euro banknotes from other euro area countries and that from non-euro-area countries.

$$(2) \quad \beta_1 = \frac{X - X_2}{X_1 - X_2}$$

$$\beta_2 = \frac{X_1 - X}{X_1 - X_2}.$$

A sensible solution to this problem exists if the characteristics of the two parts X_1 and X_2 differ ($X_1 \neq X_2$) and the calculated shares are between 0 and 1. Therefore, to implement this approach for our purpose of the calculation of German banknotes held abroad, the characteristics of the banknotes in circulation outside Germany (X^a) must differ sufficiently from those of the banknotes outstanding in Germany (X^d) so that the foreign share can be identified by observing the overall behaviour. In our case, the distinguishing feature is the seasonal pattern of banknotes. At the same time, information is required about how the demand for banknotes would have developed if there had been no foreign demand.

Table 1: Seasonality tests

	Net shipments	German banknote issuance
PAC(12)	0.014 (202.46)	0.478 (68.58)
PAC(24)	-0.044 (270.92)	0.052 (88.29)

Notes: Monthly observations from January 2002 to December 2009. The net shipments display an upward trend. They have therefore been trend-adjusted using a Hodrick-Prescott filter (λ=14,400). Banknote issuance: logarithmic difference. PAC(x): partial autocorrelation coefficient for lag x, followed by the value of the Ljung-Box Q-statistic in brackets.

Source: Authors' own calculations

The seasonal method was first applied by Sumner (1990) to the calculation of domestic hoardings. Porter & Judson (1996) as well as Seitz (1995) and Fischer et al (2004) then adopted the approach for calculating foreign cash holdings. The fundamental assumption of this approach is that foreign demand for German euro banknotes has little or no seasonality, as the growth of foreign holdings (above all those in non-euro-area countries) has little to do with domestic seasonal developments.[8] This depends more on the international reputation of the euro and unstable developments in the destination countries. Hence, foreign and domestic demand differ in terms of the seasonal component and the total volume in circulation displays a dampened seasonal factor. No precise information is available on the foreign holdings of banknotes issued in Germany (these are to be determined). However, analysing the official

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[8] Nevertheless, seasonal influences are likely in the case of small denominations used for foreign travel, especially within the euro area (see also Bartzsch et al. (2011a), ch. 3.1). However, the share of foreign demand affected by this is likely to be fairly limited in relation to the total value of banknotes circulating outside Germany.

(net) banknote shipments from Germany to non-euro-area countries provides initial indications of whether the above assumption is justified. As Table 1 shows, these net shipments display no significant autocorrelation at the seasonal frequencies 12 and 24. By contrast, the seasonal autocorrelations of cumulated German net issuance of banknotes are highly significant, particularly for the standard seasonal frequency 12.[9]

The underlying seasonal model assumes that the time series of German banknote issuance consists of three terms: a trend component T_t, a seasonal term S_t and an irregular or noise component. These are multiplicatively interlinked (multiplicative seasonal model). Attributing the noise term to the trend for simplicity and taking into account that German banknotes are also held abroad (*a*) yields the following equation (where *t* represents the time index and *d* stands for Germany)[10]

$$(3) \qquad T_t S_t = T_t^d S_t^d + T_t^a S_t^a.$$

Let β_t denote the fraction of the overall trend held domestically and, consequently, $(1-\beta_t)$ the share held abroad:

$$(4) \qquad T_t S_t = \beta_t T_t S_t^d + (1 - \beta_t) T_t S_t^a \quad \text{or}$$

$$(4') \qquad S_t = \beta_t S_t^d + (1 - \beta_t) S_t^a.$$

(4') is a concrete example of the general equation (1), with the seasonal component taking on the role of the measured characteristic *X*. Assuming that the foreign share does not vary seasonally (see comments on Table 1 above), ie $S^a = 1 \ \forall \ t$, (4') can be simplified further to

$$(5) \qquad S_t = \beta_t S_t^d + (1 - \beta_t).$$

Given values for the seasonal terms S and S^d yields an equation for the unknown value β_t, the share of banknotes held domestically:

$$(6) \qquad \beta_t = \frac{S_t - 1}{S_t^d - 1}.$$

The foreign share, in turn, is $(1-\beta_t)$. S_t corresponds to the seasonal component of total German cumulated net banknote issuance and can be calculated using standard seasonal adjustment methods (eg X12-ARIMA, Tramo-Seats). By contrast, S^d, the seasonal term for the share of

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[9] These results apply similarly to the United States and the US dollar, see Porter & Judson (1995).
[10] Explicitly incorporating the irregular component is not likely to have any impact on the general results; see also Porter & Judson (1995), subsection 3.1.8.

banknotes circulating in Germany, is unknown. It must be estimated and various methods for this are presented below. However, equation (6) does not always produce meaningful results. If, for example, there is no seasonal influence in any given period, ie $S_t = S_t^d = 1$, β_t tends to infinity, or any value of β is compatible with equation (6). If the seasonality of all outstanding banknotes is not less pronounced in all periods than that of the banknotes held domestically, problems can occur, too. This method thus produces plausible results for some, but not for all frequencies.

Therefore, further modifications are needed to allow for these eventualities and to enable this method to be implemented. Fairly accurate estimation results can often be obtained only for a certain frequency within a given year (see also Porter & Judson 1995, p 19 f). We therefore take into account the fact that seasonal fluctuations are usually greatest around Christmas owing to domestic transactions. For example, in the case of German banknote issuance, the seasonal high is in December, while there is a seasonal low in February (in this case, there is accordingly a two-month frequency). In order to factor this into the equation, we replace the time index t by m,j, where m denotes the mth month and j stands for the jth year. If equation (5) for February is subtracted from the corresponding equation for the preceding December, the domestic share β_j reads as:[11]

$$(7) \qquad \beta_j = \frac{S_{dec,j} - S_{feb,j+1}}{S_{dec,j}^d - S_{feb,j+1}^d}.$$

Now, what is the best way of modelling S^d, the unknown domestic part in equation (7)? We try three variants which might proxy the seasonal component of the euro banknotes held in Germany. These include

    a) Selection of a reference country,

    b) consideration of a transactions variable,

    c) analysis of banks' vault cash.

Options a and b have so far been used most frequently in the literature when calculating the foreign share (Seitz 1995; Porter & Judson 1995; Fischer et al. 2004). Since all three variants

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[11] For an alternative, see Seitz (1995), p 29.

include different assumptions and hypotheses concerning what share of domestic and foreign demand is captured, the calculated β will also assume differing values.[12]

3 Results

3.1 A reference country

The idea behind selecting a reference country is to find a country that is similar to Germany in its use of banknotes, except for foreign demand. We would then insert this country's seasonal factor of banknote issuance for S^d in equation (7). After careful consideration, we decided on France as our reference country.[13] There are several reasons in favour of this:

- France is a euro-area country. Thus, it has the same denominational structure.
- The standard of living in France is similar to that in Germany.
- The *overall* cashless payments behaviour of non-banks relative to cash transactions in the two countries is not too dissimilar. Furthermore, the geographical density of ATMs, the number of transactions or withdrawals by debit card, and the number of transactions at POS terminals is comparable (for more details, see Bank for International Settlements, 2009).
- The size of the shadow economy, in which most transactions are settled in cash, is similar in both countries (Feld & Schneider 2010; Thießen 2010).
- There should not be a major difference in hoarding behaviour in the two countries (see, for instance, the estimates in Boeschoten 1992, ch 4).
- Since the start of EMU, there has been a high degree of synchronisation of the business cycles and also, in particular, of private consumption expenditure between Germany and France (Aguiar-Conraria & Soares 2011; Gayer 2007). The seasonal component of transaction demand should therefore be comparable.

Moreover, there are indications that in the case of small denominations, which usually have high seasonality, not only Germany but also France within the euro area is a net exporter of banknotes to other euro-area countries. To this extent, France and Germany could be treated similarly with regard to migration within the euro area as an initial approximation.[14]

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[12] Another option would be to analyse the seasonal structure of German coin issuance. However, as this is quite dampened (reasons: losses, collectors, hoarded coins) and shows two only weakly marked seasonal highs (Christmas and the holiday period), the seasonal method does not produce any plausible results in this case.

[13] In the case of then US dollar, usually Canada is taken as the reference country, see, e.g., Porter and Judson (1996).

[14] Unlike Germany and France, it can be seen that time and time again Austria, Belgium and Spain are net importers of individual banknote denominations. This can be derived from the negative cumulated net issuances of these countries. See also Bartzsch et al. (2011a), section 3.2.

If we now assume that none of the banknotes issued by France go to non-euro-area countries (this is indicated, for example, by the fact that since the start of EMU in 2002 until the end of our sample in 2009 the official shipments are carried out almost entirely by German banks, see Figure 2), we have found in France a reference country that is rather similar to Germany in its use of euro banknotes, except the demand from non-euro-area countries. Accordingly, using this approach, we identify the share of German euro banknotes in these countries. Therefore, *ß* is the corresponding share in circulation in Germany and in other euro-area countries. The calculated holdings should at all events be higher than the cumulated official net shipments, as these can be regarded as a benchmark providing a lower bound for actual foreign demand from non-euro-area countries.

Figure 2: Official net shipments outside the euro area, total and Germany (€billion)
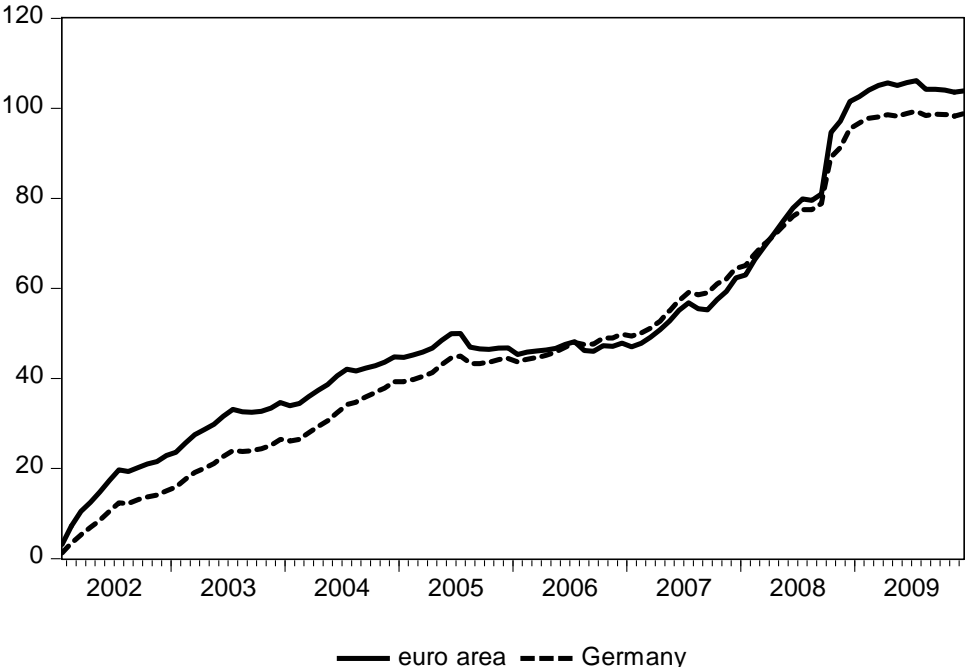
Figure 3 presents the results of this approach together with the cumulated net shipments. It is obvious that the calculated volume of euro banknotes abroad is significantly higher than the cumulated net shipments. The movements over time are rather similar. Accordingly, the volume of German euro banknotes outside the euro area amounted to around €160 billion at the end of 2009.

This approach can also be applied to individual denominations, as is done in Figure 4. The €5 banknote is not included, as only an additive seasonal component could be calculated for this denomination. Nevertheless, this is hardly likely to have distorted the results, as this denomination is not likely to be used much in non-euro-area countries. The approach had to be modified when applied to individual denominations as the seasonal lows and highs were no

longer continuously in February and December. The sum of the calculated holdings of individual denominations at the end of 2009 (around €175 billion) roughly corresponds to the figure when the approach is applied to the total volume of banknotes in circulation (see Figure 2: €160 billion). In terms of value, the €500 banknote is found most frequently outside Germany, followed by the €50 banknote. An increase for all denominations since 2002 can be observed. This increase appears to be declining in the case of €50 banknotes, but accelerating for €100 banknotes.

Figure 3: Total volume of German banknotes in non-euro-area countries: calculated on the basis of the reference country France (€billion)
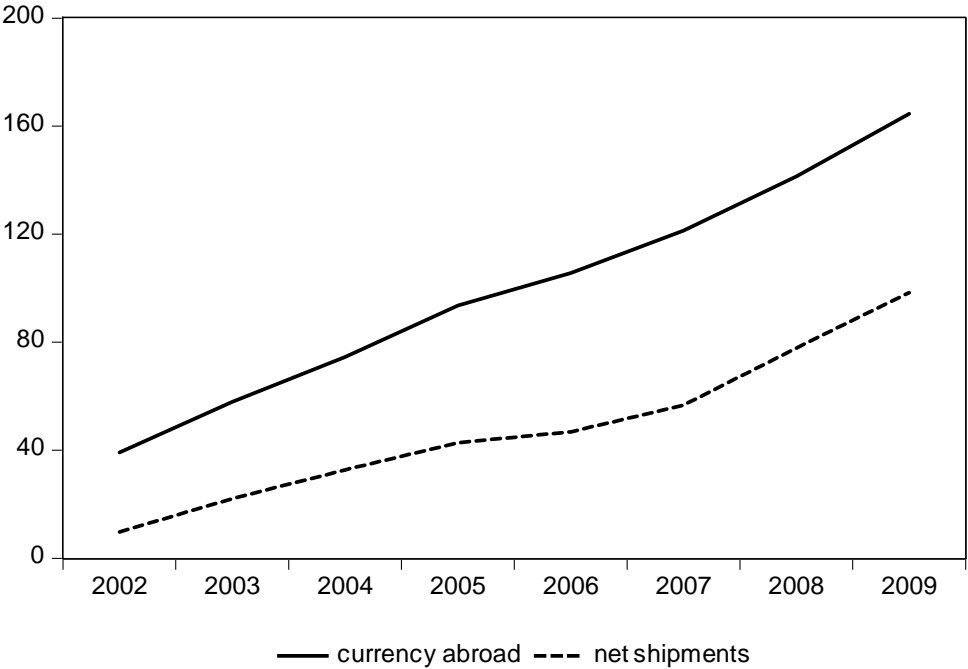
Sources: Deutsche Bundesbank and authors' own calculations.

Figure 4: German banknotes in non-euro-area countries: individual denominations calculated on the basis of the reference country France (€billion)
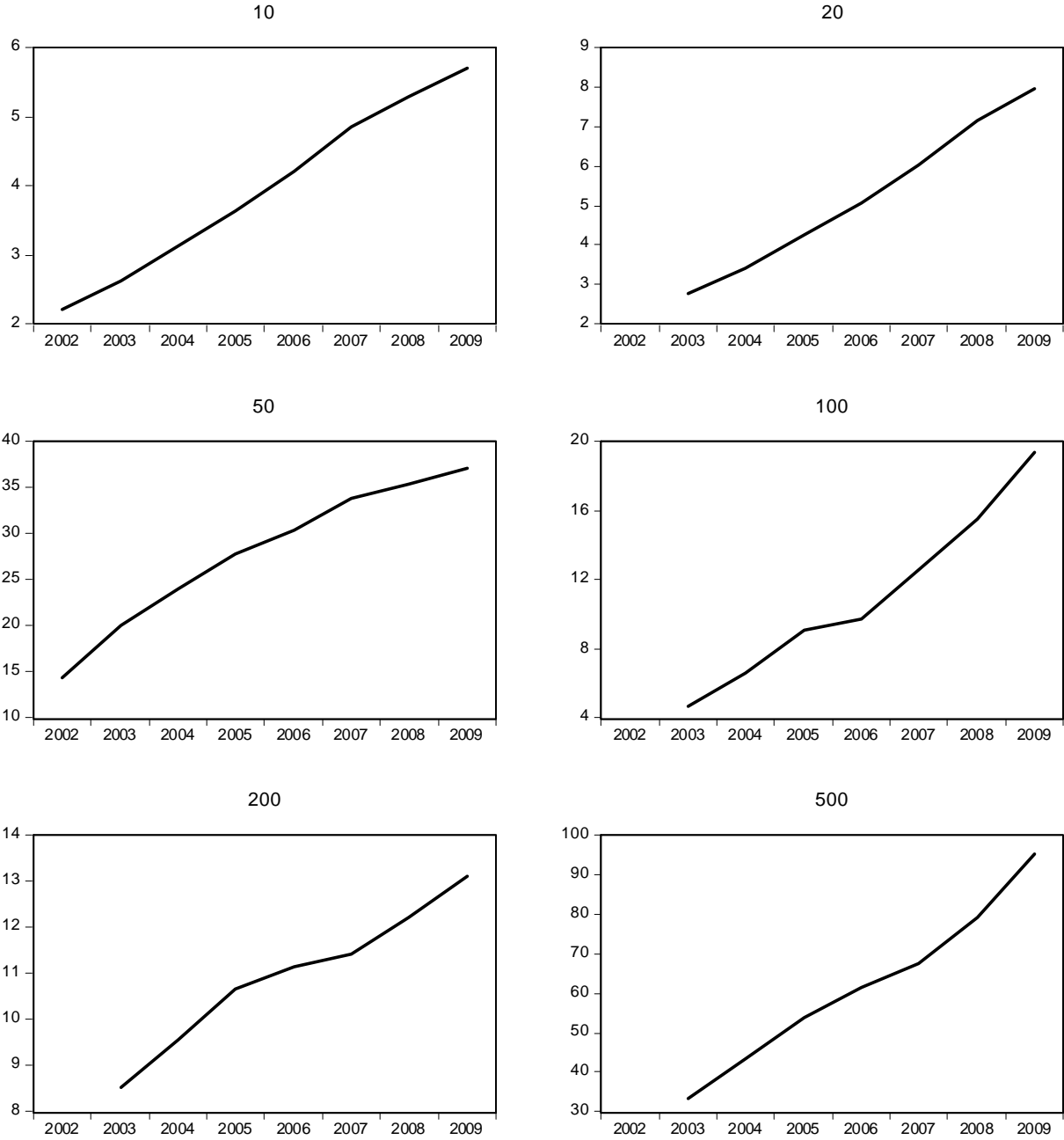
Source: Authors' own calculations.

3.2 Seasonal of a transactions variable

A further option is to compare the seasonal variation of German euro banknotes in circulation with the seasonal variation of a transactions variable.[15] Private consumption (including subcategories) or retail sales in Germany could, for example, be used for this purpose. Since cash is used in Germany for hoarding *and* transactions, the seasonal of the transactions

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[15] Different variants of this method may be found in Seitz (1995), subsection 2.2.3, Fischer et al. (2004), subsection 5.1.1c, and Porter & Judson (1995), subsection 3.1.7.

variable should be reflected in the seasonal of the volume of banknotes in circulation in Germany. This method would therefore not only record the non-euro-area countries' share, but also migration within the euro area and hoarding balances in Germany. To take hoardings into account, the approach can be modified to incorporate the domestic income elasticity (transactions elasticity) of the demand for banknotes, η, which, inter alia, captures the level of hoardings. Equation (7) can thus be rewritten as

$$(7') \qquad \beta_j = \frac{S_{dec,j} - S_{feb,j+1}}{S^d_{dec,j} - S^d_{feb,j+1}} = \frac{S_{dec,j} - S_{feb,j+1}}{\eta \cdot \Delta S(tr)},$$

where $\Delta S(tr)$ is the difference between the seasonal highs and lows of the transactions variable.

First, the value of the elasticity, η, is required for a scenario with no foreign demand. To obtain this, a banknote demand function for France during the period prior to the euro cash changeover is estimated. France is again an appropriate reference country as, during the time when both Germany and France had their national currencies, there were no major differences between the two with regard to *domestic* banknote demand behaviour. Moreover, domestic migration was not a problem before 2002, the D-Mark was not in circulation in France, and foreign demand for French francs was negligible (Seitz 1995, footnote 1). An estimate of a (long-term) banknote demand function for France from the first quarter of 1985 to the fourth quarter of 2001 produced an income elasticity which does not deviate significantly from one.[16]

Real private consumption and retail sales can be used as transactions variables in Germany. As the data quality of private consumption is significantly better, we present the results only for this case. However, this makes it necessary to switch to quarterly data (q). Equation (7') can thus be rewritten as

$$(7'') \qquad \beta_j = \frac{S_{q4,j} - S_{q1,j+1}}{\eta \cdot \Delta_{q4,j;q1,j+1} S(tr)}.$$

The resulting time series of euro banknotes circulating outside Germany is shown in Figure 5. As mentioned above, this approach captures the total volume of euro banknotes outside Germany (intra euro area and extra euro area). Once again, this results in an increasing volume since 2002, which reached approximately €250 billion at the end of 2009. Combined

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[16] Real private consumption, an interest rate variable and the consumer price index are included in the nominal estimate.

with the result of the first subsection, €90 billion remains for the cumulated net export of German banknotes to other euro-area countries. Therefore, at the end of 2009, around €100 billion was available in Germany for hoarding and transaction purposes.

Figure 5: German euro banknotes abroad: seasonal component of a transactions variable (€billion)
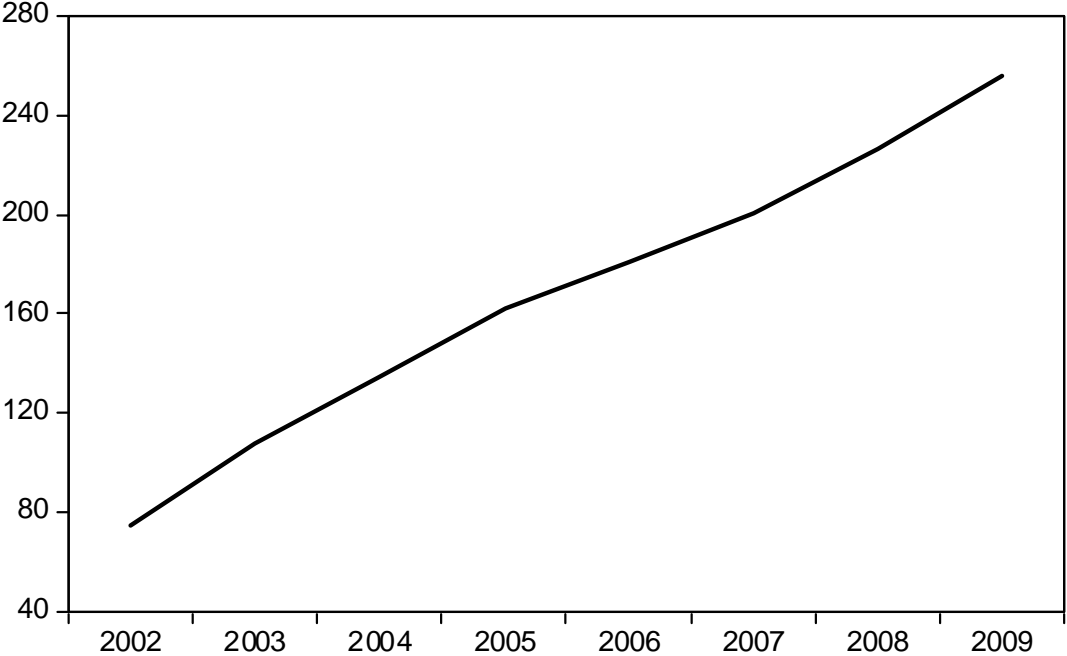
3.3 Analysis of banks' vault cash

The third possibility makes use of the seasonal pattern of vault cash in Germany (see also Porter & Judson 1995, subsection 4.2.3). Banks incur opportunity costs for cash balances held. They therefore keep them to a minimum and those held stem almost exclusively from regular domestic transactions (Allen 1998). Domestic hoarding and foreign demand have virtually no impact on banks' cash balances. The seasonal component of vault cash should therefore be more pronounced than that of German banknotes in circulation. The German share in total euro-area cash balances also provides an indirect indication of the importance of domestic transactions for the development of vault cash. In 2009 this was, at 28%, almost identical to Germany's capital share of 27% in the (fully paid-up) capital of the ECB.

Implementing equation (7) yields the results shown in Figure 6. Accordingly, the sum of euro banknotes outside Germany and domestic hoardings amounted to just under €290 billion at the end of 2009. If this is combined with the results from the other two subsections, this means that around €40 billion was hoarded. The residual of €60 billion can then only be accounted for by transaction demand from households and enterprises in Germany.

Figure 6: German euro banknotes outside Germany and hoardings of German euro banknotes in Germany: seasonal component of vault cash (€ billion)
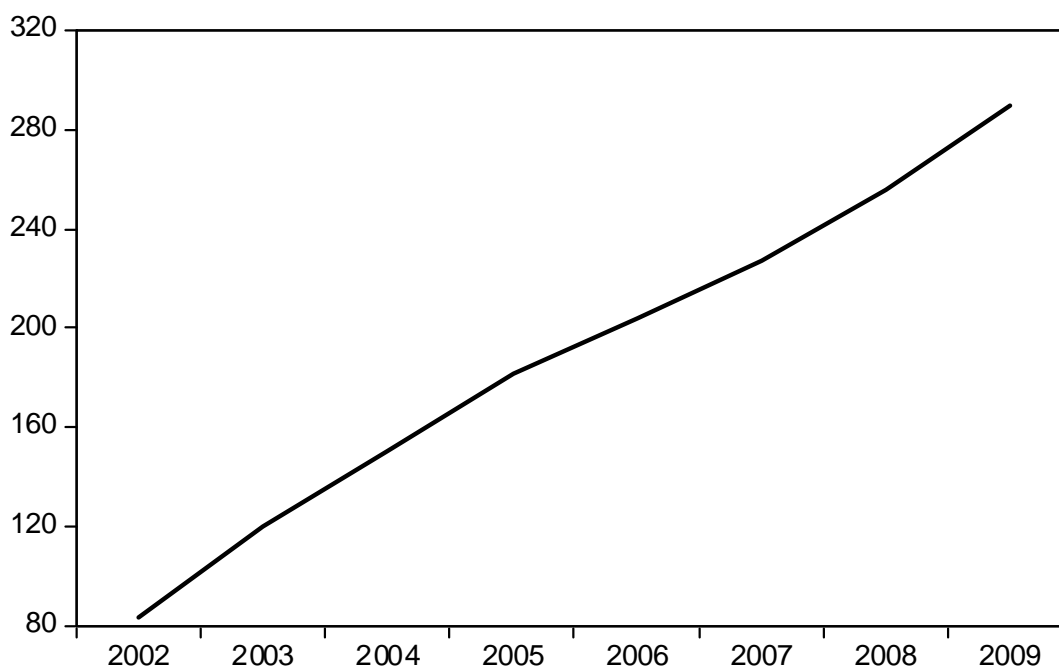
Source: Authors' own calculations

4 Summary and conclusion

This paper has endeavoured to use a seasonal method to determine foreign demand for euro banknotes issued in Germany. It has been found that, at the end of 2009, around 70% of the cumulated net issuance was held outside Germany (approx €250 billion). Of this, the lion's share, 45% (roughly €160 billion) was in non-euro-area countries, with the remainder, 25%, in other euro-area countries.[17] This also means that only a relatively small share – approximately €100 billion or 30% – was used for transaction purposes and hoarding in Germany. Our estimates suggest that banknotes hoarded in Germany amount to €40 billion. Consequently, around €60 billion were used in Germany for transaction purposes. This is the equivalent of around €700 *per capita* and is lower than in former D-Mark times (Seitz 2007).

According to estimates by the ECB (2011, p. 31), between 20% and 25% of *all* euro banknotes issued by the Eurosystem are in non-euro-area countries. At the end of 2009, this was equivalent to somewhere between €160 billion and €200 billion. Therefore, at least 80% of these banknotes are likely to have come from German origin. This is also in line with statistics on the shipments of banknotes via banks to non-euro-area countries, which put (cumulated) net shipments from Germany at the end of 2009 at 95% of total net shipments.

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[17] The share of 45% outside the euro area corresponds well with the estimated figure of 30% to 40% of D-Mark banknotes in circulation outside Germany before the euro cash introduction (Seitz 1995)

As demonstrated by Seitz & Setzer (2009), the statistical-econometric quality can be raised and the economic interpretation of cash demand functions for Germany can be made easier if arguments for foreign demand are incorporated. Given the results and the figures derived in this paper, this comes as no surprise. Aksoy & Piskorski (2005; 2006) have determined for the US that the indicator properties of narrow monetary aggregates with regard to cyclical and price developments can be improved considerably by taking foreign demand into account. Whether this is also the case for Germany or the euro area as a whole should be the subject of future research.

As figure 1 shows, German banknote issuance has increased at a significantly faster pace since the euro cash changeover. Although we do not know how banknote issuance would have developed without monetary union, one key question is why foreign demand for euro banknotes is primarily met by Germany. There are of course a number of historical reasons (Deutsche Bundesbank 2009), such as Germany's strong involvement in the global market for currency dealing as early as in the D-Mark era as well as its geographical location at the heart of Europe. Furthermore, Germans are keen travellers. All of the main holiday destinations (Austria, Italy, Spain, France) are within the euro area and Germany has a negative foreign travel account with these countries. However, a detailed examination of the potential causes would extend far beyond the scope of this paper.

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