

# Foreign demand for euro banknotes issued in Germany: estimation using direct approaches

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## **Abstract**

In this paper, we endeavour to determine the volume of euro banknotes issued by Germany that is in circulation outside Germany. In so doing, we draw a distinction between banknotes outstanding in non-euro-area countries and those that are in circulation in other euro-area countries. The analysis is based on various available statistics and, as an additional aid, on surveys (direct approaches). The observation period runs from 2002 to 2009. We discover that German euro banknotes to a total amount of approximately €220 billion are in circulation outside Germany. The lion's share of roughly €160 billion is in non-euro-area countries, with the remaining €60 billion in other euro-area countries. Thus, the volume of outstanding euro banknotes in Germany at the end of 2009 (around €130 billion) accounts for only roughly one-third of all banknotes issued by the Deutsche Bundesbank (€350 billion).

### **Key words:**

Banknotes, euro, foreign demand, hoarding, transaction balances, domestic migration

### **JEL classification:**

E41, E42, E58

## **Non-technical summary**

Following the introduction of euro cash, the value of banknotes in circulation issued by the Deutsche Bundesbank increased sharply, even after cash hoardings had been replenished due to the cash changeover. Cash held for domestic transactions alone does not account for this development, however. The increase is more likely to be due to domestic hoarding and, in particular, foreign demand (from both within and outside the euro area) for euro banknotes. In addition to helping to explain the increase in circulation, determining the volume of German euro banknotes in circulation outside Germany is important for interpreting the development of monetary aggregates, for the central bank's money market management as well as for measuring the Bundesbank's participation in cash processing. Last but by no means least, foreign demand is of significance for the Bundesbank's monetary income (before reallocation within the Eurosystem).

This article is the first detailed analysis and calculation of foreign demand for "German" euro banknotes. However, one fundamental problem must be addressed, namely that the amount of cash in circulation outside Germany cannot be measured directly but has to be determined using various statistics and plausibility considerations. It is thus appropriate to adopt an approach comprising a range of different methods. This article uses direct approaches, which are based on surveys and statistics. We have analysed the following available data: official shipments of German euro banknotes via banks to non-euro-area countries as well as household surveys of expenditure on foreign travel, payment behaviour and hoarding of cash. It transpires that these approaches have to be supplemented with additional assumptions in order to arrive at reliable estimates.

According to our estimates, the share of euro banknotes in circulation outside Germany in the Bundesbank's cumulated net issuance has been increasing steadily and noticeably since 2002 when it amounted to a mere 20%. At the end of 2009, an estimated 65% of Germany's cumulated net issuance of banknotes was in circulation outside Germany, with the majority in circulation in non-euro-area countries. The growth in the volume of German euro banknotes in circulation is therefore almost exclusively driven by foreign demand. In addition to the volume of banknotes in circulation outside Germany, the stocks of German euro banknotes accounted for by hoarding and domestic transaction balances were also estimated. While the various methods yield rather similar results, it is nevertheless advisable to additionally use indirect estimates to examine their robustness. This approach has been taken in a separate paper.

## **Nicht-technische Zusammenfassung**

Nach der Euro-Bargeldeinführung hat der Wert der von der Deutschen Bundesbank emittierten Banknoten stark zugenommen, und zwar auch noch nach der umstellungsbedingten Wiederauffüllung der Bargeldhorte. Mit dem Bargeldbedarf für inländische Transaktionen allein ist diese Entwicklung nicht zu erklären. Sie dürfte vielmehr mit der inländischen Hortung und insbesondere der Auslandsnachfrage nach Euro-Banknoten (sowohl innerhalb als auch außerhalb der EWU) zusammenhängen. Neben der Erklärung der Umlaufentwicklung ist die Bestimmung des Auslandsumlaufs deutscher Euro-Banknoten wichtig für die Interpretation der Entwicklung von Geldmengenaggregaten, die Geldmarktsteuerung der Notenbank sowie die Messung der Beteiligung der Deutschen Bundesbank an der Bargeldbearbeitung. Nicht zuletzt ist der Auslandsumlauf für die monetären Einkünfte der Bundesbank (vor Umverteilung im Eurosystem) von Bedeutung. Der Auslandsumlauf "deutscher" Euro-Banknoten wird hier zum ersten Mal genauer untersucht und bestimmt. Dabei muss das grundlegende Problem gelöst werden, dass eine direkte statistische Erfassung des Auslandsumlaufs nicht möglich ist, sondern dass auf verschiedene Hilfsstatistiken und Plausibilitätsüberlegungen zurückgegriffen werden muss. Vor diesem Hintergrund ist ein breiter Ansatz aus unterschiedlichen Methoden sinnvoll. Hier werden direkte Ansätze verwendet, die sich auf Umfragen und Statistiken stützen. Wir haben dabei folgende verfügbare Daten ausgewertet: offizielle Lieferungen von deutschen Euro-Banknoten über Banken in Länder außerhalb der EWU sowie Haushaltsumfragen zu den Reiseverkehrausgaben, zum Zahlungsverhalten und zum Horten von Bargeld. Es stellt sich heraus, dass nur unter Ergänzung der Ansätze mit zusätzlichen Annahmen verlässliche Schätzungen möglich sind.

Nach unseren Schätzungen ist der Anteil des Auslandsumlaufs an den kumulierten Nettoemissionen der Deutschen Bundesbank seit dem Jahr 2002, als er sich auf nur 20 % belief, stetig und deutlich gestiegen. Ende 2009 liefen schätzungsweise 65 % der kumulierten deutschen Nettoemissionen von Euro-Banknoten außerhalb Deutschlands um. Der Großteil davon befand sich in Ländern außerhalb der EWU. Das Wachstum des Umlaufs deutscher Euro-Banknoten wird somit fast ausschließlich von der Auslandsnachfrage getrieben. Neben dem Auslandsumlauf werden auch die Bestände von in Deutschland emittierten Euro-Banknoten abgeschätzt, die Hortungen sowie der inländischen Transaktionskasse zuzurechnen sind. Die verschiedenen Methoden führen zwar zu recht ähnlichen Ergebnissen, dennoch empfiehlt es sich zur Überprüfung der Robustheit unserer Ergebnisse, auch auf indirekte Schätzungen zurückzugreifen. Dies erfolgt in einem weiteren Papier.



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# Foreign demand for euro banknotes issued in Germany: estimation using direct approaches<sup>\*</sup>

## 1 Introduction

Generally speaking, all euro-area national central banks 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 very much faster than could have been expected on the basis of earlier growth rates for D-Mark currency. This growth cannot be explained solely by an increased holding of transaction balances – that is cash held for buying goods and services – as domestic private consumption in the observation period was weak and there was a steady decline in the percentage of cash payments in German retail sales (EHI Retail Institute, 2010). This huge surge is therefore likely to be due to domestic hoarding and foreign demand for euro banknotes. For the first two years after the launch of euro cash, this hypothesis can be plausibly substantiated by the need to replenish stocks of hoarded banknotes both inside and outside the euro area after the currency changeover. However, this should have ceased to have an effect at the end of 2003 when the volume of German banknotes outstanding returned to the hypothetical level at which it would have been had euro cash not been introduced (see Figure 1). But the pace of growth in the volume of banknotes outstanding continued thereafter to be much more dynamic than in the D-Mark era in the 1990s.

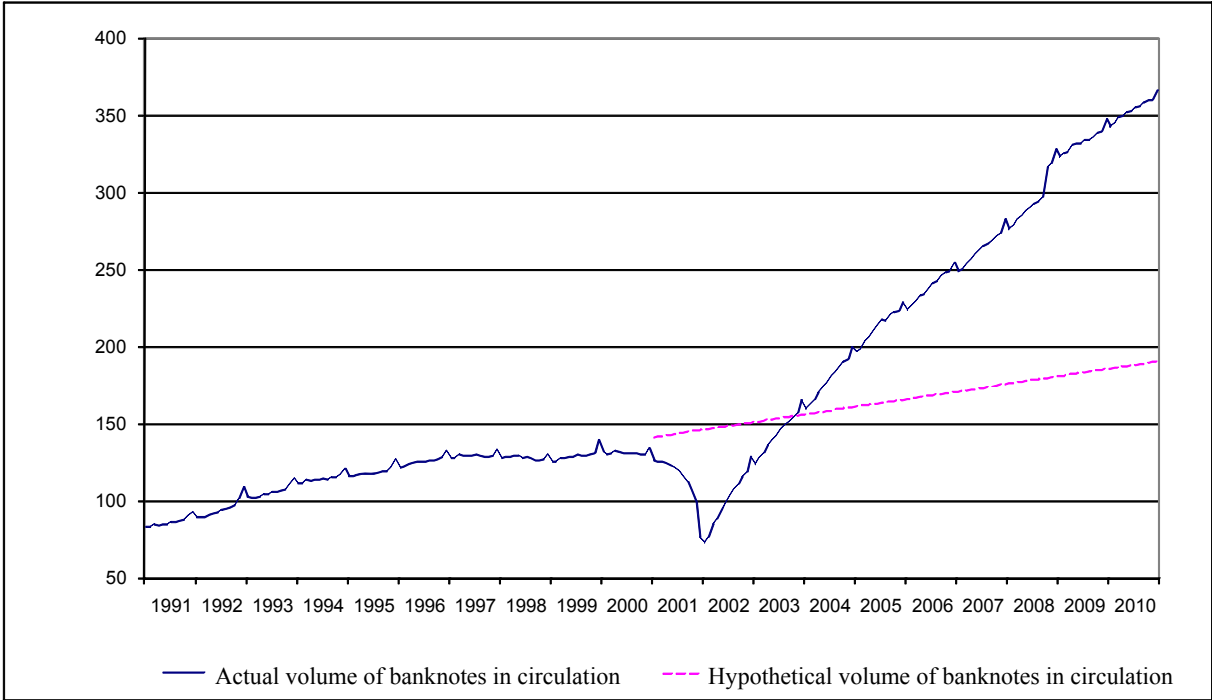
In addition to helping to explain the increase in circulation, determining the volume of Bundesbank-issued euro banknotes in circulation outside Germany is important for a number of other reasons. First, banknotes in circulation outside Germany have no impact on domestic demand, or at least a much smaller impact than those circulating in Germany. This is a

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fundamental point to bear in mind when analysing the development of monetary aggregates.<sup>1</sup> Second, foreign demand for banknotes influences the way in which central banks manage the money market. In terms of value, the volume of banknotes outstanding is the largest autonomous factor determining liquidity and is also relatively difficult to forecast. Third, banknotes in circulation outside Germany are not returned to the Bundesbank for processing as quickly as those paid in from domestic transaction balances. This is relevant when measuring the Bundesbank’s participation in cash processing (Deutsche Bundesbank, 2011). Finally, 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, 2002; Rösl and Schäfer, 2000).

**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 (excluding the cash changeover) as of January 2001.

<sup>1</sup> This is admittedly complicated by the fact that Germany’s official contributions to Eurosystem monetary aggregates do not contain currency in circulation and can on no account be interpreted as its own national monetary aggregates; nor are they comparable with the earlier German monetary aggregates M1, M2 and M3.

*Sources:* Deutsche Bundesbank and authors' own calculations

There are no statistics that directly record the volume of cash in circulation outside Germany; however, there are other statistics that enable such conclusions to be drawn. In this paper, the foreign demand for Bundesbank-issued euro banknotes is estimated directly using primary statistics and surveys of German cash (cash taken abroad, usage by individuals etc). In cases where these data alone are insufficient, certain additional assumptions are made. We refer to this as the “direct” approach to distinguish it from the “indirect” methods, which exploit the presumed different characteristics of domestic and foreign demand or extrapolate earlier developments in the circulation of banknotes to be able to comment on the foreign demand for German euro banknotes (Bartzsch, Rösl and Seitz, 2011).<sup>2</sup>

This paper initially provides a brief overview of the literature on relevant studies, focusing on countries exporting cash.<sup>3</sup> The majority of studies on foreign demand for cash examine the US dollar and the Hong Kong dollar.<sup>4</sup> The volume of outstanding cash of both currencies has increased sharply since the 1990s and stocks *per capita* of the respective domestic population are very high. However, this cannot be accounted for solely by the respective domestic demand for cash for (legal) transaction purposes, especially due to the increasing popularity of cashless payment instruments. One possible explanation for this growth is foreign demand for cash. According to analyses conducted by the Federal Reserve Board, 60% to 70% of the US currency stock is held outside the USA (Porter and Judson, 1996; US Treasury Department, 2006).<sup>5</sup> Leung, Ng and Chan (2010) have updated various econometric studies on foreign demand for Hong Kong dollars with new data. They calculate that between 50% and 70% of the Hong Kong dollar currency in circulation in 2009 was outside of the country and that this share had grown considerably over time.

There are only very few studies on foreign demand for cash in Europe. Seitz (1995) uses various estimation approaches and comes to the conclusion that in the mid-1990s 30% to 40% of the total volume of DM cash in circulation was outside Germany.<sup>6</sup> Fischer, Köhler and Seitz (2004) estimate that between 8% and 13% of the total volume of outstanding euro legacy currencies in 2000 were circulating abroad. As yet, no papers have been published that examine the (total) foreign demand for euro cash either for the euro area as a whole or for

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<sup>2</sup> For information on the standard terms used when exploring this topic, see also Judson and Porter (2000).

<sup>3</sup> For information on countries importing cash, see, for example, Feige (2003).

<sup>4</sup> However, only the US dollar and the euro are likely to be in use worldwide.

<sup>5</sup> However, estimates in literature overall fluctuate between 20% and 70% (Feige, 2009).

<sup>6</sup> 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.

individual euro-area countries. In the Bundesbank's Monthly Report article (2009a, pages 49 to 51), foreign demand at the end of 2008 is estimated to have accounted for between 25% and 35% of the total demand for Bundesbank-issued euro banknotes. This estimate corresponds to 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 to these countries via other channels (eg tourism or money sent home by foreign workers). It is thus a rather rough estimate and is based on one estimation method only. The European Central Bank (2010, page 36 and 2011b, page 31) uses the same method in its calculation of the percentage of total (Eurosystem-issued) euro banknotes outstanding that are in circulation outside the euro area and puts this figure at between 20% and 25%. Furthermore, the foreign demand for euro cash in central, eastern and south-eastern European countries was estimated using the OeNB Euro Survey. This is a survey that has been conducted by the Austrian central bank semi-annually since autumn 2007 to collect data *inter alia* on the stocks of banknotes hoarded by households in these countries. According to this survey, in 2008, households in these countries held approximately €12 billion in euro cash (Scheiber and Stix, 2009, Figure 5).

A brief look at the literature available reveals the absence of a comprehensive analysis on the calculation of foreign demand for euro banknotes. This paper on foreign demand for Bundesbank-issued euro banknotes will thus fill this gap in research. This is all the more important, as estimates are derived in it for foreign demand in both non-euro-area countries and other euro-area countries.<sup>7</sup> As a spin-off, we will also obtain domestic transaction balances and the amount of cash being hoarded. Furthermore, the results will allow conclusions to be drawn as to the total volume of euro banknotes in circulation in non-euro-area countries, ie foreign demand from the Eurosystem's perspective.

The paper is structured as follows. Chapter 2 describes the individual components of circulation of Bundesbank-issued euro banknotes. Estimates for these components are presented in chapter 3. These estimates are chiefly based on statistics and surveys (direct approaches). Chapter 4 contains an overview of the results of the individual approaches. These results are then summarised and interpreted in chapter 5.

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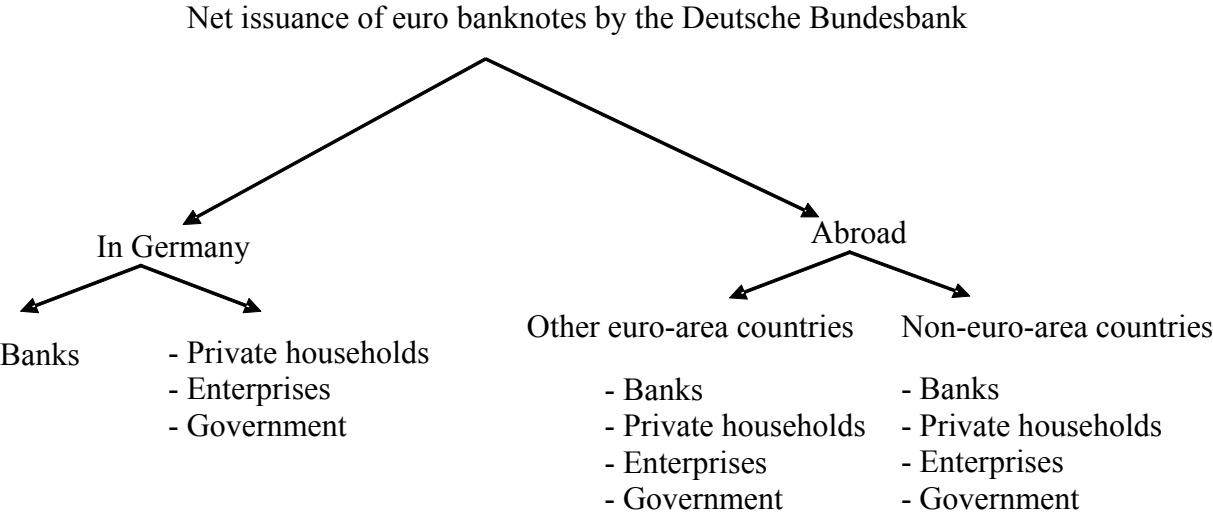
<sup>7</sup> For an analysis of the latter using Austria as an example, see Schneeberger and Süß (2007).

## 2 The geography and demography of euro cash

Anonymity is the sole characteristic that distinguishes cash from all other payment instruments. It is also one of the most attractive features of cash (Deutsche Bundesbank, 2009b, subsection II.2.2). Likewise, initially there is only direct information about how much cash a central bank has issued and how much of this remains in banks' cash holdings (vault cash). It is not known which non-banks hold cash, how much they hold, the precise location of cash (at home or abroad) or why exactly they have chosen to hold cash.

With regard to the issue of where the cash is being held, there is a further complication in the euro area. When considering foreign demand for cash, a distinction has to be drawn between demand from other euro-area countries (intra euro area) and demand from non-euro-area countries (extra euro area). Both are relevant for our analysis as Germany high issuance share is thought to be due to banknote demand in both of these regions. In this context, it is interesting to determine the stocks at a certain point in time as well as the associated flows. The aim here is to capture the volume of German euro banknotes held in the other euro-area countries as well as the volume circulating in non-euro-area countries.<sup>8</sup> If both "types of foreign demand" are successfully identified, then domestic circulation can be determined as a residual. This identification problem can be approached directly or indirectly. This paper focuses on direct approaches. Figure 2 depicts this "monetary geography" of Bundesbank-issued euro banknotes.

**Figure 2: Monetary geography**



<sup>8</sup> Where the term "German (euro) banknotes" is used, this always refers to banknotes issued by the Deutsche Bundesbank. The total outstanding volume of German banknotes (including credit institutions' cash holdings) corresponds to the cumulated net issuance, ie the volume resulting from the cumulated difference between monthly withdrawals and lodgements at the Deutsche Bundesbank. In the statistical section of the Deutsche Bundesbank's Monthly Report, the volume of banknotes in circulation is calculated in a different way because the banknotes in circulation are shown in accordance with the accounting rules of the Eurosystem.

*Source:* Authors' own chart

### **3 Direct approaches to determine foreign demand for banknotes**

Approaches that attempt to identify the volume of German euro banknotes in circulation outside Germany in a more or less direct manner, can be divided into two categories. The first category uses statistics on the shipments of Bundesbank-issued banknotes to non-euro-area countries via banks that are active in the global market for currency dealing or surveys of travellers on the amount of cash that they take on holiday or business trips. However, such data are subject to some uncertainty as these surveys are generally conducted on a voluntary basis and it is extremely difficult to verify whether the responses are correct. Moreover, the results of surveys and statistics rarely provide comprehensive answers to the issues examined here as there are a number of channels whereby banknotes can leave Germany. Another way of determining the foreign demand for German euro banknotes is to calculate this as a residual by basing calculations thereof on, *inter alia*, household surveys showing the volume of German euro banknotes in circulation in Germany and then subtracting this amount from the cumulated net issuance by the Bundesbank. However, in such calculations it is not possible to divide the outstanding volume of German euro banknotes outside Germany between those in non-euro-area countries and those in euro-area countries. By contrast, it is possible to determine the amount of banknotes being used in domestic transaction balances and being hoarded in Germany.

#### **3.1 Net shipments of euro banknotes from Germany to non-euro-area countries and foreign travel**

Euro banknotes are issued by Eurosystem national central banks (NCBs).<sup>9</sup> Although the exact volume of euro banknotes issued and collected by each NCB is known, there is only limited information about the migration movements of banknotes between euro-area countries (domestic migration) and to non-euro-area countries. Initial information can be ascertained from examining the cumulated net issuance by the NCBs broken down by denomination.

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<sup>9</sup> The ECB itself does not issue any banknotes. However, its balance sheet reports an 8% share of outstanding euro banknotes. For information on the banknote allocation key, see Decision ECB/2001/15 of 6 December 2001 on the issue of euro banknotes, OJ L 337, 20 December 2001, p 52, as amended.

**Table 1: Cumulated net issuance of euro banknotes up to the end of 2009, broken down by denomination, cross-country comparison, in € million**

	Cumulated net issuance				NCB's share of cumulated net issuance	ECB capital share
	€5-€20	€50-€100	€200-€500	Total		
Germany	48,204	162,380	137,525	348,110	43.2%	27.1%
France	43,329	28,480	4,739	76,548	9.5%	20.4%
Italy	4,734	117,480	20,984	143,198	17.8%	17.9%
Spain	-16,625	38,733	58,492	80,599	10.0%	11.9%
Netherlands	-5,476	17,298	10,700	22,523	2.8%	5.7%
Belgium	-335	16,412	-8,990	7,087	0.9%	3.5%
Portugal	7,691	-6,632	-397	663	0.1%	2.5%
Luxembourg	-1,042	10,438	51,164	60,560	7.5%	0.3%
Austria	-3,271	-28,599	35,594	3,725	0.5%	2.8%
Ireland	1,430	23,608	372	25,410	3.2%	1.6%
Finland	2,151	4,242	3,028	9,420	1.2%	1.8%
Greece	-1,831	20,947	1,856	20,972	2.6%	2.8%
Malta	363	238	168	769	0.1%	0.1%
Cyprus	21	883	397	1,301	0.2%	0.2%
Slovenia	1,943	-1,229	278	991	0.1%	0.5%
Slovakia	429	2,478	1,628	4,535	0.6%	1.0%
EMU-16	81,715	407,158	317,539	806,412	100.0%	100.0%

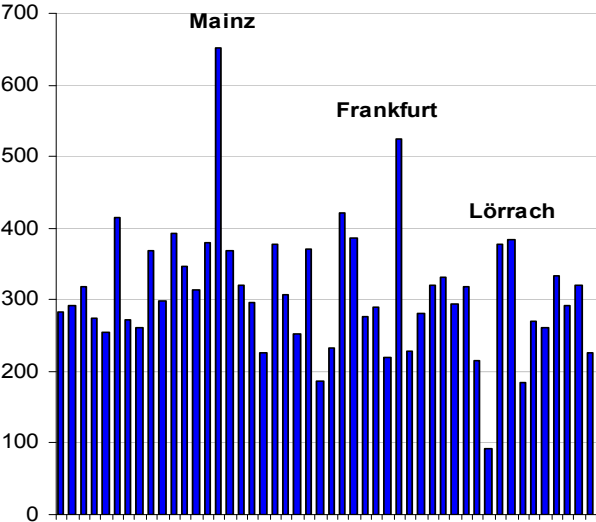
Source: ECB

The table above shows that, in terms of value and across all denominations, to date all NCBs have issued more euro banknotes than they have received. The largest issuer by far is the Bundesbank which issued 43% of all euro banknotes in circulation at the end of 2009. The “German contribution” to cash supply is thus clearly in excess of the German ECB capital share of 27% which, along with the relative share of the population and Germany’s economic output, reflects important determinants for transaction balances. It is precisely the Bundesbank’s extensive net outpayments of denominations under €100 that are typically used for transaction purposes, and net inpayments of these denominations at central banks in countries where Germans typically spend their holidays that suggest that these balances are closely connected with foreign travel. But, at just under 45%, Germany’s share in the issuance of €200 and €500 euro banknotes, which experience has shown are almost exclusively hoarded (and possibly used for transactions in the shadow economy, too), is also very high. However, according to a household survey by the ECB, there is no indication that the hoarding of cash in Germany is particularly pronounced in contrast to other countries.<sup>10</sup> The reference to individual countries’ different levels of preference for using cash in payment transactions can only explain the Bundesbank’s high percentage share of issuance to a limited

<sup>10</sup> For more information on this survey, see section 3.3.

degree.<sup>11</sup> Extensive issues of high-value banknotes by the Bundesbank are instead likely to be driven to a large extent by demand from non-euro-area countries. This effect became particularly pronounced as the financial crisis intensified following the insolvency of Lehman Brothers when the issue of €500 banknotes soared (Deutsche Bundesbank, 2009a, pages 52 and 53). The main parties involved here were the Bundesbank branches in Mainz and Frankfurt am Main which, due to their proximity to Frankfurt airport, traditionally meet a majority of the demand for euro banknotes from non-euro-area countries. But the operating unit in Lörrach which, given the Swiss banking system’s logistical connection to the euro cash cycle, also plays an important role in the global market for currency dealing, likewise recorded a sharp rise in the demand for high-value euro denominations at that time (see Figure 3).

**Figure 3: Issuance of €500 banknotes by the Bundesbank**



*Note:* Percentage change in October 2008 compared to August 2008 per Bundesbank branch.

*Source:* Deutsche Bundesbank

The official shipments of banknotes to non-euro-area countries also give a further indication that the Bundesbank plays a pivotal role in supplying euro cash beyond its borders, especially to non-euro-area countries. These shipments comprise withdrawals and lodgements of euro banknotes by or at Eurosystem central banks that are processed by wholesale banks active in the global market for currency dealing. According to these figures, since the introduction of the single currency up to the end of 2009, euro banknotes with a total value of €346 billion were shipped via these banks, of which €259 billion were provided by the Bundesbank. At €149 billion, almost 60% of German banknotes sold were €200 and €500 notes.

<sup>11</sup> See also the comments in section 3.2.



According to the shipping banks, the main recipient countries were those in geographical proximity to the euro area.<sup>12</sup> For instance, in 2009 37% of all gross shipments of banknotes sold were to the “rest of Europe” (especially Switzerland), a further 28% of sales were to those EU countries that have not yet introduced the euro as legal tender (especially the United Kingdom) and a further 22% of euro banknotes were shipped to eastern Europe.<sup>13</sup> By contrast, shipments to North and South American banks were negligible. However, caution is required when interpreting these figures with regard to the ultimate location of the net shipments of banknotes. The extremely large gross shipments to Swiss banks in particular should be seen against these institutions’ significance in the global market for currency dealing where they act as an international hub. On balance, the Swiss banks sold the euro banknotes acquired almost exclusively to banks in non-euro-area countries as, according to the reporting institutions, there were no noteworthy sales of euro banknotes to euro-area banks from this region. At 34%, counterparties from eastern Europe are the most important group of countries with regard to foreign lodgements of euro banknotes; in second place are banks from the country group “EU excluding euro area” at 25%. The remaining amounts are shared between Asia, Africa and the Middle East, which together make up roughly one-third of all return flows of euro banknotes processed via banks. North and South American banks again were of no significance here. Thus, cumulated return flows of euro banknotes to the euro area from banks in non-euro-area countries totalled €242 billion in the period from 2002 to 2009, €161 billion of which were attributable to Germany.

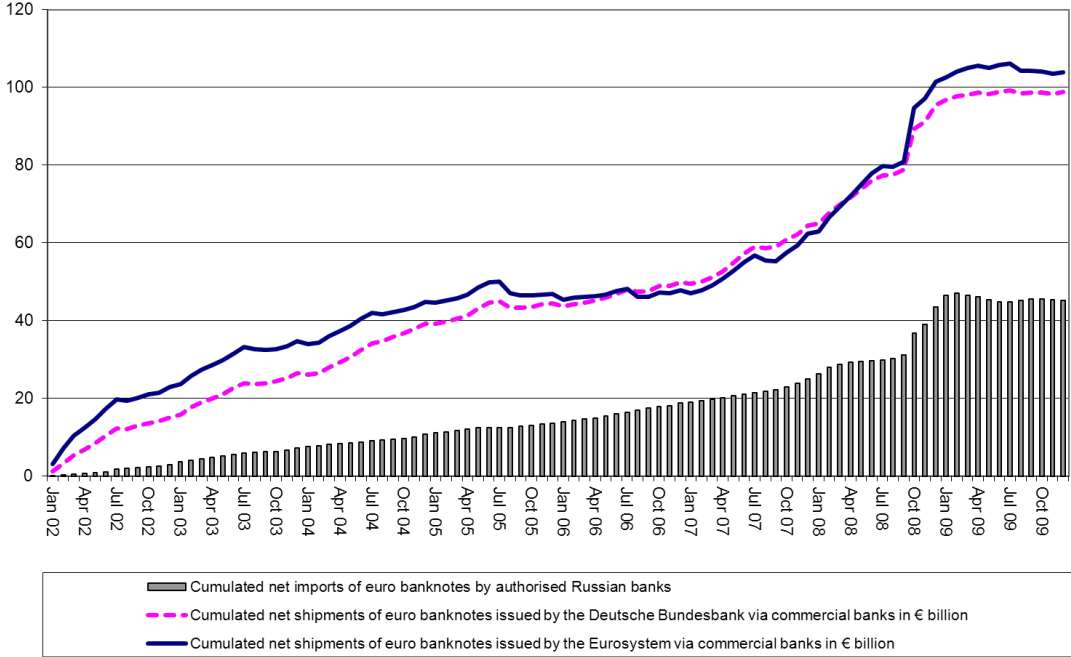
Despite these sizeable return flows, the cumulated net export of euro banknotes via banks rose steadily to €104 billion between the introduction of the single European currency and the end of 2009 whereby, at €99 billion on balance, the Bundesbank provided almost the entire amount (see Figure 4).

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<sup>12</sup> Scheiber and Stix (2009, p 6) use surveys based on random sampling in central, eastern and south-eastern European countries to show that euro banknotes are kept in Balkan nations predominantly due to their store-of-value function, whereas in the central European countries of Poland, the Czech Republic and Hungary, the most important reason for keeping euro banknotes is for making purchases or holidaying in the euro area.

<sup>13</sup> See ECB (2010), p 35 ff.

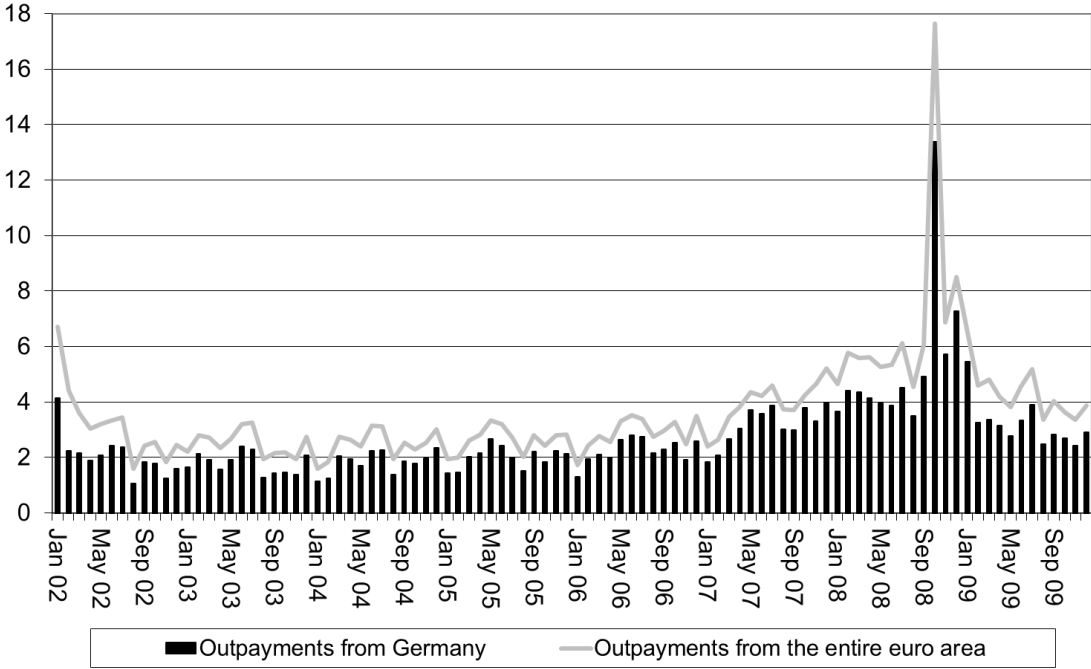
**Figure 4: Cumulated net shipments of euro banknotes via commercial banks in € billion**



Sources: Deutsche Bundesbank, ECB, Bank of Russia and authors' own calculations

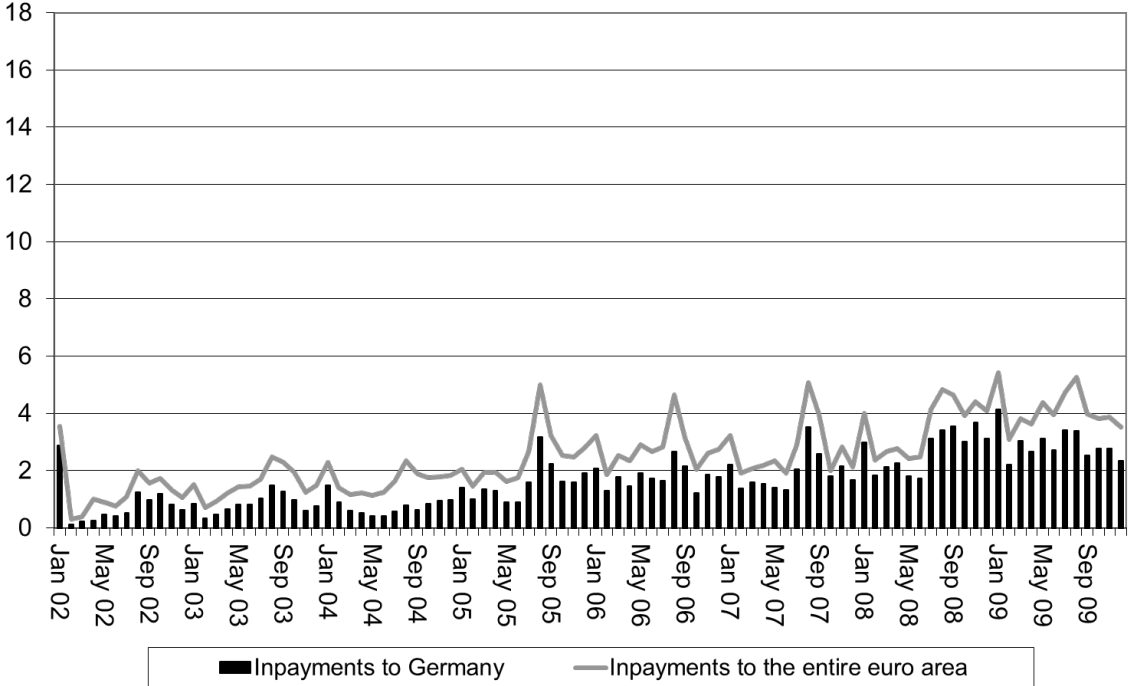
The following two figures show just how dominant a role the Bundesbank played in both the outpayment and inpayment of banknotes.

**Figure 5: Outpayments of euro banknotes from Germany and the entire euro-area to non-euro-area countries via banks in € billion**



Sources: ECB and Deutsche Bundesbank

**Figure 6: Inpayments of euro banknotes to Germany and the entire euro-area from non-euro-area countries via banks in € billion**



Sources: ECB and Deutsche Bundesbank

Furthermore there is evidence indicating that the cumulated net shipments by the Bundesbank – with the exception of the financial crisis in autumn 2008 following the insolvency of Lehman Brothers, when there was an exceptionally sharp rise in notes paid out – are the result of a relatively continuous process.

However, the data provided by banks on their lodgements and withdrawals of euro banknotes at the Deutsche Bundesbank are only a lower bound for the euro banknotes in circulation in non-euro-area countries issued by the Bundesbank. Any net exports of banknotes that leave the euro area permanently via tourism, cash sent home by foreign workers and other transactions have to be added to this lower bound. The following shows that here again Germany had a crucial role to play. When drawing up the balance of payments statistics, the Bundesbank surveys travellers on the basis of household samples to determine how much cash they take with them on trips abroad (see Table 2).<sup>14</sup> This covers trips to both euro-area and non-euro-area countries.

<sup>14</sup> See also Deutsche Bundesbank (2003), p 60 and Deutsche Bundesbank (2005). Since most cash amounts taken abroad are likely to take the form of banknotes, no explicit distinction is made in this section between banknotes and cash in circulation.

**Table 2: Results of a household survey to determine volume of foreign travel / means of payment, in € million**

Year	Euro cash taken abroad, then changed into foreign currency	Cash payments made abroad using euro imported from Germany		Foreign currencies (bought in Germany and left-overs from past trips) outflow via travel to foreign countries	German travel expenditure			
	Total	Total	in other euro-area countries	in non-euro-area countries	Total	Total	for trips to other euro-area countries	for trips to non-euro-area countries
2002	3,745	9,959	7,197(+)	2,762(+)	1,872	55,904	31,014	24,890
2003	4,618	16,041	12,446	3,595	3,208	57,757	32,493	25,265
2004	4,506	16,735	12,561	4,174	2,858	57,545	30,380	27,164
2005	4,738	17,839	12,793	5,046	2,816	59,766	31,080	28,686
2006	4,689	17,135	12,021	5,114	2,837	58,895	30,252	28,643
2007	4,745	17,933	12,525	5,408	2,786	60,619	30,572	30,047
2008	4,727	17,950	12,793	5,157	2,719	61,854	32,226	29,628
2009	4,452	17,487	12,393	5,094	2,538	58,183	29,311	28,872
<b>Total</b>	<b>36,220</b>	<b>131,079</b>	<b>94,729</b>	<b>36,350</b>	<b>21,634</b>	<b>470,524</b>	<b>247,327</b>	<b>223,197</b>

*Notes:* Figures may not add up due to rounding. (+) Estimated value as no figures are available.

*Sources:* Deutsche Bundesbank and authors' own calculations

According to the collected data, euro cash totalling €167 billion migrated to foreign countries between the start of 2002 and the end of 2009 as a result of trips abroad by German travellers, €95 billion of which was for trips to euro-area countries.<sup>15</sup> Of the €73 billion in euro cash taken to non-euro-area countries, half was exchanged there for foreign currency and the remaining €36 billion was used directly for cash purchases in euro in the destination countries. However, the amount of foreign currency that was taken on trips to non-euro-area countries was marginal, accounting for only approximately 10% of total travel expenditure in these countries. By contrast, at around 40% of travel expenditure in euro-area countries, the share of euro cash taken on trips to these countries is, as expected, fairly high and relatively constant over time. Furthermore, it is of interest that, at €36 billion, the total amount of euro cash taken by German travellers to non-euro-area countries and exchanged there for foreign currency in the observation period accounts for only 14% of the official gross shipments of banknotes, which almost exclusively comprise high-value denominations, from Germany to these countries. As euro cash taken abroad for exchange to foreign currency is conceptually to be assigned to transaction balances and thus probably chiefly consists of low-value denominations, this small percentage share can be interpreted as an indication that euro banknotes outstanding in non-euro-area countries are predominantly hoarded.

By contrast, the amount of euro cash inflows to Germany resulting from foreign visitors is unknown.<sup>16</sup> However, if it is assumed that foreign tourists exhibit a similar payment

<sup>15</sup> The information on foreign travel comprises both holidays and business trips.

<sup>16</sup> We are not aware of similar surveys on the use of cash in travel in other countries.

behaviour to German travellers, the travel-related import of cash can be estimated as shown in Table 3.

**Table 3: Estimated euro cash inflows to Germany via travel, in € million**

	Germany's travel income				Assumed use of euro cash by travellers from non-euro area countries <sup>2)</sup>	Estimated inflow of euro banknotes to Germany via travel by residents of other euro-area countries	Estimated inflow of euro banknotes to Germany via travel by residents of non-euro-area countries	Total estimated inflow of euro banknotes to Germany via travel
	Total	Spending by travellers resident in other euro-area countries	Spending by travellers resident in non-euro-area countries	Assumed use of euro cash by travellers from other euro-area countries <sup>1)</sup>				
2002	20,350	9,397	10,953	23.2%	7.5%	2,181	0,824	3,004
2003	20,426	9,766	10,660	38.3%	12.7%	3,741	1,354	5,094
2004	22,243	10,506	11,737	41.3%	10.5%	4,344	1,235	5,579
2005	23,448	11,133	12,315	41.2%	9.8%	4,583	1,209	5,791
2006	26,124	12,498	13,626	39.7%	9.9%	4,966	1,350	6,316
2007	26,295	12,819	13,476	41.0%	9.3%	5,252	1,250	6,501
2008	27,211	13,173	14,038	39.7%	9.2%	5,229	1,288	6,518
2009	24,885	12,321	12,564	42.3%	8.8%	5,209	1,104	6,314
<b>Total</b>	<b>190,982</b>	<b>91,613</b>	<b>99,369</b>			<b>35,505</b>	<b>9,613</b>	<b>45,118</b>

<sup>1)</sup> Figures calculated analogously to the use of euro cash by Germans travelling to EMU-countries in percent of the total travel expenditures Germans spent in these EMU-countries

<sup>2)</sup> Figures calculated analogously to the use of foreign cash by Germans travelling to Non-EMU-countries in percent of the total travel expenditures Germans spent in these Non-EMU-countries

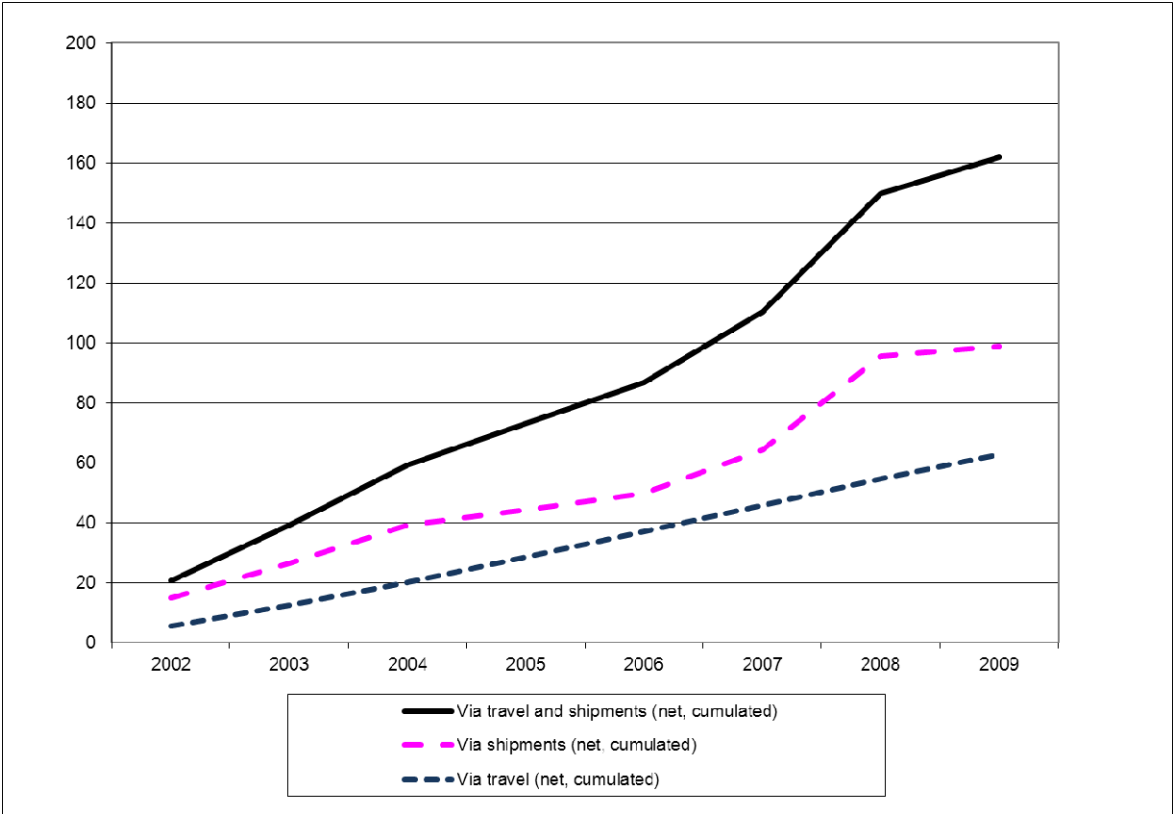
*Sources:* Deutsche Bundesbank and authors' own calculations

Such an approach would put the cash inflows to Germany as a result of travel in the period from 2002 to 2009 at a value of €45 billion, with euro-area countries accounting for the lion's share (€36 billion).

Overall, this would mean that cash with a net value of €122 billion was exported from Germany via foreign travel in the period from 2002 to 2009, with approximately half (€59 billion) remaining in the euro area. This value is quite consistent with the negative entries shown in Table 1 that the NCBs in question reported for the cumulated net issuance of banknotes, broken down by denomination. Across all denominations, this amounts to €74 billion, and for the denominations (from €5 to €100) used for transaction purposes, which are predominantly used in foreign travel, this amounts to €65 billion.

The contribution of German travel to the (cumulated) net export of euro banknotes to non-euro-area countries can hence be put at around €63 billion. Combined with figures from banks about their net shipments of euro banknotes to these countries, the volume of euro cash outstanding in non-euro-area countries at the end of 2009 can be estimated at just over €160 billion.

**Figure 7: Estimated cumulated net exports of euro banknotes from Germany to non-euro-area countries via travel and shipments by banks, in € billion**



Source: Authors' own calculations

Together with the above-mentioned estimates of the cumulated net exports of German euro banknotes via travel to other euro-area countries of roughly €59 at the end of 2009, the domestic circulation of banknotes can also be calculated as a residual and, at this point in time, is likely to have amounted to just under €130 billion. In turn, this means that only approximately one-third of the total net issuance of euro banknotes by the Bundesbank is in circulation in Germany (see Table 4). The remaining share of the net issuance of banknotes by the Bundesbank of just over €220 billion is predominantly accounted for by non-euro-area countries (just over €160 billion) or was exported to other euro-area countries (just under €60 billion).

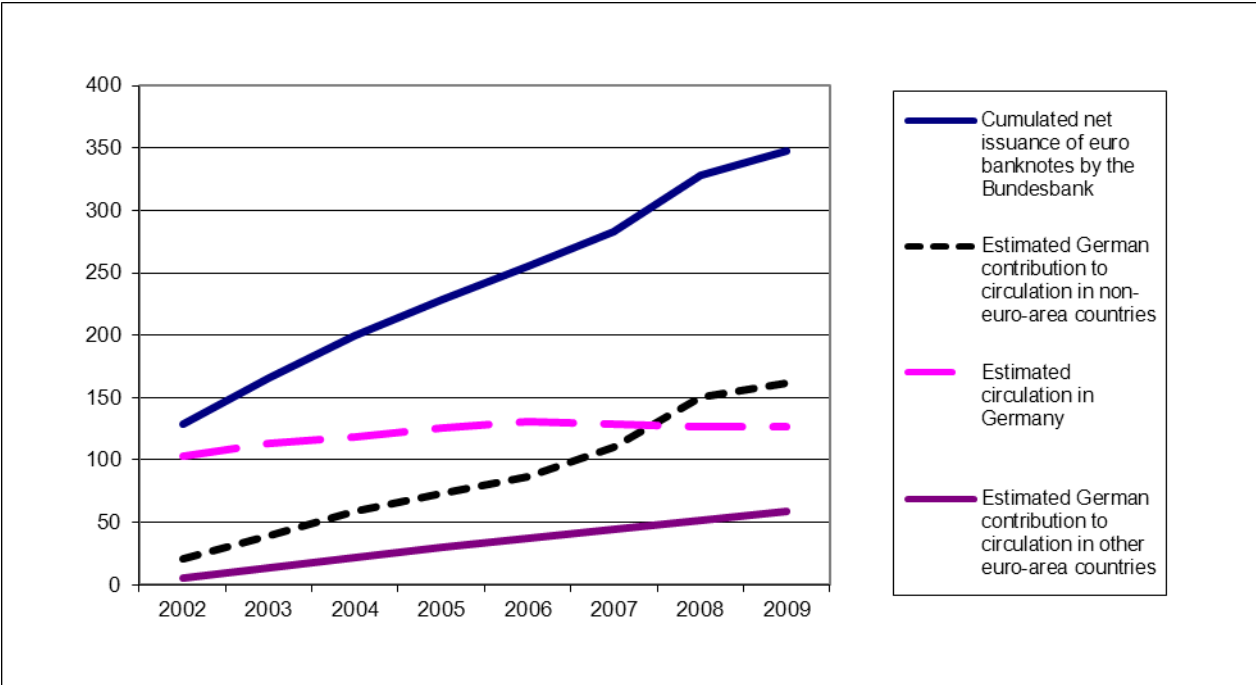
**Table 4: Estimated regional distribution of cumulated net issuance of euro banknotes by the Bundesbank in € million**

Year	Cumulated net issuance of euro banknotes by the Bundesbank	Estimated circulation in Germany	Estimated German contribution to circulation in other euro-area countries	Non-euro-area countries			
				Estimated German contribution to circulation in non-euro-area countries	Shipments (net)	Travel (net)	
2002	128,879	103,102	5,016	20,761	15,078	5,683	
2003	165,958	113,203	13,722	39,033	26,490	12,543	
2004	199,734	118,534	21,939	59,261	39,274	19,988	
2005	228,873	125,739	30,149	72,984	44,421	28,563	
2006	255,216	131,173	37,204	86,839	49,822	37,016	
2007	283,279	128,430	44,477	110,371	64,452	45,920	
2008	328,380	126,413	52,041	149,926	95,411	54,515	
2009	348,110	127,109	59,224	161,776	98,819	62,957	

Sources: Deutsche Bundesbank and authors’ own calculations

The following chart shows that over time the supply of banknotes to the German economy accounts for an ever smaller percentage of cumulated net issuance by the Bundesbank. The domestic share of the Bundesbank’s cumulated net issuance of euro banknotes has more than halved since 2002.

**Figure 8: Cumulated net issuance of euro banknotes by the Bundesbank and estimated regional distribution thereof, in € billion**



Sources: Deutsche Bundesbank and authors’ own calculations

### 3.2 Analysis of net issuance by NCBs, broken down by denomination

The above approach demonstrates that only about one-third of the cumulated net issuance of euro banknotes by the Bundesbank remains in Germany.<sup>17</sup> The lion's share goes to non-euro-area countries, with the remainder circulating in other euro-area countries (German contribution to domestic migration of euro banknotes). The following section examines net issuance by the NCBs against this background, broken down by denomination. From this we can glean an additional important insight into the Bundesbank's pivotal role in the supply of euro banknotes beyond Germany's borders. The following table shows the cumulated net issuance by the Eurosystem NCBs, broken down by individual denominations.<sup>18</sup>

**Table 5: Cumulated net issuance by NCBs at the end of 2009, broken down by denomination, in € million**

	€5	€10	€20	€50	€100	€200	€500	Total
Germany	6,413	16,267	25,524	104,240	58,140	14,655	122,870	348,110
France	-342	6,169	37,502	15,965	12,515	1,071	3,668	76,548
Italy	782	1,908	2,044	82,404	35,077	554	20,431	143,198
Spain	-66	-4,434	-12,125	32,419	6,314	4,107	54,385	80,599
Netherlands	-213	-249	-5,014	17,215	83	6,228	4,473	22,523
Belgium	398	-1,864	1,130	17,435	-1,023	-2,690	-6,300	7,087
Portugal	425	1,325	5,942	-4,736	-1,896	-591	194	663
Luxembourg	88	-218	-912	2,127	8,311	10,034	41,130	60,560
Austria	-335	2,433	-5,368	-49,785	21,186	663	34,931	3,725
Ireland	187	-12	1,254	22,970	638	43	329	25,410
Finland	103	53	1,995	4,211	31	347	2,681	9,420
Greece	13	-1,157	-687	14,508	6,440	993	863	20,972
Malta	-4	35	331	214	23	50	118	769
Cyprus	7	-31	46	721	162	53	344	1,301
Slowenia	-5	92	1,856	-1,113	-117	-72	350	991
Slowakia	37	105	287	1,175	1,303	202	1,425	4,535
EMU-16	7,488	20,423	53,804	259,972	147,186	35,647	281,891	806,412

Source: ECB

Positive/negative issuance balances mean that the respective monetary authority issued more/fewer euro banknotes (in terms of value) than it received on balance over the entire observation period (2002 to 2009).<sup>19</sup> The fact that the Bundesbank probably supplied not only non-euro-area countries but also (other) euro-area countries with banknotes in net terms can be seen in the Bundesbank's percentage shares in cumulated net issuance broken down by denomination (Table 6).

<sup>17</sup> See also Bartzsch, Rösl and Seitz (2011), where this result is confirmed using indirect methods.

<sup>18</sup> The deviation from the Eurosystem's weekly financial statement on euro banknotes of €806,522 million on 1 January 2010 results from the fact that figures from the Bundesbank's euro banknote vaults (extended custodial inventories) in Hong Kong and Singapore are reported one day later.

<sup>19</sup> Shipments of banknotes between NCBs are not recorded here as these banknotes are not considered to be "in circulation" in conceptual terms.



**Table 6: NCBs' percentage shares in cumulated net issuance of individual euro banknote denominations at the end of 2009**

	€5	€10	€20	€50	€100	€200	€500
Germany	85.6%	79.7%	47.4%	40.1%	39.5%	41.1%	43.6%
France	-4.6%	30.2%	69.7%	6.1%	8.5%	3.0%	1.3%
Italy	10.4%	9.3%	3.8%	31.7%	23.8%	1.6%	7.2%
Spain	-0.9%	-21.7%	-22.5%	12.5%	4.3%	11.5%	19.3%
Netherlands	-2.8%	-1.2%	-9.3%	6.6%	0.1%	17.5%	1.6%
Belgium	5.3%	-9.1%	2.1%	6.7%	-0.7%	-7.5%	-2.2%
Portugal	5.7%	6.5%	11.0%	-1.8%	-1.3%	-1.7%	0.1%
Luxembourg	1.2%	-1.1%	-1.7%	0.8%	5.6%	28.1%	14.6%
Austria	-4.5%	11.9%	-10.0%	-19.2%	14.4%	1.9%	12.4%
Ireland	2.5%	-0.1%	2.3%	8.8%	0.4%	0.1%	0.1%
Finland	1.4%	0.3%	3.7%	1.6%	0.0%	1.0%	1.0%
Greece	0.2%	-5.7%	-1.3%	5.6%	4.4%	2.8%	0.3%
Malta	-0.1%	0.2%	0.6%	0.1%	0.0%	0.1%	0.0%
Cyprus	0.1%	-0.2%	0.1%	0.3%	0.1%	0.1%	0.1%
Slovenia	-0.1%	0.5%	3.5%	-0.4%	-0.1%	-0.2%	0.1%
Slovakia	0.5%	0.5%	0.5%	0.5%	0.9%	0.6%	0.5%
EMU-16	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Sources: ECB and authors' own calculations

As is demonstrated below, the net outflow of denominations up to €100 is likely to take place largely via foreign travel (intra and extra euro area), whereas the €200 and €500 banknotes are likely to be shipped *en masse* to non-euro-area countries via banks. At the end of 2009, the official net shipments of euro banknotes – processed by banks – from the euro area to non-euro-area countries amounted to €104 billion. These came almost exclusively from Germany (see Figure 4).

It is also interesting to take a look at the structure of the euro banknote denominations sent from Germany to non-euro-area countries (see Table 7).<sup>20</sup>

**Table 7: Percentage shares of denominations in the cumulated gross shipments (in terms of value) of euro banknotes from Germany to non-euro-area countries from the start of 2002 to the end of 2009**

Denomination	€5	€10	€20	€50	€100	€200	€500	Total
Share	0.5%	2.6%	6.1%	9.0%	22.5%	8.1%	51.2%	100.0%

Source: Deutsche Bundesbank

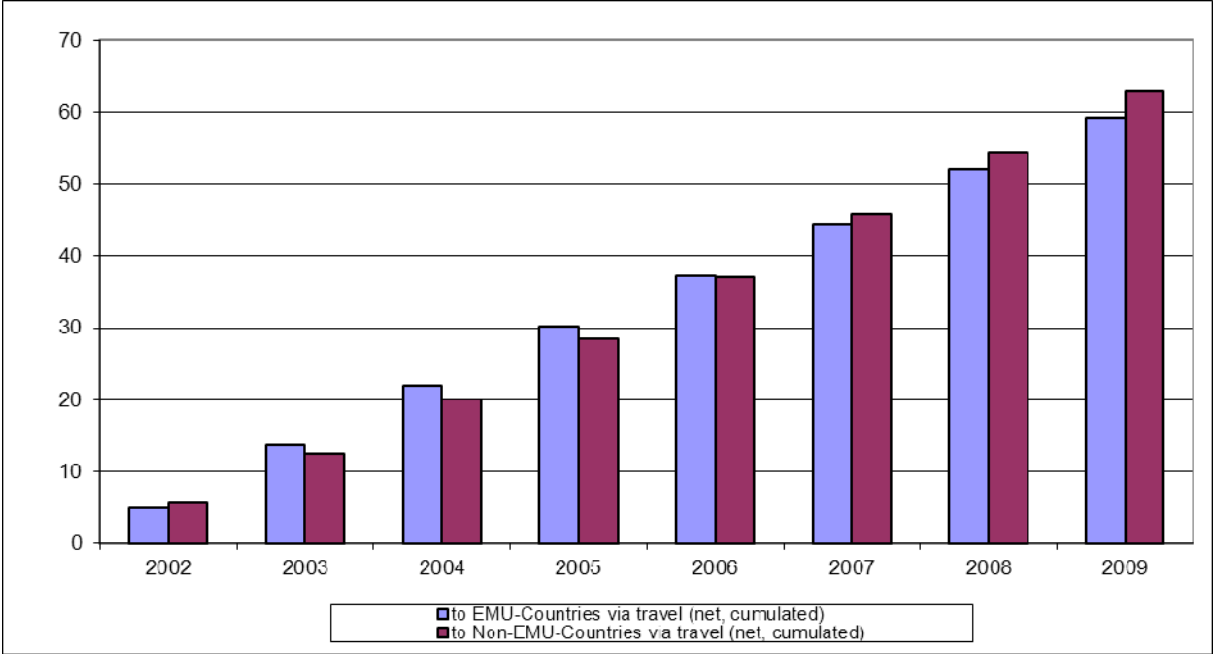
In the observation period, just over 80% of euro banknotes shipped by the Bundesbank via banks were €100, €200 or €500 banknotes. The €500 banknote alone accounted for more than half. If one also considers that roughly half of the German (€99 billion) or total (official) cumulated net shipments (€104 billion) are likely to have been to Russia (€45 billion) and that these banknotes are likely to be kept there due to their store-of-value function or for activities

<sup>20</sup> Unfortunately no information is available on the structure of the euro banknote denominations that the Bundesbank receives from non-euro-area countries via banks.

on the shadow economy, as is the case in the Balkan nations, Germany's large share in the issuance of high-value banknotes comes as no surprise.<sup>21</sup> The situation is probably similar – albeit to a considerably lesser extent – for Austria, whose comparatively large share of cumulated net issuance of high-value euro banknote denominations is also likely to be explained by its geographical proximity to the Balkan nations (see Table 6).<sup>22</sup>

With regard to the foreign use of Bundesbank-issued denominations that are used for transaction purposes (up to €100), cross-border travel is likely to be key. In this regard, section 3.1 has already demonstrated that the euro cash taken abroad via travel is probably equally distributed between travel to other euro-area countries and travel to non-euro-area countries. Figure 9 shows the estimated distribution of the cumulated amount of cash taken abroad by German travellers over the years.<sup>23</sup>

**Figure 9: Estimated cumulated net exports of euro banknotes from Germany via foreign travel, in € billion**



Source: Authors’ own calculations

Although there are no statistics that show the denomination structure of the euro banknotes taken abroad, there is much to suggest that the structure of the euro banknote denominations taken abroad by German travellers is very similar to the average composition which has been

<sup>21</sup> For information on the Balkan nations’ keeping of euro cash, see Scheiber and Stix (2009).  
<sup>22</sup> Such developments are also to be expected for issuance by the Slovenian central bank. However, as it did not join the euro area until 2007, such developments are yet to be reflected in the issuance data.  
<sup>23</sup> The data on which this chart is based are taken from Table 4. For information on the estimation methodology, see the comments in section 3.1.

determined by surveys and is shown in Table 8. These surveys have confirmed expectations namely that Germans' wallets contain almost exclusively those denominations that are used for transaction purposes, with the €50 note accounting for virtually half of the value of all notes. By contrast, Germans carry next to no €200 and €500 banknotes and these are instead chiefly used for the purpose of hoarding.

**Table 8: Structure of the average amount of banknotes in Germans' wallets**

Denomination	At least 1 banknote in wallet	Average number of banknotes per each respondent	Average value of banknotes in wallet in €	Share of denominations in total value of banknotes in wallet
€5	64%	1.3	6.5	6.0%
€10	72%	1.5	15	14.0%
€20	68%	1.2	24	22.3%
€50	53%	1	50	46.5%
€100	10%	0.1	10	9.3%
€200	1%	0.01	2	1.9%
€500	0%	0	0	0.0%

*Source:* Deutsche Bundesbank (2009b), p 42

With the aid of data on the denomination structure of the official gross shipments of euro banknotes to non-euro-area countries on the one hand, and figures on the average structure of banknotes in Germans' wallets on the other hand, the cumulated net issuance of euro banknotes by the NCBs (see Table 5) is "adjusted" across all banknote denominations to enable the circulation of euro banknotes in non-euro-area countries to be computationally eliminated. The resulting values provide an interesting insight into the NCBs' contribution to maintaining banknote circulation in the euro area and thus implicitly to domestic migration, too. As not all the information required to calculate this is available, we assume that on balance the entire volume of euro banknotes outstanding in non-euro-area countries is put into circulation by the Bundesbank. As far as shipments of euro banknotes via banks are concerned, this assumption does not present any major problems since – as is demonstrated above – on balance, almost all banknotes that are shipped via banks to non-euro-area countries were issued by the Bundesbank anyway. However, in the case of the net volume of cash taken to non-euro-area countries, it is more problematic to assume that it is solely German travellers who are exporting this cash. But it is not just in terms of (long-distance) travellers that Germans make up by far the biggest group; compared with other euro-area countries their share of travel expenditure is also comparatively high both in absolute and

relative terms.<sup>24</sup> Nevertheless, this method underestimates the amount of net exports of banknotes by travellers from the euro area as a whole and thus overstates the role played by the Bundesbank in the supply of notes to non-euro-area countries via foreign travel in relation to the other Eurosystem NCBs.

Adjustments result in the following figures for cumulated net issuance by NCBs of banknotes outstanding in the euro area, broken down by denomination.

**Table 9: Estimated cumulated net issuance by NCBs at the end of 2009, broken down by denomination, in € million**

	€5	€10	€20	€50	€100	€200	€500	Total
Germany	2,153	4,894	5,428	66,038	30,086	5,432	72,302	186,334
France	-342	6,169	37,502	15,965	12,515	1,071	3,668	76,548
Italy	782	1,908	2,044	82,404	35,077	554	20,431	143,198
Spain	-66	-4,434	-12,125	32,419	6,314	4,107	54,385	80,599
Netherlands	-213	-249	-5,014	17,215	83	6,228	4,473	22,523
Belgium	398	-1,864	1,130	17,435	-1,023	-2,690	-6,300	7,087
Portugal	425	1,325	5,942	-4,736	-1,896	-591	194	663
Luxembourg	88	-218	-912	2,127	8,311	10,034	41,130	60,560
Austria	-335	2,433	-5,368	-49,785	21,186	663	34,931	3,725
Ireland	187	-12	1,254	22,970	638	43	329	25,410
Finland	103	53	1,995	4,211	31	347	2,681	9,420
Greece	13	-1,157	-687	14,508	6,440	993	863	20,972
Malta	-4	35	331	214	23	50	118	769
Cyprus	7	-31	46	721	162	53	344	1,301
Slowenia	-5	92	1,856	-1,113	-117	-72	350	991
Slowakia	37	105	0,287	1,175	1,303	202	1,425	4,535
EMU-16	3,228	9,050	33,708	221,770	119,132	26,424	231,323	644,635

*Note:* After deduction of net shipments from Germany and net cash taken to non-euro-area countries by Germans.

*Source:* Authors' own calculations

This shows that in comparison to almost every other NCB, in the observation period from 2002 to 2009 the Bundesbank still issued more banknotes of all denominations than it received, even after the German contribution to euro banknotes outstanding in non-euro-area countries has been taken into consideration. This can be interpreted as a further indication of the pivotal role that the Bundesbank (also) plays in providing the rest of the euro area with banknotes. The resulting sizeable cumulated net issuance of €500 notes to a value of just over €70 billion, which still exists even after those notes outstanding in non-euro-area countries are excluded, can be interpreted as the mean for notes hoarded in Germany.<sup>25</sup> The final step would be to deduct an appropriate amount for cash sent home by foreign workers and for that used in activities in the shadow economy, which have not been included in the above

<sup>24</sup> See Eurostat (2008), p 37.

<sup>25</sup> For more information on this, see the estimation results for the financial crisis approach in section 3.4 and for the seasonal approach in Bartzsch, Rösl and Seitz (2011), which put hoarding in Germany at €110 billion and €40 billion, respectively.

calculations due to a lack of reliable data. In addition, it is of course also possible that German €500 notes are used in the euro area. Nevertheless, these data are in line with other estimates of cash being hoarded in Germany (see section 3.4 and Bartzsch, Rösl and Seitz, 2011). Furthermore, the relevant cumulated net issuance by the different NCBs shows that the migration movements of banknotes within the euro area (domestic migration) are of minor importance for the high-value denominations compared with the low-value ones. However, one exception here is the cross-border transport of banknotes between Luxembourg and Belgium, where regional integration in terms of currency dealing stems from pre-euro days when these two countries already had a currency union. This also partly explains why, despite Luxembourg being a relatively small country, the Banque Centrale du Luxembourg has an extraordinarily high issuance of banknotes, while the Belgian central bank has a clearly negative issuance of high-value denominations. By contrast, in Spain the high net issuance of €500 banknotes by the Banco de España is likely to be driven by domestic demand for the purpose of hoarding and use in the shadow economy (especially due to the real estate boom at that time).

### **3.3 Calculating foreign demand for euro banknotes as a residual**

Foreign demand for German euro banknotes corresponds to the difference between the cumulated net issuance of euro banknotes by the Bundesbank and the circulation of German euro banknotes in Germany. The latter is approximated below by estimating the (entire) circulation of euro banknotes in Germany.

However, the volume of German euro banknotes in circulation in Germany does not necessarily correspond to the volume of all euro banknotes in circulation in Germany. This is due to the migration of banknotes between euro-area countries, which is only partly captured in the statistics.<sup>26</sup> However, the following qualitative statements can be made about banknote migration: if euro banknotes issued by foreign central banks are imported to Germany, this initially causes German transaction balances to rise (disregarding hoarding). The entire circulation of euro banknotes in Germany is thus in excess of the circulation of German euro banknotes in Germany. In a second stage, the surplus transaction balances from the cash cycle are paid in to the Bundesbank in the form of German or imported foreign banknotes by retailers, either directly or via commercial banks (Deutsche Bundesbank, 2011). The faster the

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<sup>26</sup> Examples of such imports and exports of banknotes are tourism, business trips and foreign workers taking cash back to their home countries. For information on the impact of this migration on one central bank in the euro area and the effects on banknote flows to neighbouring non-euro-area countries in eastern Europe, see Schautzer (2006). There is a similar migration problem for coins, see Seitz, Stoyan and Tödter (2009).

imported foreign banknotes reach the German central bank, the sooner the (entire) circulation of euro banknotes in Germany corresponds to the circulation of German euro banknotes in Germany. Exports of German euro banknotes reduce the volume of German euro banknotes in circulation in Germany and thus the (entire) volume of euro banknotes in circulation in Germany declines by the same amount. Hence, such exports do not cause the volume of German euro banknotes in circulation in Germany to differ from the (entire) circulation of euro banknotes in Germany.

It can be assumed that Germany is a net exporter of euro banknotes (see section 3.1). Consequently, the volume of German euro banknotes in circulation in Germany can be approximated by estimating the (total) volume of euro banknotes in circulation in Germany.<sup>27</sup> The latter can be divided into domestic transaction balances and domestic hoardings. A Bundesbank estimate of domestic transaction balances is used (Deutsche Bundesbank, 2009a, page 49).<sup>28</sup> According to this estimate, on an annual average for 2008, banknotes to the value of €31 billion were circulating in Germany for transaction purposes.<sup>29</sup>

We have taken data on euro banknotes hoarded in Germany from a household survey that was conducted in 2008 by TNS opinion on behalf of the ECB (European Central Bank, 2011a).<sup>30</sup> This survey is representative of German nationals over the age of 14. In this survey, 1,042 people were asked how much cash they keep as a store of value. The results are shown in Table 10. According to these figures, around 45% of German adults do not hoard any cash and about 35% have cash hoardings of less than €500. Less than 4% possess cash hoardings of more than €999. Total cash hoardings are calculated by multiplying the weighted average

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<sup>27</sup> Unless they are permanently hoarded or taken to non-euro-area countries, euro banknotes that Germany exports on balance to the rest of the euro area are paid in at the respective euro-area central banks after some time and are thus withdrawn from circulation. This causes the cumulated net issuance by the euro area to fall while the cumulated net issuance by the Bundesbank remains unchanged. As a result, we can conclude that, first, the entire volume of German euro banknotes in circulation is lower than the cumulated net issuance of euro banknotes by the Bundesbank; and, second, that the actual foreign demand for German euro banknotes in the rest of the euro area (and consequently also the actual total foreign demand for German euro banknotes) is lower than the estimates derived in this paper.

<sup>28</sup> Seitz (2007) calculated transaction balances to amount to 25% for Germany in 2000. If this figure is extrapolated with nominal private consumption, this would yield transaction balances of approximately €40 billion in 2008 and 2009.

<sup>29</sup> These comprise the cash balances held by banks to the value of €14.5 billion, average cash balances held for transaction purposes by individuals aged 18 and over to the value of €14.4 billion and cash balances held for transaction purposes by retailers and service providers to the value of €2.1 billion. Banks report their cash balances to the Bundesbank. Cash balances held for transaction purposes by individuals were derived from a representative survey on payment behaviour in Germany conducted in 2008 on behalf of the Bundesbank (Deutsche Bundesbank, 2009b). Cash balances held for transaction purposes by retailers and service providers were estimated using simplified assumptions on the basis of sales figures.

<sup>30</sup> In the payments diary used as a basis for the Bundesbank's empirical study (2009b), German adults were asked how much cash they saved in one week. The value obtained is the *gross savings*, in other words the dishoarding of cash is not included. As a rule, cash hoardings could be determined by aggregating the flows of "cash savings". However, for this calculation data on *net cash savings* are required.

of the specified cash hoardings by the total number of German individuals over the age of 14 (64.5 million).<sup>31</sup> This then results in estimated hoardings of all (adult) German individuals of just under €20 billion. The percentage share of this in the cumulated net issuance of euro banknotes in Germany at the end of 2008 of just over €328 billion therefore amounts to only 5%.

**Table 10: Cash hoarding by individuals in Germany in 2008**

Do you keep an amount of cash larger than for everyday purchases as a store of value ?	Weighted and rounded frequency	Percentage share of all 1,042 responses	95% confidence interval for percentage share of all 1,042 responses	Cumulated percentage share of all 1,042 responses
No	475	45.50	[42.47 ; 48.53]	45.50
Yes, less than €500	364	34.87	[31.97 ; 37.77]	80.37
Yes, €500-€999	59	5.70	[4.30 ; 7.10]	86.07
Yes, €1,000-€4,999	39	3.78	[2.63 ; 4.93]	89.84
Yes, €5,000-€9,999	0	0.07	[0.00 ; 0.26]	89.91
Yes, but cannot name the figure (at this time)	28	2.71	[1.73 ; 3.69]	92.63
I don't know (at this time)	19	1.81	[1.00 ; 2.62]	94.43
Do not wish to respond (at this time)	58	5.57	[4.18 ; 6.96]	100.00
Total	1,042			

*Sources:* ECB and authors' own calculations

The level of hoarding derived from the survey is likely to considerably underestimate actual hoardings, however.<sup>32</sup> For instance, it can be assumed that the respondents may deliberately have provided false information, as they were reluctant to disclose the full amount of their cash hoardings for obvious personal reasons.<sup>33</sup>

Nevertheless, these estimates of domestic transaction balances (€31 billion) and euro banknotes hoarded in Germany (€20 billion) add up to a lower bound of roughly €50 billion for the volume of euro banknotes in circulation in Germany at the end of 2008. If this value is deducted from the total circulation of German euro banknotes at the end of 2008 of just under €330 billion, this puts the estimated upper bound for (total) foreign demand for German euro banknotes at €280 billion, or 85% of total circulation.

<sup>31</sup> As hoardings are only asked about in intervals, assumptions have to be made about how these are distributed among the individual intervals. We assume that the exact amount of all cash hoardings corresponds to the middle of the respective interval. For instance, in the interval [€500, €999] all hoardings are assumed to amount to €750.

<sup>32</sup> TNS opinion conducted the household survey between 18 September 2008 and 31 October 2008. It thus already contains the sharp increase in net issuance of large banknote denominations for hoarding purposes following the intensification of the financial crisis in October 2008.

<sup>33</sup> Questions about cash in household surveys are certainly most likely to lead to participants refusing to respond or deliberately providing false information. Such surveys have often only been able to explain a minimal percentage of demand for cash; see for example Boeschoten (1992) and Avery et al (1986, 1987).

Hence, if the volume of German euro banknotes in circulation in non-euro-area countries (calculated using the official net shipments) is deducted from the estimated total volume of German euro banknotes in circulation outside Germany, this results in an estimate for the (cumulated net) banknote migration from Germany to other euro-area countries of a maximum of €185 billion as at December 2008.<sup>34</sup>

### **3.4 Conclusions from the financial crisis**

The following section investigates what conclusions can be drawn from the escalation of the financial crisis in autumn 2008 in terms of its impact on the level of hoardings of euro banknotes in Germany and abroad.

In the wake of the subprime crisis, the US investment bank Lehman Brothers Inc. was forced to file for bankruptcy in September 2008 after the US government stopped providing assistance. This represented a break with the existing “too big to fail” principle and greatly unsettled the financial markets. German households responded to this in the fourth quarter of 2008 by making considerable shifts in their financial investment (see Deutsche Bundesbank 2009c, pages 39 and 40). This resulted in sharp inflows into liquid and (relatively) secure short-term types of investment, from which cash also benefited. As a result of the crisis, the net issuance of banknotes rose by €16 billion in Germany in October 2008.<sup>35</sup> This increase in holdings of euro banknotes is clearly due to banknotes being held as a store of value and accordingly to hoarding. In line with this, the outstanding volume of €500 banknotes (the denomination typically used by hoarders) increased by just over €10 billion, making the largest contribution to this rise. As a result of the crisis, official net shipments of euro banknotes from Germany to non-euro-area countries increased by around €8 billion in October 2008, solely on account of higher gross withdrawals. This corresponds to 50% of the total increase in German net issuance in the amount of €16 billion. This picture is confirmed by looking at gross withdrawals of €500 banknotes in Germany and non-euro-area countries in October 2008 (see Deutsche Bundesbank, 2009a, pages 52 and 53). In that month, withdrawals were divided almost equally between demand from Germany and demand from non-euro-area countries. Hence, during the financial crisis, demand for “German” euro

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<sup>34</sup> As the upper bound is used for the minuend and the lower bound for the subtrahend, this estimate for the cumulated net export of German euro banknotes to the other euro-area countries should also be interpreted as a clear upper bound of the actual figure.

<sup>35</sup> This figure was calculated from the estimated coefficients of dummy variables for October 2008 in regARIMA models for the cumulated net issuance of individual banknote denominations in Germany. Thus, the volume outstanding of the following denominations increased significantly: €50 banknote (+€1.9 billion), €100 banknote (+€3.0 billion), €200 banknote (+€0.9 billion) and €500 banknote (+€10.2 billion). In sum, the outstanding volume of these denominations went up by €16 billion in October 2008 as a result of the crisis.



banknotes as a store of value evidently rose just as sharply in Germany as it did in countries outside the euro area. Assuming that German residents and non-euro-area residents have the same average hoarding behaviour, ie with regard to the size and timing of hoarding, it follows that the volume of Bundesbank-issued euro banknotes hoarded in Germany roughly matches that in non-euro-area countries.<sup>36</sup>

The stocks of banknotes hoarded outside the euro area can be estimated using the “OeNB euro survey” – a survey which has been conducted semi-annually by the Austrian central bank since autumn 2007. This survey collects data on the volume of cash and savings held in foreign currencies by households in four central and eastern European countries (Poland, Slovakia, Czech Republic and Hungary) and seven south-eastern European countries (Romania, Bulgaria, Croatia, Bosnia-Herzegovina, Serbia, Macedonia and Albania).<sup>37</sup> The first survey in autumn 2007 produced the following results (Österreichische Nationalbank, 2008): 26% of the population in south-eastern Europe have euro cash holdings, with a median value of €470 per capita. These figures are higher than those for central and eastern Europe, where 17% of the population have euro cash holdings and the median value amounts to only €190. The motives behind euro cash holdings in the two regions under examination are also quite different. While, in south-eastern Europe, they are predominantly kept as a store of value, in central and eastern Europe they are used for holidays and purchases made in neighbouring countries. According to the “OeNB euro survey”, it is therefore likely that holdings of euro banknotes in non-euro-area countries are concentrated on less developed countries and that they are predominantly hoarded. This impression is confirmed by information from Russia, which, measured in terms of its state of development, is more like south-eastern European countries than central and eastern Europe. As stated in section 3.1, cumulated net imports of euro banknotes by authorised Russian banks between the euro cash changeover and the end of 2009 amounted to €45 billion. Demand for euro cash holdings in Russia is therefore very high. According to anecdotal evidence, the vast majority of these holdings are cash hoardings. We therefore assume that the majority of euro banknotes issued in Germany and circulating in non-euro-area countries consist of cash hoardings. We take

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<sup>36</sup> It is assumed that, of the €16 billion crisis-induced increase in net issuance in October 2008, the €8 billion not sent to non-euro-area countries remained in Germany and did not go from there to other euro-area countries during the same month. This assumption appears plausible. First, it is likely that the volume of cash taken abroad by business travellers, tourists or foreign workers during this short period of time is negligible. Second, cross-border cash transports between euro-area countries have so far had virtually no impact. Such transports are made very difficult by the differing national legal provisions. These include, for example, provisions on security staff carrying weapons, training of security staff, and the armour plating and equipping of cash-in-transit vehicles.

<sup>37</sup> With the exception of Poland, the survey results are representative of the respective population structure. In Poland, only a random sample of the population in the ten largest cities was surveyed.

70% as a rough estimate of the percentage share of these hoardings in total foreign demand for German euro banknotes in non-euro-area countries. This value is produced by the ratio of the store-of-value share (€470) to the sum of the transaction and store-of-value demand (€470 + €190). In section 3.1, an estimate of €160 billion was derived for the volume of euro banknotes issued in Germany and circulating in non-euro-area countries at the end of 2009. This produces an estimate of €110 billion for the volume of euro banknotes hoarded in non-euro-area countries. Under the above assumption of the same hoarding behaviour on the part of both German and non-euro-area residents, domestic hoarding at the end of 2009 is likewise estimated at €110 billion.

#### **4 Overview of results**

The results from the approaches discussed in chapter 3 are shown in Table 11. Chapter 5 concludes with an analysis of these results.

**Table 11: Overview of estimation results**

Approach	3.1 Net shipments and foreign travel	3.2 Analysis of net issuance broken down by denomination	3.3 Foreign demand as a residual	3.4 Financial crisis
	End of 2009	End of 2009	End of 2008	End of 2009
	€ billion			
<b>Cumulated net issuance of euro banknotes in Germany</b>	<b>350</b>	<b>350</b>	<b>330</b>	<b>350</b>
<b>Total volume of German euro banknotes in circulation outside Germany</b>	<b>220</b>	-	<b>280 (UL)</b>	-
Volume of German euro banknotes in circulation outside the euro area	160	-	-	110 (LL)*
Cumulated net exports of euro banknotes from Germany to other euro-area countries	60	-	185 (UL)	-
<b>Domestic circulation</b>	<b>130</b>	-	<b>50 (LL)</b>	-
Transaction balances	-	-	30	-
Hoarding	-	70	20 (LL)	110
	Percentage of cumulated net issuance of euro banknotes in Germany			
<b>Cumulated net issuance of euro banknotes in Germany</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>
<b>Total volume of German euro banknotes in circulation outside Germany</b>	<b>65%</b>	-	<b>85% (UL)</b>	-
Volume of German euro banknotes in circulation outside the euro area	45%	-	-	30% (LL)*
Cumulated net exports of euro banknotes from Germany to other euro-area countries	15%	-	55% (UL)	-
<b>Domestic circulation</b>	<b>35%</b>	-	<b>15% (LL)</b>	-
Transaction balances	-	-	10%	-
Hoarding	-	20%	5% (LL)	30%

Notes: Lower limit: LL, upper limit: UL. \*: Only hoarding. All values have been rounded to the nearest €5 billion or 5%. Figures may not add up due to rounding.

Sources: Deutsche Bundesbank and authors' own calculations

## 5 Summary and conclusions

This paper has endeavoured to use direct methods to determine the foreign demand for euro banknotes issued in Germany. On the basis of this information, it is estimated that at the end of 2009, roughly two-thirds of the cumulated net issuance was held outside Germany (€220 billion). Of this, the lion's share (roughly €160 billion) is in non-euro-area countries, with the remainder in other euro-area countries. At approximately €130 billion, only a relatively small share is used for transaction and hoarding balances in Germany. Particularly due to the relatively short time span since 2002, the direct approaches still yield quite reliable results. This thus largely confirms the figures obtained in the indirect approaches (see Bartzsch, Rösl and Seitz, 2011). However, experience has shown that the quality of the direct methods is likely to worsen considerably as time progresses (see, for example, Seitz, 1995, as well as Porter and Judson, 1996). The results derived indirectly point roughly in this direction, too. According to the estimates presented here, the sharp growth in demand for German euro banknotes that continued even after cash hoardings had been replenished following the introduction of euro cash is largely driven by foreign demand. By contrast, the percentage of total net issuance by the Bundesbank accounted for by supplying the domestic economy with banknotes has shrunk over time.

According to estimates by the ECB (2010, page 36 and 2011b, page 31), between 20% and 25% of total issuance of euro banknotes is 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 the banknotes circulating outside euro area are likely to have German origin. This is also in line with statistics on the total shipments of euro banknotes to non-euro-area countries which put Germany's share at the end of 2009 at 95%. Our results, according to which around 45% of the German net issuance is in non-euro-area countries, also 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).

In a study of the consequences of the introduction of the euro for individual euro-area-countries' seigniorage income, Sinn and Feist (2000) as well as Rösl and Schäfer (2000) determined that, due to the pooling of banknote issuance following the changeover from D-Mark to euro, Germany is a clear "loser" as the pooling process means that income from central bank assets which national central banks had before they joined the euro area, is also communitised. Seitz, Stoyan and Tödter's (2009) analysis of coin issuance and movements of coins in the euro area concluded that Germany transfers seigniorage to other euro-area

countries precisely due to the absence of a pooling process. In the pooling process, seigniorage is ultimately not dependent on issuance but on the ECB capital share.

Foreign demand, which is predominantly met by Germany, entails costs which can be directly allocated. Germany is reimbursed for only part of these costs via the allocation mechanism in the euro area. While the costs of banknote *production* are allocated to the NCBs in accordance with their ECB capital share, when monetary income is allocated claims cannot be made for banknote *processing* costs incurred by the NCBs. In Germany, these costs are higher than the German capital share of 27%. However, it must be borne in mind that German banknote issuance has increased at a significantly faster pace since the euro cash changeover (see Figure 1). How banknote issuance would have developed without monetary union is a matter of speculation.

As demonstrated by Seitz and 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 included. Given the results and the figures derived in this paper, this comes as no surprise. Aksoy and 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.

One key question brought to light by these results is why foreign demand for euro banknotes is primarily met by Germany. There are of course a number of historical reasons (Deutsche Bundesbank, 2009a), 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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