

THE DEMAND FOR CURRENCY IN GERMANY\*

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## 1. Introduction

In the 1980s many central banks either abandoned monetary targets (for instance the Fed) or switched to wider targets (for instance the Bundesbank). Still there are some economists who argue that a target for the monetary base would be the best policy (McCallum 1989, Brunner/Meltzer 1993) or that the monetary base should be an important indicator of monetary policy. Thus, in Germany, the council of economic advisers still uses the monetary base as principle indicator. Other economists favour a narrow aggregate like M1 as indicator of monetary policy (for instance Laidler/Robson 1993 for Canada and von Hagen 1994 for Germany).

The monetary base or any other aggregate which gives a large weight to cash in circulation can only be a useful guide for monetary policy if the demand for cash is fairly stable. Although cash is by far the largest component of the monetary base (approx. 80 per cent) there is only little research on the behaviour of cash balances (see references). The principle reason probably is that there is hardly any statistical information about cash holdings and cash payments. This is not pure coincidence. Cash payments allow for a high degree of anonymity. Unlike other means of payments they do not leave a paper trail (or byte trail) behind. Therefore, it is not very well known how cash is divided on its various uses. However, it is more and more suspected that only a small portion of existing cash balances is used for 'regular' payments. Thus Charles Goodhart (1989, 381-2) states:

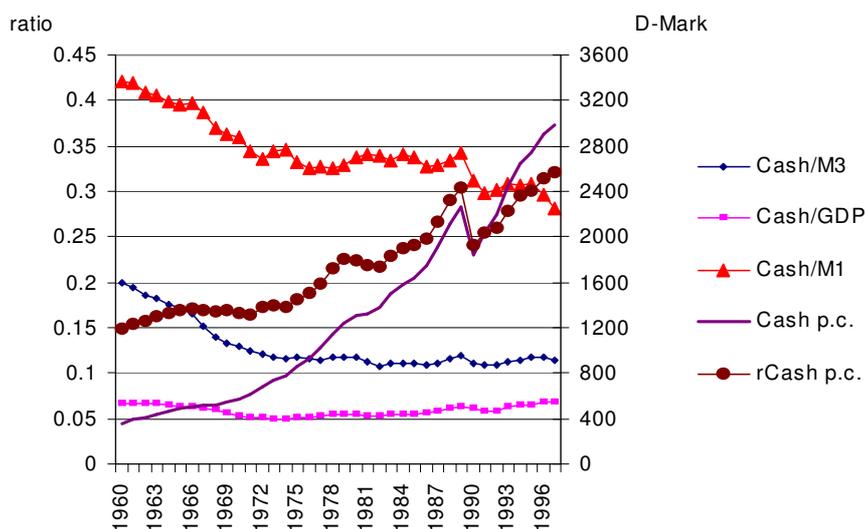
*'...much of such demand probably relates to nefarious activities, the 'black economy', gambling, prostitution and drugs, where anonymity of currency is prized; indeed a large portion of outstanding notes is never caught in surveys. Would one really want to relate one's target to such a base?'*

Other economists such as McCallum (1989, 340, fn.8) do not seem to worry about the moral dimensions of the demand for cash - as long it is stable. However, if certain kinds of shocks such as a public debate about tax increases or a political crisis in foreign countries

can lead to abrupt changes in the demand for cash, the informational content of narrow aggregates is seriously reduced.

The Bundesbank has always distanced itself from a base concept, emphasizing that the ‘Zentralbankgeldmenge’<sup>1</sup> (its target until 1988) is just a weighted average of the components of M3. Still, no matter how this aggregate is interpreted (as a variant of the monetary base or as a weighted average of M3 components), cash is by far its largest component. Therefore, instability in the demand for cash had to impair the former Bundesbank concept in the same way as a monetary base concept. And indeed, one of the main reasons to switch to M3 in 1988 were the large fluctuations in the demand for cash. From December 1987 to December 1988 currency in circulation increased by 15 per cent with 1000 DM and 500 DM notes accounting for about two thirds of the increase. According to the Bundesbank, the strong elasticity of the demand for cash with respect to interest- and exchange rates reduced the informational content of the monetary base to such an extent that it decided to switch to an aggregate, in which the weight of cash is much smaller (Deutsche Bundesbank 1988, 19).

**Chart 1 Currency Per Capita and the Share of Currency in Monetary Aggregates**



Source: Deutsche Bundesbank, Statistisches Bundesamt and own calculations

The fact that cash is not only used for regular transactions in the domestic economy becomes evident simply by looking at per capita cash holdings. At the end of 1995 average p.c. cash holdings in Germany amounted to DM 2,910 (about US\$ 2,000). In spite of the introduction of new payment techniques the share of cash in the monetary aggregates M1, M2 and M3 has been surprisingly stable since the early 1970s (Chart 1). Even when considering that some cash balances are held by firms such amounts of cash are hardly required in order to carry out regular cash payments. The stock of cash held by firms can be assumed to be much smaller than the cash held by households. Looking at deposits, where the respective holdings are known, it can be seen that deposit holdings of private households are twice as large as deposits of firms. Since it can be assumed that the share of cash payments is larger for households than for firms, the relative size of cash holdings is probably smaller for firms. According to Boeschoten (1992, 65) Dutch enterprises hold a maximum of 15 per cent of the whole stock of cash. Based on results of questionnaires Virén (1996, 5) derives the same figure for Finland. If this estimate is used for Germany p.c. cash holdings still are as high as DM 2,500 (ca. US\$ 1,750).

Apart from the level, the increase of nominal and real cash balances is also noteworthy. Both increased handsomely (Chart 1). Given the spread of financial innovations this increase is quite remarkable. Because of the spread of cashless payments facilities, one should have expected a declining share of cash in M1. However, the cash to M1 ratio declined only until the early 1970s and has remained at about one third throughout the 1970s and 80s and declining only marginally after German monetary union.<sup>2</sup>

This evidence, especially the high *level* of per capita cash holdings clearly shows, that considerable amounts of cash must be either used for illegal transactions and as store of value in the domestic economy or must be held in foreign countries. Empirical estimates of foreign cash balances suggest that about 35-40 per cent of DM notes are held in foreign countries (Seitz 1995). Estimates for the U.S. are even higher. Porter and Judson (1996)

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<sup>1</sup> Cash in circulation outside banks plus required reserves at constant reserve rates.

<sup>2</sup> Finland has witnessed a similar stability of the cash to M1 ratio in the 1980s. However, the share of cash was only 7 per cent (Virén 1996, 4)

estimate the share of foreign US\$ holdings at about 55 per cent. Other studies indicate that there are also high cash balances which are hoarded in the domestic economy or used for illegal transactions (Sumner 1990, Boeschoten 1992, Virén 1993). Therefore, it seems likely that there is also a considerable amount of internal hoards in Germany.

In order to get a better understanding of the demand for currency, in the following, currency will be divided in four components:

1. medium of exchange in regular (legal) transactions,
2. medium of exchange in illegal (statistically not recorded) transactions,<sup>3</sup>
3. store of value in the domestic economy and
4. medium of exchange and store of value in foreign economies.

To simplify, in the following, type 1 balances will be labeled 'transaction balances', type 2 and 3 will be combined as 'internal hoards' and type 4 will be referred to as 'foreign balances'. The division between transaction balances and internal hoards is not straight forward. Since transaction balances are interest elastic, they partly behave like a store of value. Therefore, in the following cash balances which react in a predictable manner in case of income and interest rate changes will be counted as transaction balances. This has the advantage that internal hoards and foreign stocks can be interpreted as 'nuisance variables', which impair the informational content of narrow monetary aggregates.

In the following, the quantitative importance of these nuisance variables will be analyzed. The chapters are organized as follows. First, existing studies of the demand for currency in various countries will be reviewed. Second, non-transaction balances of DM-bank-notes will be estimated. Third, the question will be addressed why agents should wish to hoard cash balances and fourth, the implications of internal hoarding and foreign circulation for monetary policy will be lined out.

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<sup>3</sup> In some countries estimates of illegal income are included in the national account figures of national income.

## 2. Existing Estimates of Internal Hoards and Foreign Balances

This chapter provides a survey of the different methods to estimate non-transaction balances.<sup>4</sup> The results suggest that non-transaction balances are quite large. However, in many cases the results depend on strong assumptions and the size of the estimates varies considerably. Often it is not possible to discriminate between the two possibilities ‘internal hoards’ and ‘foreign balances’.

### *Seasonal method*

This method is based on the simple assumption that monthly or quarterly payments exhibit seasonal variation. Consequently, transaction balances should exhibit similar fluctuations.<sup>5</sup> If there is no seasonal variation in internal hoards and foreign cash balances,<sup>6</sup> seasonal variations of the whole stock of cash will be smaller than seasonal variations of the transaction balances. If the ‘true’ seasonal variation of transaction balances were known, their relative share ‘ $\alpha$ ’ could be deduced with the help of equation (1):<sup>7</sup>

$$(1) \quad \alpha = \frac{S_{observed}}{S_{true}}$$

where  $S_{observed}$  is the seasonal variation of the total amount of currency and  $S_{true}$  is the seasonal variation of the transaction balances. The latter is not observable and has to be estimated from the seasonal variation of a proxy variable.

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<sup>4</sup> Cash has been analyzed for various reasons: (1) to assess cash as a monetary indicator, (2) to assess the efficiency of the payments system and (3) to estimate the size of the underground economy.

<sup>5</sup> Seasonal variations can also be used as an additional source of information in estimates of money demand functions. See Bohl and Sell (1996).

<sup>6</sup> This is a strong assumption. Especially internal hoarding may exhibit a pattern which is similar to transactions because the increase of transactions and income payments at the end of the year may also increase hoarding. Still, it seems reasonable to assume that the seasonal variation of the accumulated stock of hoards is much smaller. But when interpreting the results it has to be kept in mind that the estimates of non-transaction balances may be downward biased.

Therefore, the estimate depends on finding a good proxy. Fortunately, there are many diverse proxies which can be used. Foreign cash holdings in foreign countries are one possible proxy. However, they can only be used if payment patterns are quite similar in the foreign country in question, and if there are no big internal hoards or cash balances held in third countries. Local deposits are another proxy. Foreign holdings of domestic deposits are known and deposits are less likely to be hoarded internally. Finally retail sales, household consumption or aggregate income may be used as a proxy for transactions. All these proxies may have their drawbacks. But the variety allows to derive many estimates which can be compared with each other so that there is a certain check on the estimates.

Seitz (1992, 27-34) uses the seasonal variation of Austrian and Dutch banknotes to estimate the foreign holdings of DM. According to these estimates the relative share of foreign DM-balances is 30-40 per cent. The share has been highest in the mid-80s and declined a little since. In a second estimate he compares the seasonal fluctuations of M1 and retail sales (Seitz 1995, 35). The estimates of non-transaction balances thus derived declines from 60 per cent (1970) to 35 per cent (1994). The estimates for 1994 are all within a narrow range but the development over time differs and does not conform to the widespread belief that foreign holdings have increased over the last decade.

Sumner (1990) uses the seasonal method to estimate all US\$ cash balances which are not used for domestic regular transactions. As a proxy of the 'true' seasonal variation of transaction balances he uses the seasonal variation of retail sales. In accordance with the Baumol-Tobin model (Baumol 1952, Tobin 1956) he assumes that transaction balances are proportional to the square root of retail sales. For 1985 his estimates of the relative share of internal hoards and foreign balances range from 65-75 per cent. Using seasonal variations of Canadian cash holdings Porter and Judson (1996, 890-2) produce an estimate of non-transaction balances in the U.S. of 75 per cent. Unlike Sumner, they are assuming that most of these balances are held abroad.

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<sup>7</sup> See appendix.

### *Age of bank-notes*

Central banks continuously replace old bank notes by new ones. Therefore, notes in circulation are a mixture of notes of different age. Under certain assumptions the average age of notes can be calculated. Furthermore, it can be assumed that the average age depends on the intensity of use (in transactions). Therefore, a rise in foreign holdings or hoards will raise the average note life. Boeschoten (1992, 105-13) has used the relationship between note age and intensity of use to estimate the share of non-transaction cash balances. Given that for most currencies it is unlikely that large amounts are held outside the country of origin these non-transaction balances are mostly internal hoards. Assuming that small notes are only used for domestic transactions the share of hoarded notes with larger denominations can be deduced from their age.<sup>8</sup>

**Tab. 1 Hoarding in 14 Countries**  
(Derived from note-age)

Country	Hoarding as % of currency outside banks	
	1970	1989
Austria	14	32
Belgium	67	40
Canada	16	34
Denmark	12	17
Finland	0	37
France	0	26
Germany	17	40
Italy	7	35
Netherlands	43	62
Norway	19	11
Sweden	14	36
Switzerland	35	45
United Kingdom	0	0
United States	18	39
Average	19	33

*Source: Boeschoten (1992, 168)*

Boeschoten (1992, 161-169) has applied this method to 14 countries in order to compare hoarding across countries (see Table 1). According to his estimates hoarding has increased on average from 19 per cent in 1970 to 33 per cent in 1989. By far the highest hoarding-ratio (hoarding as per cent of currency outside banks) can be found in the

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<sup>8</sup> Boeschoten took into account that large notes are likely to be used less even when they are not hoarded. Boeschoten (1992, 106-7)

Netherlands (62 per cent in 1989). The hoarding-ratio in Switzerland amounts to 45 per cent, in Germany and Belgium to 40 per cent and in the U.S. to 39 per cent. In the case of the U.S., Germany and Switzerland Boeschoten's result may also reflect foreign holdings of bank notes. But since foreigners probably also hold small notes the estimates are unlikely to capture *all* foreign holdings. Therefore, they have to be interpreted as a mixture of internal hoarding and an unknown share of foreign holdings.

Seitz (1995, 44-7) uses Boeschoten's results as a starting point to estimate the foreign holdings of German marks. He uses the age of small guilder notes as a benchmark for the age of small German notes (5 DM up to 50 DM). Assuming that differences in the average note life of small notes are only due to foreign holdings of DM balances he derives the following results. Foreign holdings of small DM notes rose from 4 per cent in 1980 to 26 per cent in 1994.

The idea of using age as an indicator of the intensity of note-use is quite plausible. However, its precision is hard to judge. Changes in the way people treat bank notes (the way they store it) or changes in the replacement procedures of central banks may influence the estimates in a way which is hard to quantify (Boeschoten 1992, 169). Furthermore, the 'normal' age must be known in order to estimate non-transaction balances. Boeschoten uses the age of small notes. But if small notes are also hoarded to a certain extent, his results are downward biased (see also ch. 3, fn. 27).

#### *German monetary union*

German unification provides an interesting opportunity to estimate transaction balances. If it can be assumed that the increase in cash balances between June 1990 and August 1990 (approx. DM bn. 10 or DM 630 p.c. of the East-German population) reflects the balances which the East-Germans needed in order to carry out transactions, then the total amount of transaction balances can be estimated. However, when estimating the p.c. transaction balances of the entire German population it has to be born in mind that the average income in Germany as a whole is higher than average income in East-Germany.

Seitz (1995, 35-6) produces an estimate of transaction balances of DM 1,235 p.c. in 1990 and DM 1,700 in 1994. This implies that about one third of German currency was internally hoarded or held abroad.

These estimates are based on two crucial assumptions. First, it has to be assumed that payments in the East are as 'cash-intensive' as in the West. This is conceivable. But it may also be the case that cashless means of payments were used to a lesser extent in East-Germany. Second, Seitz assumes that transaction balances rise proportionally with nominal income. However, the Baumol-Tobin model suggests that transaction balances rise proportional to the price level but less than proportional to real income. Both assumptions have the effect to overstate the amount of transaction balances. Finally, it is not clear whether the 35 per cent of non-transaction balances consist only of foreign balances (as assumed by Seitz) or also of internal hoards. If it is assumed that the initial 630 DM p.c. were only transaction balances, then the resulting 35 per cent must be a mixture of the other two components.

#### *Statistical data on outflows*

The Bundesbank uses various sources in order to estimate inflows and outflows of DM-notes.

1. information provided by other central banks,
2. information from the German labour administration about migrant workers,
3. interviews with migrant workers,
4. notes returning from Luxembourg, Austria and Switzerland and
5. official note exports to other countries.

If all these flows are accumulated over the period from 1958 to 1994 the resultant stock of foreign balances amounts to DM bn. 12.57 which is equal to 5.5 per cent of the total currency in circulation. This estimate is not plausible. The sources quoted above understate the amount of outflows. This can, for instance, be inferred from the fact, that since 1987 these sources are reporting net *inflows* of DM from Eastern Europe back into

Germany although it is commonly assumed that the circulation of DM-notes has strongly increased in these countries (Seitz 1995, 23).

U.S. statistics on note outflows and inflows seem to be more reliable. Shipments of US\$-notes to foreign countries are all made from New York. The Federal Reserve Bank of New York gathers data on currency shipments by banks and other institutions. On the basis of these data Porter and Judson (1996, 896) estimate a share of 54 per cent for foreign dollar-balances. Data from the U.S. customs on the other hand seem to catch only a small fraction of the outflow.

#### *Trend of the cash ratio*

There are many reports on the shadow economy which try to use the rise of cash holdings or some kind of cash ratio to measure the size of the informal economy (Gutman 1977, Feige 1979, Tanzi 1983).<sup>9</sup> The simple cash ratio approach assumes that the cash to deposit ratio remains constant in the official sector. If cash is the only means of payment in the underground economy changes in the cash to deposits ratio can be used to deduce changes in the size of the shadow economy. In addition, if the size of the shadow economy is known for some base year and cash velocity is the same as in the official sector, the method can be applied to estimate the level of payments and the income generated in all other years. This simple method can also be modified to allow for other kinds of payment in the underground economy or for differences in velocity between the official sector and the informal economy. Still, given the many strong assumptions that have to be made, the results are not very reliable (Porter/Bayer 1984, 182, Laflèche 1994, 53).

A somewhat more sophisticated version of the cash ratio approach is Tanzi's method. Tanzi regresses the cash to M2 ratio on the tax rate<sup>10</sup> and other explanatory variables such

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<sup>9</sup> A critical analysis of this approach can be found in Laflèche (1994), Porter/Bayer (1984) and (1989) and Boeschoten/Fase (1984).

<sup>10</sup> Tanzi (1983, 290) uses two different tax rates: a weighted average tax rate on interest income and total tax payments to gross income.

as income, interest rate and the ratio of wages and salaries to national income. The coefficient of the tax rate is assumed to capture the effect of cash holdings in the underground economy on the cash to M2 ratio. Then he re-estimates the model assuming taxes to be zero. The differences in the predicted cash values are interpreted as the cash holdings of the underground economy. Depending on the tax rate used in the regression he produces estimates of the currency absorbed in the underground economy between 15 and 20 per cent of currency outstanding. Like the other cash ratio methods Tanzi's method involves strong and implausible assumptions. He has to assume that any rise in taxes above zero triggers a shift into the informal sector. Furthermore, there may be other factors like changes in the payments system which can effect the cash to currency ratio. Therefore, it can be expected that the results are not very robust. And indeed, as Porter and Bayer (1989) have shown, a re-estimation for the after-war period yields an insignificant tax coefficient.

For Germany Langfeldt has used Tanzi's method. In three separate estimations Langfeldt (1989b) regresses the currency to deposit ration, the currency to M2 ratio and real currency balances on a number of variables (the usual suspects) and the tax rate. However, the tax coefficient is positive and significant only in the regression for real currency balances. In the currency to M2 equation the tax coefficient is negative<sup>11</sup> and significant and in the currency to deposits equation the coefficient is insignificant. Still, Langfeldt uses the positive tax coefficient in one of the equations to estimate currency holdings which are due to tax evasion. For 1980 he derives an estimate of DM bn. 26.57 (Langfeldt 1989b, 207). This is equal to 11 per cent of total currency in circulation. However, the variety of the estimates shows, that his results are not very robust and may suffer from misspecification.

Yet another variant of the cash ratio method has been employed by Seitz (1995) in order to estimate foreign holdings of DM-notes. Seitz uses the ratio of cash to private

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<sup>11</sup> In this estimation the tax coefficient probably catches the effect of the banks' spreading branch network and the rising number of bank accounts on the relative ratio of currency to M2 between 1960 and the mid 1970s.

consumption. However, he does not assume a constant cash ratio but uses different trends to extrapolate this cash ratio. In order to reflect increased demand for DM-notes these trends should be derived from periods in which foreign DM holdings were relatively small or non-existent. Seitz uses the periods from 1960-80 and 1970-77. In addition, he also works with the Austrian cash ratio. Based on this approach he derives the result that an estimated 30-45 per cent of German bank notes are held abroad (Seitz 1995, 42-4). The crucial assumption of this method is that deviations from trend are only (or mainly) due to outflows into foreign countries. However, such changes may also be due to changes in internal hoards and changes in the payments system. For example, the shift from weekly cash payments of wages to monthly bank transfers and the parallel build up of a large bank branch network lasted until the early 1970s. So it is quite likely that with the completion of this process there is a break in the development. Such a break can, indeed, be found in the cash to M1 (M2, M3) ratio (see Chart 1) as well as in the changes of in the seasonal pattern of cash holdings (see next chapter).

#### *Best fit*

If DM-notes are partly held abroad econometric estimates of local cash demand should be biased. A certain share  $\beta$  should not be included. But  $\beta$  is unknown. However, that relative share  $\beta^*$  which provides the best fit for the money demand function can be used as an estimate of the share of foreign held DM-balances. Seitz (1995, 38) has used this method and derived a  $\beta^*$  of 40 per cent. Unfortunately, this coefficient can only be interpreted as the average share of foreign holdings over the entire period. Furthermore, it is not quite clear whether the estimate comprises only foreign held money balances or also internal hoards. While internal hoards may, at times, behave in an unpredictable way, it is plausible to assume that it is influenced in 'normal' times by quite the same arguments as transaction balances (income and interest rates, for instance).

#### *Residuals*

If hoards and foreign holdings were small in the early 1960s a money demand function fitted to the 1960s could be used to estimate the transaction demand for the entire period

up to the 1990s. Given there were no other shifts in the demand for cash, the residuals could be interpreted as the result of outflows into foreign countries or internal hoarding. Using this method Seitz (1995, 41) produces an estimate of foreign holdings of 40 per cent. However, these 40 per cent may also comprise internal hoards. Furthermore, financial innovation may have reduced the demand for currency so that the estimate is likely to be downward biased.

#### *Pooled panel data regressions*

In the industrial countries there are large differences of per capita currency holdings. In theory such differences can be traced back to differences in income, different taxes, different payment systems and inflation differences.<sup>12</sup> In addition, the non-observable foreign share of currency balances may influence per capita currency holdings - although this is probably only the case for the US\$, the DM and maybe the Swiss Franc. Therefore, a cross sectional analysis can provide information on the determinants of the demand for currency.

Boeschoten (1992, 141-54) has estimated the demand for currency outside banks for a data set with 15 countries spanning 20 years. The variables included in the regression are: consumption, interest rates, automated teller machines (ATM) per person, point-of-sale terminals (POS) per person, credit cards per person, inflation and revenue to GDP. Apart from the standard results that the scale variable (in this case consumption) has a positive and the interest rate a negative effect on currency holdings he finds that the use of ATMs seems to increase currency holdings, whereas the spread of POS terminals and credit cards reduces it. But the coefficient for revenue to GDP was always insignificant. Thus Boeschoten finds no evidence for an impact of taxes on the demand for currency. While these results shed some light on the question how financial innovation effects the demand for currency, they do not provide any information about the importance of hoarding. Furthermore, it has to be noted that the estimates are plagued with problems of

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<sup>12</sup> There may also be differences which can only be explained by historical facts. See Humphrey et al. (1996, 926).

autocorrelation. Different specifications could not improve the results or yielded implausible estimates (Boeschoten 1992, 149).

Porter and Judson (1996) have performed a pooled panel data regression over 14 countries and 7 years. Their results are quite impressive. When subtracting the estimated share of foreign holdings from US\$- and DM-banknotes they can account for nearly 80 per cent of the cross country variation in the velocity of currency. They find that besides opportunity cost variables like the nominal interest rate and the inflation rate, variables capturing financial innovation (number of noncash transactions and ATMs per capita) as well as a tax variable (government revenue to GDP) are significant (see Table 2). Their estimates seem to indicate that the adjusted dollar and DM balances are not too far off the mark. Or put differently: The estimates of foreign holdings seem to be quite accurate.

**Tab. 2 A Pooled Panel Data Regression for Velocity of Currency**

Variable	Low Denomination Countries <sup>13</sup>	High Denomination Countries
Nominal Rate	4.47 (3.0)	1.21 (0.4)
Inflation Rate	7.52 (3.9)	5.05 (1.4)
Ratio of Revenue to GDP	-0.7 (-4.7)	-0.81 (-5.9)
Violent Crime	-0.02 (-0.3)	0.29 (1.5)
Noncash Payments	0.7 (7.2)	1.60 (5.6)
ATM Per Capita	-0.15 (-1.8)	-0.36 (-3.3)
Intercept	1.82 (4.3)	-3.40 (-4.1)
R <sup>2</sup>	0.78	0.79
Number of Observations	60	34

*14 countries and 7 years (1987-93); number in parentheses are t-statistics*

*Source: Porter and Judson (1996), 902*

If these results should prove to be robust, most of the changes in the demand for currency (except foreign outflows) will be predictable. However, given the differences between the various countries the result nearly seems ‘too good to be true’. For instance, it is difficult to understand why the coefficient for ‘revenue to GDP’ is significant. Revenue to GDP reflects central government revenue to GDP. Given that in some countries states and local authorities raise taxes as well, this variable is only a poor indicator of total taxes. Still, it is highly significant, contradicting the results of Boeschoten (1992, 148) who found that

<sup>13</sup> High denominated currencies are: Belgium, Canada, Germany, Netherlands and Switzerland; low denomination currencies are Denmark, Finland, France, Italy, Japan, Norway, Sweden, United Kingdom and United States.

the tax and social security variable was never significant. So there is a certain probability that this coefficient has picked up other influences as well. And indeed, the chosen period seems to have been special in at least one respect. For the period 1960-93 the coefficient of correlation for velocity and revenue to GDP is positive (0.48 on average for the 14 countries used by Porter and Judson).<sup>14</sup> But for the period 1987-93 the coefficient of correlation is negative (-0.21). Therefore, it must be doubted that the negative coefficient in the Porter/Judson estimate is robust.

### *Questionnaires*

'Money' is a delicate subject. Therefore, the results of questionnaires about private cash holdings have to be interpreted very carefully. Especially when it comes to those cash balances which are hoarded in order to hide wealth it is highly unlikely that people will respond correctly. However, if the questionnaire is about payment habits the results are likely to be much more reliable. The Nederlandsche Bank, the Federal Reserve Board and the Bank of Finland have conducted questionings to get more information about the use of cash (see Virén 1993 and 1996, Boeschoten 1992 and Avery et al. 1986 and 1987). All these questionings could account for only a small portion of total cash balances.

Boeschoten (1992, 65) can account for 12 per cent of guilder-notes outstanding, in the case of US\$-bills the portion is 12-14 per cent (Avery et al. 1987, 191). In Finland the share is higher. Virén can account for 25-35 per cent (Virén 1993, 8) of bank notes. But this can easily be explained by the fact, the per capita cash holdings in Finland are very low in comparison to other countries (Virén 1993, 8).

In the U.S. and the Dutch analysis it has been attempted to separate transaction balances and hoards. Boeschoten (1992, 55) found that in 1990 only 5 per cent of total cash balances were held as transaction balances. Avery et al. (1986, 104; 1987, 191) estimate that private households in the U.S. use around 11 per cent as transaction balances.

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<sup>14</sup> For some countries there is a break in the statistical series covering government revenue. In these cases the period has been shortened. For Switzerland moving two-year averages were used. The coefficient of correlation for the period 1960-86 was 0.64. Source: IMF, International Financial Statistics, own calculations.

According to the answers in the questionnaires only 2 per cent of total cash balances in the U.S. were hoarded. However, it is nearly certain, that there has been massive underreporting with respect to hoards.<sup>15</sup> So, the results of the questionnaires show that evidently only a small portion of total cash balances is required to carry out regular transactions. However, they shed little light on the question for what purposes the by far largest portion of the cash balances is used.<sup>16</sup>

Unfortunately, no such questionings have taken place in Germany in the past. But the results for the U.S., the Netherlands and Finland clearly show that normally a few hundred DM should be sufficient to carry out regular payments. Still, these results leave open the question how much money is abroad. And they say little about the determinants of hoards and foreign balances.

### *Conclusions*

Table 3 provides a summary of the estimates of internal hoards and foreign circulation. Such estimates have been produced for the U.S., the Netherlands, Finland and Germany. In addition, there is Boeschoten's (1992) estimate for 14 countries. All these estimates are tentative. But taken together they clearly show that a considerable share of cash holdings is not used as transaction balance for legal (or 'regular') domestic transactions. In case of the US\$, the results of Porter and Judson (1996) clearly show that large amounts of bank notes are held abroad. Seitz's (1995) results show that the same is true for Germany, however on a smaller scale. The Finnish and Dutch results, on the other hand, make clear that there also may be considerable internal hoards in industrialized economies.

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<sup>15</sup> Further investigations of the Nederlandsche Bank - including interviews with experts - led to the conclusion that much of the 'missing cash' was held in connection with tax avoidance and illegal activities. See Boeschoten (1992, 117-26) and Boeschoten/Fase (1992).

<sup>16</sup> The results of the questionnaires are interesting in another aspect: the relationship between income and money demand. While the standard inventory model suggests that the elasticity of money demand with respect to real income should be around 0.5, empirical estimates often produced estimates close to 1. The results of the questionnaires suggest that the income elasticity of money demand is probably quite low. Virén (1994, 13) calculates an income elasticity of transaction balances of 0.3 and Boeschoten (1992, 49) derives a value of 0.4 for transaction balances in the Netherlands. Avery et al. (1986 and 87) can show that there is a clear link between income and the volume of payments but not between income and average cash balances. Transaction balances hardly seem to rise at all for groups with higher incomes.

**Tab. 3 Estimates of Internal Hoards and Foreign Balances**

<b>Seasonal variation</b>		
Porter/Judson (USA)	70%	Canada as reference-country
Seitz (D)	30-40%	Aust.+Neth. as reference-countries
Sumner (USA)	65-75%	Retail sales plus squ. root formula
<b>Age of bank notes</b>		
Boeschoten (14 countries)	33%	(US: 39%; Germany: 40%)
Porter/Judson (USA)	59%	
Seitz (D)	26% of notes from 5-50 DM	
<b>Currency ratio</b>		
Langfeldt (D)	11% (1980)	Tanzi's method
Seitz (D)	30-45%	Extrapol. of various trends
Sprenkle (Ind. countries)	80%	NewZealand as reference-country
<b>Best Fit</b>		
Seitz (D)	40%	Average 1960-94
<b>Residuals</b>		
Seitz (D)	40%	
<b>Questionnaires</b>		
Avery et al. (USA)	89%	
Boeschoten (NL)	95%	
Virén (Finl.)	65-75%	Minimum
<b>German unity</b>		
Seitz (D)	35%	
<b>Statistics on flows</b>		
Porter/Judson (USA)	17-60%	
Seitz (D)	5,5%	

Sources: See references in the text.

In the case of Germany the most recent estimates have been produced by Seitz (1995). Seitz applies a whole series of methods to estimate the share of foreign DM-holdings. Thus, he tries to estimate only a subset of non-transaction balances. Consequently, his estimates cannot be used as indicators of total non-transaction balances - even if it is taken into account that some of the methods employed are likely to capture internal hoards as well. Therefore, in the following, some of the methods will be re-employed and extended, using modified assumptions in order to get an estimate of all non-transaction balances of DM-notes.

### 3. Estimating Non-Transaction Balances of DM-Bank-Notes

#### *German Unity*

Seitz' estimate is based on the assumption that transactions balances and transactions vary proportionally. However, an inventory model of the Baumol-Tobin type suggests that the demand for money varies underproportionally. If the well-known square root formula is applied the transaction demand rises only by 40 per cent when real income or consumption rises by 100 per cent. Consequently, the estimate of the transaction demand has to be corrected downward to DM 875 per capita for 1990. If the square root formula is applied the subsequent rise of transaction balances also has to be revised. Statistical material for the transition period in Germany is hard to get. Seitz' estimate is based on a nominal increase in spending of 38 per cent. If this increase is divided into equal rates of real growth and inflation the increase in transaction balances is an estimated 28 per cent. This implies transaction balances of DM 1,120 per capita in 1994. If this estimate is correct, only 40 per cent of the currency stock were used for transactions. The other 60 per cent were either hoarded or were held in foreign countries.

#### *Seasonal method*

In order to estimate foreign holdings of DM-notes Seitz (1995) used seasonal variations of Dutch and Austrian banknotes. If Dutch and Austrian banknotes are not held in foreign countries and if hoards are as important as in Germany, the estimate accurately reflects foreign DM-holdings. However, in order to estimate total non-transaction balances a monetary aggregate has to be found which is not influenced by hoarding. Since internal hoarding seems to be occurring in all countries, currency holdings in other countries cannot be used. So what remains is (1) an alternative means of payment which is less likely to be hoarded or (2) the amount of transactions which are carried out with currency.

Except for currency, only (sight-)deposits are used as a means of payments.<sup>17</sup> In Germany they are usually non-interest bearing. Though deposits may also be used as a medium of

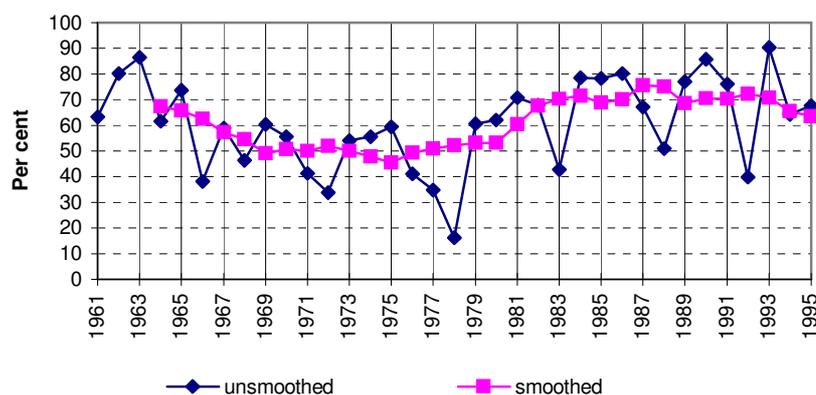
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<sup>17</sup> Even if credit cards or checks are used, the ultimate payment takes place via transfer of deposits.

transactions in the shadow economy, they are likely to be much less used for this purpose because of the risk of detection. And as a means to hide wealth they appear totally inappropriate. However, deposits are probably also used as a store of value. This assumption is supported (1) by the observation that there is a negative correlation between sight deposits and time deposits<sup>18</sup> and (2) by the level of per capita deposits. In 1995 deposits of private households amounted to DM 4,346 (approx. US\$ 3,000) per capita. This is more than 2.5 times the monthly average net income of DM 1,672.<sup>19</sup>

Still, it can be assumed that the seasonal variation of deposits is a better reflection of the seasonal variation of payments. If these variations are similar to the variations of currency payments, the seasonal variation of deposits can be used as a proxy of the true seasonal variation of bank notes. Using deposits as a reference, the estimated share of non-transaction balances of DM-notes is 70 per cent in the 1990s. This estimate is about twice as high as Seitz' estimate. If both estimates were correct, internal hoards and foreign holdings would be equally large, both being equal to about 35 per cent.

**Chart 2 The Share of Non-Transaction Balances of DM-Bank-Notes**  
(Derived from seasonal variations of DM-deposits.)



Share of non-transaction balances in per cent; 'smoothed': 7-year moving average  
Source: Deutsche Bundesbank and own calculations<sup>20</sup>

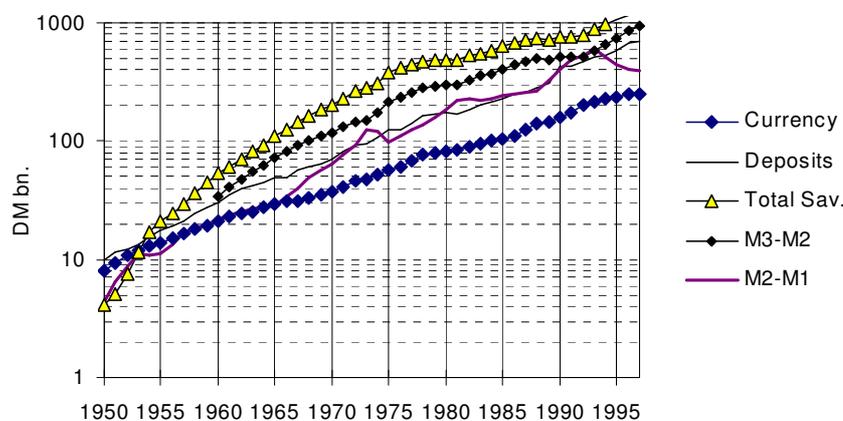
<sup>18</sup> Lately, this correlation has been not as close as in the past.

<sup>19</sup> Net household income after taxes and compulsory social security deductions per capita per month.

<sup>20</sup> The seasonal method is described in the appendix.

On first sight, the development of non-transaction balances since the early 1960s seems hard to interpret (Chart 2). Throughout the 1960s the share of non-transaction balances declined from 70 per cent to approx. 50 per cent. From the mid-1970s until the mid 1980s it bounced back to 70 per cent. Afterwards, from 1983 to the early 1990s this share remained around 70 per cent, rising only in 1987/88 when the source tax on capital income was in the making.

**Chart 3 The Growth of Components of M3**



*'S-t Sav.': Short-term savings' accounts included in M3; 'Time deposits': short-term time-deposits included in M2; 'Total savings': all savings accounts; 'Deposits': transferable (non-interest bearing) deposits; 'Currency': Currency in circulation outside banks.*

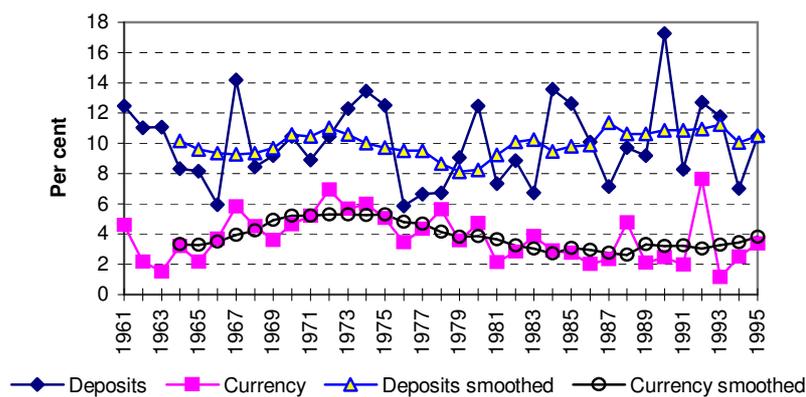
*Source: Deutsche Bundesbank*

The development from the early 1960s to the mid-70s can be explained by financial innovation (see ch. XXX). This was the transition period from weekly cash payments of wages to monthly transfers of deposits. The banks' branch network expanded vigorously in this period and with it the number of bank accounts. Regular payments such as rents, payments for electricity or the telephone bill were carried out more and more by deposit transfers. But not only the number of sight deposits increased. The number of savings accounts also rose considerably. This has probably led to a reduction of currency hoards. As long as people did not have a bank account, in many cases the most convenient liquid store of wealth must have been cash. Once they opened up a bank account switching into savings or time deposits became cheaper and more convenient. The effects of this

development can be seen in the change of the currency to M1 ratio which declined from 42 per cent to 33 per cent (see Chart 1) and the steep rise of funds in savings accounts and time deposits (see Chart 3). Up to the mid-1970s deposits, time deposits and savings rose much faster than currency balances.

The subsequent development is more difficult to explain. If the estimates are correct internal hoards and/or foreign holdings accelerated in the early 80s raising the portion of non-transaction balances to 70 per cent where it has remained up to the early 1990s. This contradicts the widespread believe that internal hoards and foreign balances have strongly increased in the last ten or fifteen years. Since these estimates are hardly very precise it cannot be determined, however, whether common prejudices or the estimates are wrong.

**Chart 4 The Seasonal Variation of Deposits and Currency**



'Smoothed': 7-year moving average

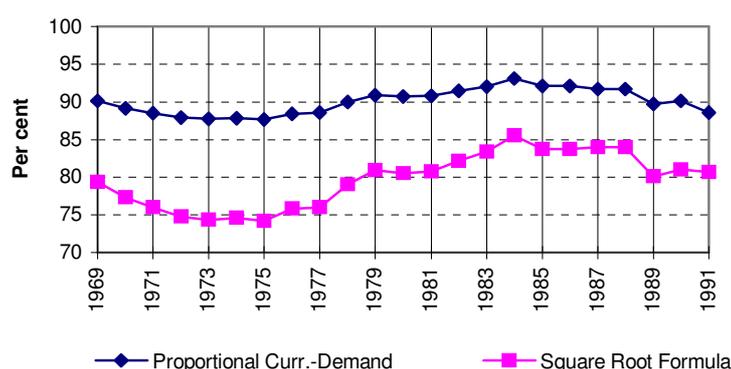
Source: Deutsche Bundesbank and own calculations (see appendix).

A separate look at the seasonal variations of currency and deposits shows that both are quite volatile (Chart 4). However, it can be clearly seen, that the general tendency of the estimate reflects mainly the rise of seasonal variation of currency until 1975 and the subsequent decline. Furthermore, it becomes evident that this method only allows to estimate a trend. The unsmoothed figures are highly volatile and may be severely biased due to special factors. For instance, as can be seen in Chart 4 the December-January difference has been very high for currency in the years 1988 and 1992. Therefore, the

(unsmoothed) percentage share of non-transaction balances was very small. However, the size of the December-January difference was not due to seasonal effects but was due to internal hoarding (because of the introduction of a source-based tax on capital income in 1988) and foreign holdings (because of the EMS crisis at the end of 1992).

A more straight forward way of estimating the true seasonal variation of transaction balances seems to be the estimation of the seasonal fluctuations of *payments*. However, it is neither known which portion of payments is carried out with currency nor what the exact relationship between changes in payments and the required amount of currency is. Since there is no statistics on the amount of currency payments, retail payments have been chosen as a proxy. In Germany, by far the largest fraction of retail payments are made with currency (Zellekens/Rueters 1992, 13). If it is assumed that transaction balances vary proportionally with currency payments, the estimated share of transaction balances in 1990 is 10 per cent. But if it is assumed (as in the Baumol-Tobin model) that transaction balances vary proportional to the square root of payments, the share is about 20 per cent. A share of 20 per cent is equal to 600 DM an amount which seems to be rather on the high side.<sup>21</sup>

**Chart 5 The Share of Non-Transaction Balances of DM-Bank-Notes  
(Derived from the seasonal variation of retail sales.)**



Source: Deutsche Bundesbank, Statistisches Bundesamt and own calculations (see appendix).

<sup>21</sup> When applying the square root formula no distinction was made between nominal and real changes. Taking account of inflation would yield values closer to the results for proportional currency demand.

The development over time looks quite similar to the one which was found in the estimation based on the seasonals of deposits (Chart 5). Although the comparison can only start in 1969 because there are no earlier monthly figures for retail sales, there clearly seems to be an upward trend for the share of transaction balances until the mid 70s, a decline until the mid-80s and a rather stable value thereafter. Given the strong assumptions that had to be made in order to carry out these estimations the similarity of the intertemporal pattern is somewhat reassuring.

The additional estimates of non-transaction balances yield a share of non-transaction balances between 60 and 90 per cent. Furthermore, as has been pointed out, there is reason to believe that the lower estimates are downward biased. Therefore values of 80 to 90 per cent do not seem unreasonable. This would still leave 300 to 600 DM per capita as transaction balances. Since the results are much higher than Seitz' estimates of foreign currency holdings, in Germany, as in other countries, there seems to be a considerable amount of internal hoards.

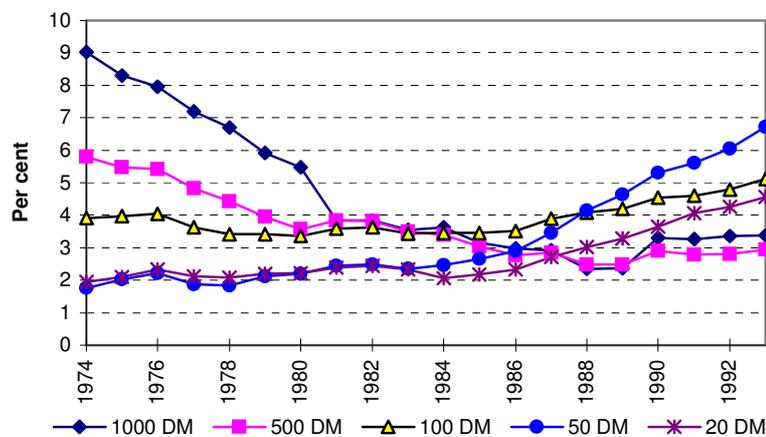
#### *Seasonal variation across different denominations*

A noteworthy property of the currency stock is the high share of 1000 DM notes. At the end of 1995 the value of these notes amounted to DM bn. 81,162 (nearly US\$ bn. 57 ). This was about one third of the total stock. Sometimes the increase of the share of 1000 DM notes is interpreted as an indicator of increasing internal hoarding or foreign balances. However, such an increase can also be due to the rise of average transactions' values. A model developed by Cramer (1983) shows that the structure of notes can be quite sensitive to little changes in the average value of transactions.<sup>22</sup> The change in the structure alone is therefore not sufficient to conclude that non-transaction balances have been increasing. However, the development of the seasonal pattern of the different note sizes can provide further information on the use of the different banknotes for transaction- and non-transaction purposes.

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<sup>22</sup> See also Porter/Judson (1996).

**Chart 6 Seasonal Variations of DM-Bank-Notes**



*Moving 7-year averages of the yearly seasonal variation (see appendix)  
Source: Deutsche Bundesbank and own calculations*

Unfortunately, monthly figures for the different denominations are only available since 1970. All the same, the results of the decomposition of the seasonal variation are quite remarkable. As Chart 6 shows, in the 1970s the two largest bills exhibited the strongest seasonal pattern.<sup>23</sup> This indicates that these bills have been used for transactions fairly intensively. Judging from the seasonal variation the ‘smaller’ notes were used less in transactions. In the 1970s seasonal fluctuations of small notes (DM 5, 10, 20, 50)<sup>24</sup> were relatively modest. But this could also be due to less seasonal variations of those transactions which are carried out with small notes. After all, in this analysis, seasonal variation is measured as the difference between December and January currency holdings. This difference mainly captures the ‘Christmas effect’ and it may well be that during Christmas shopping mainly the holdings of large notes are increasing.

However, such an explanation can only account for the level but not for the steady rise of the seasonal variation of small notes. Unless the seasonal variation of small payments has increased dramatically relative to large payments, the increase of seasonal variation of

<sup>23</sup> The DM 200 bill was introduced only in October 1990. Therefore, it is not included in this analysis. Currently, the value of DM 200 notes in circulation is about DM bn. 10. This is equal to roughly 4 per cent of all notes in circulation.

<sup>24</sup> The DM 5 note has always been competing against the DM 5 coin and has only been little used.

DM 10, 20 and 50 notes<sup>25</sup> indicates that a larger portion than before is now used for transactions. Thus the changes of seasonal variation of the different ‘sizes’ of banknotes indicate that the share of large banknotes which are used for non-transaction purposes has been rising considerably over the past 20 years<sup>26</sup> and the share of small notes which are hoarded or held in foreign countries has declined. Throughout the 1970s, the seasonal fluctuations of DM 10, 20, and 50 notes were well below current fluctuations of DM 500 and DM 1000 notes. Therefore, the share of small notes in non transaction balances may have been quite substantial.<sup>27</sup>

#### 4. Foreign Balances or Internal Hoards?

It may seem quite far-fetched that people in the developed world hold large amounts of cash. Even the term ‘hoarding’ seems to come from times long past. Nowadays, where investors can choose between a wide variety of assets, cash holdings should be reduced to pure transaction balances. After all, cash does not yield any interest, it constantly loses real purchasing power due to inflation and may be lost, stolen or accidentally destroyed. Therefore, it seems plausible to associate any non-transaction balances with payments in the underground economy or with foreign balances. However, as some economists point out, even if it is assumed that the underground economy is fairly large, the transactions demand of the black economy can hardly be very big because bank notes are likely to return quickly into the regular circulation (Langfeldt 1989a, 55-6; Seitz 1995, 48-9). Avery et al. (1987, 191) estimate that the shadow economy in the US absorbs only 5 per

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<sup>25</sup> Seasonal variations of the DM 100 note display the smallest changes. This may be due to the fact that the DM 100 note is large enough to be hoarded even today and - unlike the US\$ 100 bill - it is widely circulating as a medium of exchange. (The DM 10 notes are not displayed in the chart. However, the seasonal variations of these notes are similar to the variations of DM 20 notes.)

<sup>26</sup> Hyland (1994, 67) points out that the frequency of deposits of Can.\$ 1000 notes has been declining from the early 1980s on, suggesting that this indicates an increased use as a store of value.

<sup>27</sup> This result contradicts Seitz’ finding that a *decreasing* share of small notes is used for transactions. This contradiction can possibly be explained by the fact that Seitz’ estimate is based on Boeschoten’s results. Boeschoten, however, assumes that small guilder-notes are *not* hoarded. But the results above for DM-notes suggest that small notes may also have been hoarded in the Netherlands.

cent of the currency in circulation in order to carry out transactions. Boeschoten (1992, 100) derives an estimate of 22 per cent for the Netherlands.

On this account, it seems that most of the cash should be expected to circulate in foreign countries. Porter and Judson (1996) think that internal hoards are a minor problem for the U.S. Sprenkle (1993) goes even further. He estimates that 80 per cent of all US\$ bills are held abroad. Furthermore, he thinks that this is also true for other currencies from industrial countries. Thus he derives an estimated US\$ 1 trn. of bank notes of industrial countries circulating in the developing world. However, this estimate seems to be unrealistic. There is general agreement that only very few currencies, such as the US\$, the DM and maybe the Swiss Franc, are held outside national borders. Whereas the US\$ is held in nearly all parts of the world, DM-notes and Swiss Franc are probably only circulating in Eastern Europe, the DM also in Turkey.

**Tab. 4 The Most Important Parallel Currency in East-European Countries in the 1980s**

Bulgaria	CSSR	Former Jugoslawia	Poland	Romania	Hungary	USSR
US\$	US\$/DM	DM	US\$	DM/sfr	DM/sfr	US\$/sfr

*Source: Wingender (1989, 78); for Jugoslawia: various press reports*

Sprenkle's estimate lacks a certain sense for proportions. In 1991, the countries with low or medium income had a combined income of approx. US\$. bn. 4. This is not even one fourth of the income of industrial countries (US\$ bn. 17). Therefore, it is hardly conceivable that these countries hold US\$ bn. 816 worth of bank notes from industrial countries (in addition to their own bank notes), whereas the currency circulation in the industrial countries amounts to only US\$ bn. 205 (Pieper 1994). This assumption becomes even less plausible when it is taken into consideration that rich citizens from developing countries often choose to purchase interest bearing assets in industrial countries - a thing which is often referred to as 'capital flight'. So when the whereabouts

of such large quantities of bank notes is considered, those countries should be looked at which have an income- and wealth level which is high enough to explain such significant hoards (Rogoff 1998).

A number of economists therefore assume that the high demand for currency is - at least partly - due to internal hoarding (Boeschoten 1992, Langfeldt 1989a and b, Laurent 1979, Sumner 1990). In order to explain internal hoarding they point out that currency offers a number of distinct advantages. Currency is well suited to hide wealth from the authorities or one's spouse (Sumner 1990) or anybody else.<sup>28</sup> Especially (explicit or implicit) taxes on the stock of wealth which may occur in the case of divorce<sup>29</sup> (Sumner 1990), donation or inheritance (Langfeldt 1989a) can induce wealth holders to hoard currency.

Furthermore, currency hoards may be preferred over other stores of value when certain social services are paid for by the state only when the person in question does not have any savings (Boeschoten (1992, 104). Before the public insurance for the care of elderly people was introduced in Germany everybody had to pay for care out of existing wealth. Only when there was no wealth, did the state provide financial assistance. This provides a strong incentive to hide wealth from the state. Finally other factors may be important which are hard to judge: 'privacy' - some people do not want anybody to know the size of their savings, mistrust against others, shyness etc. (Anderson 1977, 25; Boeschoten 1992, 101).

It may appear that foreign investment is to be preferred over hoarding because it offers secrecy and pecuniary returns. However, foreign investment has also drawbacks. Money has to be transported in cash over the border. This is not only costly but also implies that the wealth held in a foreign country is much less liquid than wealth held in cash.

Transporting large amounts of currency to a foreign country entails the probability of being caught at the border. In addition, there is the threat of theft which is nicely illustrated by a quote from Kindleberger (1987, 58) about conditions in Italy in 1963:

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<sup>28</sup> In a personal conversation a former Canadian tax inspector remarked that the most important rules for tax evaders is "Don't tell your wife." Otherwise the matter may come up in a divorce case.

<sup>29</sup> In Germany, the divorce law was changed in 1977 in a way, that may have influenced hoarding.

*'the middle class started carrying its money in packets to Switzerland to such an extent that highway robbers found it profitable to work on the main highway leading to Lugano.'*

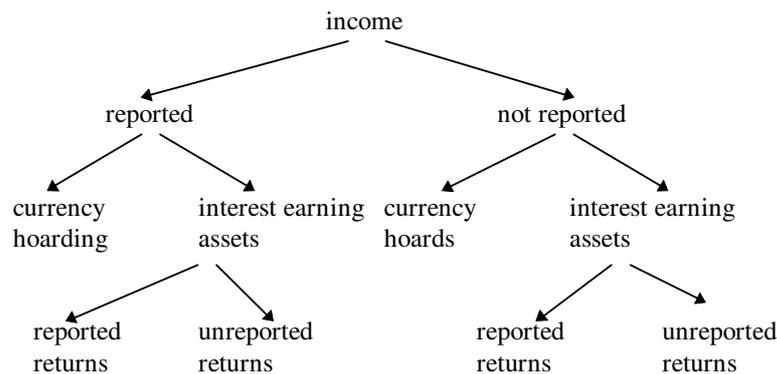
It also has to be kept in mind that in the case of theft the victim can hardly go to the police. Furthermore, these 'transfer risks' have to be born at least twice, one time when the money is transported to a foreign country and a second time when the money is carried back. Finally, it is not guaranteed that the domestic authorities will not learn about the foreign holdings. Thus, when a computer specialist stole a list of a customers of a Luxembourg subsidiary of a German bank and tried to blackmail the bank, the list finally got into the hand of the German police. The German police handed the list to the German tax authorities. German investors now have to explain to the authorities where the money came from.

As Cagan (1958, 315) pointed out: *'unreported income produces an abnormal demand for currency to hoard.'* Those who earn high incomes with illegal activities can try to launder the money. However, since this entails costs and risks, it may often be preferable to hold wealth in the form of currency. Laurent (1979, 6) presents a related point, arguing that it may be easier for 'small tax evaders' to spend unreported income than for 'large tax evaders'. Therefore, for the latter, it may be preferable to keep large currency balances (even for many years) instead of running the risk of being caught when laundering the money. Therefore, the argument is not totally convincing that money that is used in the underground economy can always be expected to 'surface' quickly. The shadow economy does not only create a transaction demand but also a demand to hoard. This conclusion is reaffirmed by the results of questionings of 'experts' in the Netherlands (Boeschoten 1992, 117) and by the above average circulation of large bank notes in the Federal Reserve Districts 'Miami' and 'Jacksonville' that are supposed to be locations with active drug trade (Kimball 1981, 47-8).

The decision between reporting and not reporting of income and the subsequent decision how not reported income is to be held depends on a variety of variables (see also

Boeschoten 1992, 102-4): interest rates, wealth taxes, income taxes, inflation rate, the expected value of the costs if unreported income is detected and the expected value of loss (theft, physical destruction).

**Chart 7 Currency Hoarding and Tax Evasion**



Potential tax evaders do not face just one alternative: ‘report everything’ versus ‘currency hoards’. Rather they can choose between a wide variety of options. Their wealth after  $t$  periods depends on the specific option chosen. If agents are risk neutral and principally prepared to evade taxes,<sup>30</sup> the decision between the various alternatives is determined by the relative pay off after  $t$  periods. Unfortunately it is difficult (empirically as well as theoretically) to determine the relative size of the pay offs. The expected values of the costs of being detected are hardly observable. The same is true for the subjective risk of losing hoarded currency.<sup>31</sup> Even the relevant tax rates are hard to measure. Both the income and the wealth tax have to be interpreted very broadly encompassing explicit as well as implicit taxes. State payments which are conditional on lack of own resources can be interpreted as an implicit tax just like payments after a divorce. Even when only explicit taxes are considered there is the problem that the relevant *marginal* tax rate is often not known.

<sup>30</sup> Frey, Pommerehne and Weck-Hannemann (1983) argue that the general attitude towards taxes (‘tax moral’) may also influence the size of tax evasion and thus the size of hoards.

<sup>31</sup> The fact that in the aggregate only little currency is lost (Laurent 1974) does not necessarily imply that this risk is low at the level of the individual. Theft, for instance, does not influence aggregate figures but can be an important risk for the individual agent.

These problems notwithstanding, there is a number of empirical analyses on the influence of taxes on the size of the shadow economy and the size of currency hoards. Probably the earliest study was Cagan (1958). Cagan derives a positive relationship between the average income tax and currency holdings (Cagan 1958, 319-24). Tanzi's (1983) much quoted analysis reaches the same conclusion. Other analyses in the Netherlands, the U.S. and Germany support these results (Boeschoten 1992, 127; Sumner 1990; Langfeldt 1989 and b; Pommerehne/Kirchgässner 1994).

However, the econometric results have to be interpreted cautiously. The results derived by Cagan and Tanzi are strongly influenced by the tax rises from 1930 to world war two and the subsequent decline of taxes after the war - a development which was accompanied by a parallel movement of currency holdings. But in the period from the late 1950s to the early 1980s taxes did not change much at least when measured as tax receipts in per cent of national income. This makes it difficult to evaluate the effect of taxation on currency holdings. Not surprisingly, when Porter and Bayer (1984, 182) re-estimated Tanzi's regression for the after war period the tax coefficient was no longer significant. A similar problem arises in Germany, where taxes in per cent of GDP rose in the late 1960s and early 1970s but have been more or less stable since. This indicates that Langfeldt's results may also not be very robust.<sup>32</sup> The evidence from pooled panel data regressions is also mixed (see ch. 2).

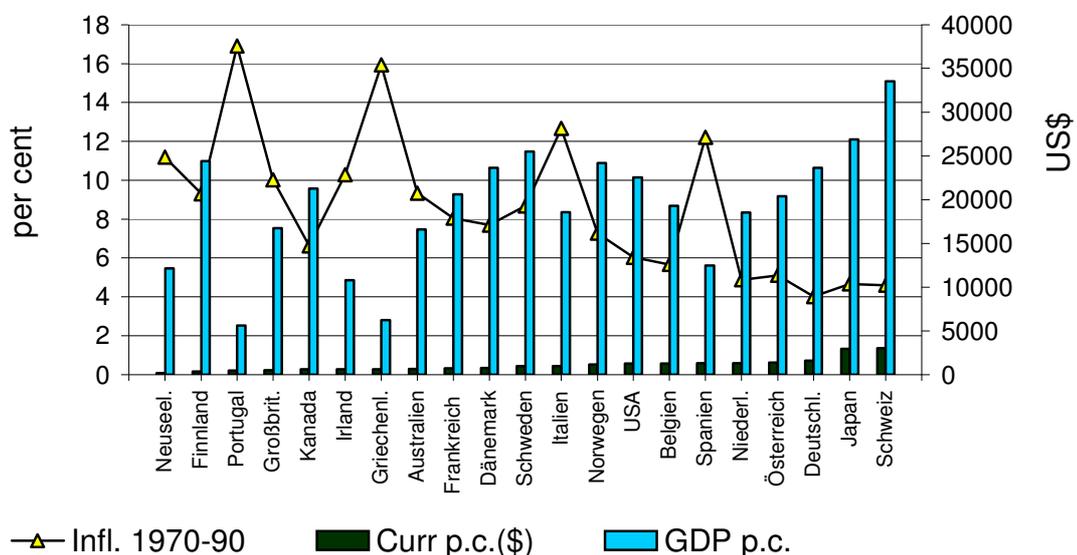
Internal hoards do not preclude the possibility of foreign circulation. Even though many estimates cannot discriminate between foreign balances and internal hoards, the evidence presented by Seitz (1995) clearly shows that large amounts of DM-notes are held abroad. This finding is also supported by econometric evidence which shows that the US\$-DM exchange rate is a significant argument of the demand for currency. Using a cointegration approach Seitz (1995, 7-14) shows that the US\$-DM exchange rate negatively influences the demand for DM banknotes. According to his estimates this negative influence has been increasing in the early 1990s. As Seitz points out, the increase in the exchange rate

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<sup>32</sup> Compare ch. 3.

elasticity of currency demand may indicate a rising significance of foreign holdings. Even if this conclusion has to be interpreted with care, the US\$-DM exchange rate seems to have a significant effect on the demand for DM-notes. This does not imply that dollars and marks are substituted by agents in the U.S. and Germany. However, it indicates that both currencies compete in third countries. Thus if the dollar is 'strong' the demand for dollar bank notes relative to the DM bank notes rises and vice versa. Unfortunately, these elasticity estimates do not allow to estimate the amounts held abroad.

**Chart 8 Currency Per Capita in Various Countries**



*Ordering of countries according to p.c. cash holdings  
Source: IMF, own calculations*

Given that all estimates of internal hoarding and foreign circulation are tentative the single most important evidence is the sheer size of per capita cash holdings. Average balances are far higher than normal transactions' balances. The fact that per capita holdings are large, even for currencies that do not circulate in foreign countries, suggests that internal hoarding may be substantive. This conclusion is supported by the close correlation between inflation and per capita cash holdings. Closely related with the estimation of the size of internal hoarding is the analysis of the reasons for hoarding.

Although the evidence of the effects of taxation on currency hoards is not very robust, there can be little doubt that taxation and social policy provide strong incentives to hide wealth from the authorities. So there are strong economic motives - besides fear or mistrust - to hoard currency although it is not-interest bearing.

## **5. Lessons for Monetary Policy**

In all industrial countries (with the possible exception of New Zealand) currency per capita is much higher than any conceivable transaction demand. This is even true for countries like Finland where per capita currency holdings are far below the international average. Since most currencies usually are not found outside national borders in significant quantities, this indicates the presence of internal hoards.

In the case of Germany foreign balances and internal hoards account for the lion's share (approx. 80 per cent) of bank notes outside the banking system. According to Bundesbank estimates 35-40 per cent of currency balances may be held outside Germany. This implies that 40-45 per cent is internally hoarded. However, it has to be kept in mind that these estimates are tentative. Since there are better data on the outflow of US\$ bank-notes, the latest estimates of Porter and Judson (1996) are probably more reliable. They estimate foreign circulation of the US\$ to be around 50-60 per cent. Since the US\$-banknotes are much more widely accepted throughout the world than DM-notes, it can be taken for granted, that the portion of foreign balances for the DM is smaller. Therefore, it can be safely assumed that the Bundesbank estimate does at least not significantly underestimate the share of foreign DM holdings.

Internal hoards and foreign circulation of local bank-notes do not have to be a problem for monetary policy. As long as both change relatively smoothly, the informational content of currency (or aggregates which give a high weight to currency) is not impaired. However, in both cases there is a certain probability of strong shifts in currency demand. The period before the introduction of the source tax on capital income has shown that the demand for

cash can react significantly in case of tax changes. Outflows into foreign countries seem to be influenced by exchange rate movements - however to a changing degree (see Seitz 1995, 11). Furthermore, political crisis and/or a rise in inflation in foreign countries can trigger large currency outflows. Thus, in the late 1980s and early 1990s exports of US\$ bank notes first to Argentina and then to Russia surged. In 1994 and 95 Russia received an estimated US\$ billion 40 in bank notes (Porter/Judson 1996, 886).

If foreign shocks can be well observed and if the effects on the demand for currency are predictable, then monetary policy would be somewhat more difficult because narrow aggregates would be more volatile. But narrow aggregates still could serve as a useful indicator. However, if these conditions are not fulfilled it would be impossible to predict such influences on the demand for money. Consequently, the informational content of narrow monetary aggregates would be strongly reduced.

If the demand for currency is not well behaved, it is not advisable for central banks to pursue a rigid policy of monetary base targeting. The least they have to do is constantly look out for special factors in foreign countries or at home which may influence foreign demand or internal hoarding. Narrow targets like M1 are also sensitive to currency demand instability. This leaves the choice either to use wider aggregates as monetary indicators or to make deposits the prime indicator of monetary policy.

As yet, it is also difficult to predict how the demand for DM bank notes will react when the exchange of local bank notes into Euro notes approaching. It is at least conceivable that large amounts will flow back into the banking system.<sup>33</sup> Under a tight regime of base control this would lead to a strong expansion of the money supply because the banking system could use the inflowing cash as a base for credit creation. But in a system of interest rate pegging changes in the demand for cash are less of a problem. If central banks peg interest rates changes in the demand for money are mainly reflected in money

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<sup>33</sup> This 'flow' can easily become a 'flood' if proposals to use the introduction of the Euro to check for illegal currency hoards should find political support.

supply changes. Therefore, they are neutral with respect to income and prices. This is the well-known result derived by Bailey (1962) and Poole (1970). However, this result is based on the assumption that an excess supply of money leads to a corresponding excess demand for bonds or other financial assets. This assumption may be plausible in cases in which money is substituted for cash (see ch. XXX). It is less convincing when agents try to reduce internally hoarded cash balances. Owners of illegal balances which are too 'hot' to be deposited directly in the banking system may try to convert cash into whatever kind of assets can be obtained without the knowledge of the authorities (such as jewelry, art, antiques, used cars etc.). Thus, in this case, money market disequilibrium would lead to goods' market disequilibrium. So once the decision has been made to go ahead with EMU there may be a decline in currency holdings and at the same time an increase in aggregate demand.<sup>34</sup>

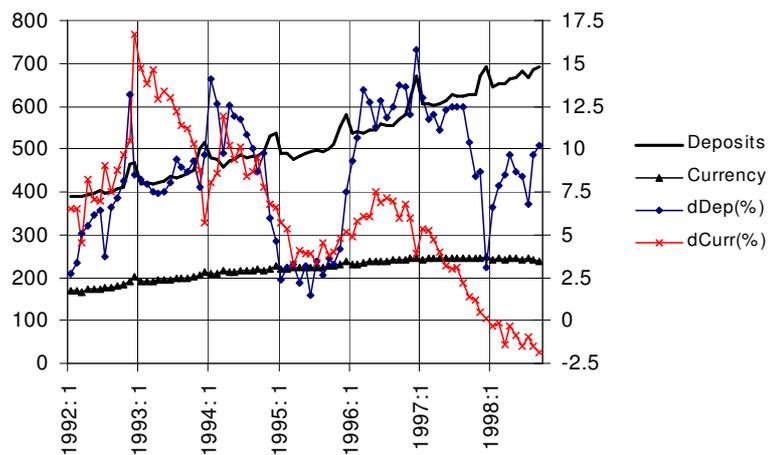
It may be argued that this problem will not be very important quantitatively. After all, cash is only a small fraction of M3, the monetary aggregate used by the Bundesbank. However, a wide aggregate like M3 does not just contain media of exchange but also short-term stores of value. Thus the cash/M3 ratio does not say very much about the significance of cash as a means of payment. A better measure is the cash to M1 ratio. This ratio has been relatively stable at around 0.3 in recent years. It shows that cash accounts for a considerable fraction of media of exchange. So, even relatively small movements out of hoards into spending could have noticeable expansionary effects. Furthermore, it is not just the amount of cash that counts but also its velocity. In the case of dishoarded illegal balances velocity may be quite high. In order to avoid taxes and inquiries about the origin of the cash sellers of goods and real assets may also try to spend the cash rather than report it as normal earnings. Thus, large amounts of cash would be handed around like a "hot potato" increasing aggregate spending. This problem is not just confined to Germany. As chart XXX shows, there are large per capita cash holdings in all EC countries. Therefore, it is likely that dishoarding and rising velocity of cash will be

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<sup>34</sup> As pointed out by Brunner and Meltzer (1993, 87-8), there is another reason why changes of the demand for money may affect income and prices under interest rate pegging. If there is more than one asset and if

observable in the entire EMU area. In the case of Germany, the demand for currency has been very sluggish lately (see chart XXX). This may be an indicator, that dishoarding is already beginning.

### Deposits and Currency 1992-1998



Source: Deutsche Bundesbank, own calculations

Under such circumstances monetary policy becomes increasingly difficult. First, there may be excess amounts of cash floating through the personal sector raising demand for consumer goods and certain types of real assets. Second, bank notes will be flowing back into the banking system. This may reduce the growth rate of narrow monetary aggregates. In the case of currency, even an absolute decline is possible. Thus monetary aggregates may lose informational content in the transition period and monetary policy will be more difficult during the period preceding and following the exchange of bank-notes.

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different assets are not perfect substitutes, money demand changes may affect relative asset prices and thus the behavior of banks and households.

## APPENDIX

The seasonal method<sup>35</sup> is based on the idea that the observable seasonal fluctuations of currency should be due to seasonal fluctuations of *transaction-balances* rather than internal hoarding or foreign circulation. Thus, the observable seasonality of currency ( $S^C$ ) can be interpreted as a weighted average of seasonal variations of transaction-balances ( $S^T$ ) and of the other components of currency ( $S^H$ )

$$(1') \quad S^C = \alpha S^T + (1-\alpha)S^H$$

where  $\alpha$  is the ratio of transaction-balances to total currency balances.

If the other components of currency do not exhibit any seasonal fluctuations at all, equation (1') can be simplified to

$$(2') \quad S^C = \alpha S^T$$

or

$$(3') \quad \alpha = S^C/S^T$$

$S^C$  is observable and if a proxy can be found to estimate the unknown seasonal fluctuation of the transaction-balances ( $S^T$ ) then  $\alpha$  can be estimated. The ratio of internal hoarding and foreign balances is simply  $(1-\alpha)$ .

The estimates of seasonal variation are derived using a slightly simplified version of the method described by the Bundesbank (Deutsche Bundesbank 1987). For the period 1960-94 moving 12-month averages are calculated (correcting for the jump in 1990). These are used to estimate the seasonal variation ( $S$ ) which is defined as follows:

$$(4') \quad S = \left[ \frac{\text{December value}}{\text{moving average}} - 1 \right] - \left[ \frac{\text{January value}}{\text{moving average}} - 1 \right]$$

December and January have been chosen, because the December is the month with the highest circulation of cash and January is the month with the lowest circulation of cash (relative to the moving average). Therefore, the first term on the right-hand side of (4') is usually positive and the second term is negative. The difference between the two yields *yearly* seasonal fluctuations. Since these fluctuations are highly volatile, a moving 7-year average is calculated, in order to get a better view of the medium- and long-term changes.

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<sup>35</sup> See Seitz (1995), 28 and Porter and Judson (1996), 891.

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