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SUMMARY

Study on currency requirements in Germany

Introduction

In 2002 the Federal Ministry of Finance asked the Deutsche Bundesbank to present a study on currency requirements in Germany. This study is intended to contain a macroeconomic analysis of the quantitative development of cash, as well as qualitative aspects which could influence currency requirements. This includes behavioural changes in connection with the introduction of euro banknotes and coins but also more long-term changes in the population's payment habits and currency holding habits, such as the increased use of card-based payment instruments. The intention is to identify these developments and forecast their impact on currency and, in particular, coin requirements. The study focuses on the development of coin requirements because the Federal Ministry of Finance, which issues the coins, has a particular interest in this.¹ The study aims at an improvement of the quality of the forecast so that it can be used as the basis for medium-term production planning. If we are able to estimate coin requirements more accurately in the future, we can reduce risks related to planning the Federal budget and enable coin production planning to be more closely orientated to actual demand than in the past. In addition, the Federal Court of Auditors also proposed to the Federal Ministry of Finance that a concept for future minting volumes should be developed. With the aid of longer-term requirement planning, the intention is to avoid excess euro coin stocks and provide the

¹ Pursuant to Article 106(1) of the EC Treaty (Treaty establishing the European Community), "the ECB (shall have) the exclusive right to authorise the issue of banknotes in the Community. The ECB and the national central banks may issue such notes". The member states hold the coinage prerogative, that is, the right to mint coins (Article 106(2) of the EC Treaty).

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mints with an idea of the orders they can expect.² On this basis, the mints could stabilise production planning and utilise their production capacities more evenly.

Main findings of the forecast

After initial return flows during the first few months, the demand for German euro coins increased noticeably over the course of the past year. At the end of April 2002, an all-time low of 8.6 billion coins with an approximate value of €2.9 billion were in circulation. By the end of March 2003 the figure had risen to 12.1 billion German euro coins with a total value of approximately €3.65 billion. This represents an increase of two-fifths in the number of German euro coins in circulation within the period of eleven months, with the value of German euro coins in circulation increasing by roughly a quarter.

According to the results of this study, a further substantial increase in the number of coins in circulation can also be expected this year and in 2004. The main reason behind this is the ongoing accumulation of private coin hoards which currently represents the driving force behind the demand for coins. However, this element of coin requirements only has a short-term impact. As coin hoards become increasingly saturated, a distinct slowdown in the growth rate can be expected.

In the long term, the growth rates for German euro coins in circulation should drop noticeably. On the basis of econometric analyses, this study predicts a decline to the range of 1% to 3% annually. Thus the long-term forecast for the growth rate of the German euro coins in circulation roughly corresponds to the trend observed in the second half of the 1990s, although it is below the pre-reunification level in western Germany. This is mainly due to the increase in card-based forms of payment, which by nature cover exact amounts, and the resulting reduction in currency, as well as weaker growth in nominal consumer spending.

The estimate for the year 2007 shows a **prediction interval for the total amount of German euro coins in circulation** ranging between a **lower limit of 17.7 billion coins at a value of €4.6 billion** and an **upper limit of 18.6 billion coins at a value of approximately €4.9 billion**. This amounts to an increase of between 5.6 and 6.5 billion

² See Federal Court of Auditors (2002), p 140 f.

coins (46% to 54%) on the level at the end of March 2003. According to this estimate, the total value of coins in circulation would increase by €1.0 to €1.3 billion (27% to 34%). The actual figure achieved within this corridor depends primarily upon the development of nominal consumer spending and the further use of non-cash payment forms, such as credit, debit and prepaid cards, in the coming years. Production planning must also take into account the **need to replace** coins which are no longer fit for circulation and have been withdrawn. On the basis of experience from the Deutsche Mark era, this component is estimated at **close to 200 million coins** in the period up to 2007.

Results of the study in detail

1 From D-Mark to euro - facts about currency development in Germany

In view of the short statistical reference period for the euro which, on its own, does not provide a sufficient basis for longer-term forecasts, in the first stage of the analysis we take a retrospective look at the development of the D-Mark currency. This retrospective study, which extends across more than five decades, illustrates the main determinants, as well as disruptive factors and structural breaks during the era in which D-Mark coins were in circulation. In particular, considerable temporary disruptions were caused by the exchange of D-Mark coin series (1958, 1973 and 1975). Special factors triggered, for instance, by the cigarette industry's vending machine sales, also had a temporarily distorting effect on coin circulation. In addition, the 1948 currency reform and German unification in 1990 are examined closely as two events which are most comparable to the introduction of euro banknotes and coins.

The long-term analysis clearly shows that the DM coin circulation, which had grown steadily since the 1950s as a result of increasing transaction needs in West Germany, was increasingly curbed by innovations in payment systems. Alongside a substitution of cash and at least a partial substitution of coins, the use of exact change to pay generally unrounded retail trade prices also played a decisive role. Until roughly the beginning of the 1980s, growth continued at a notably constant rate of approximately 7%. In the 1980s, for the first time there was a marked slow down in coin growth. Between 1982 and 1989 coin circulation increased at an average annual rate of only 4.8%. The extension of the D-Mark zone in consequence of the reunification in 1990 resulted in a surge in the demand for

currency and marked the beginning of a further structural change in this demand. Even though the accumulation of money hoards in eastern Germany has continued, coin circulation growth rates have dropped gradually since 1992. In the second half of the last decade the growth grounded to a halt at times, which meant that between 1992 and 2000 coin circulation grew at an average rate of only 2.1%.

The reasons behind the shift in coin requirements lie in the trend towards flatter macroeconomic growth and changing payment habits (initially increases in payments by cheque and later by card). The fact that this trend strengthened from 1992 onwards indicates that coins were increasingly being substituted by other payment instruments when settling transactions. This is also evident from the development of the velocity of D-Mark coins in circulation (ratio of domestic product to coins in circulation). Whilst this variable was initially relatively constant from the mid-1970s onwards, after German unification it increased steadily. This trend persisted until the end of the D-Mark era and it could increase even further in the future as a result of a further use of card payments.

The structure of D-Mark coin circulation remained relatively stable when viewed over the long term. The ratio of individual coin denominations changed considerably less than that of banknotes. The four highest coin denominations dominated in terms of value, whilst in terms of volume, the four smaller denominations were by far more prominent. The proportion of coins in the entire circulating D-Mark currency also remained remarkably stable. Without taking into account large denomination D-Mark banknotes (DM1000, DM500 and DM200 notes), which did not play any noteworthy role in the settlement of domestic transactions, from the beginning of the 1970s to the end of the D-Mark era this ratio fluctuated within a narrow range of approximately 8% to 9%, although a proportion of the D-Mark coins brought into circulation since the currency reform could no longer be classified as coins available for active use.

The collecting and the steady loss of coins mean that a proportion of coins are withdrawn from the economy. Over time this increasingly affected the amount and the structure of the D-Mark coins in circulation. Theoretical sample-based calculations lead to the conclusion that, depending on the denomination, the losses annually accounted for between almost 1% and approximately 4% of the D-Mark coins in circulation. Owing to the long life span of the D-Mark coin series, these losses accumulated over many years. Furthermore, a certain

share of DM2 and DM5 coins from earlier series were not returned to the Deutsche Bundesbank at the end of the D-Mark era. Statistics therefore considerably overstated the number of coins in circulation when compared with effective coin requirements.

When euro banknotes and coins were introduced in Germany, these permanent coin losses had to be taken into consideration, as did the structural changes in coin requirements stemming from the fact that the denominational structure of the banknotes and coins, as well as their purchasing power, changed with the currency changeover. Thus, for example, a €2 coin has approximately double the purchasing power which the DM2 coin previously had. An assessment of these structural influences on euro currency requirements is still fraught with considerable uncertainty even in the light of present knowledge. This was even more so during the run-up to the introduction of the euro. The initial euro stock requirements deemed necessary to replace the D-Mark coins in circulation in 2002 were therefore determined with the aid of three individual estimates (valuation, transaction and reunification approach). An additional 10% sum was also calculated to take account of potential disruptions during the introduction of the euro. Overall, on the basis of estimated requirements, approximately 15.5 billion coins with a value of roughly €4.8 billion were calculated to cover the initial stock requirements, as well as a logistical stock of 1.5 billion coins with a value of €0.5 billion.

The currency changeover in Germany was effected rapidly and, by and large, smoothly. By the end of 2001, €4.3 billion (12.4 billion coins) had been frontloaded. In the first few days of January 2002 further coins were put into circulation, reducing the logistical stock of some denominations to a small amount. However, considerable return flows of coins subsequently occurred. The lowest level of coins in circulation was at the end of April (€2.9 billion). Coin circulation did not begin to rise again until May 2002. At the end of March 2003, 12.1 billion German euro coins with a total value of €3.65 billion were in circulation. This corresponds to a two-fifths increase in the number of coins in circulation within the period of eleven months. The value of the German euro coins in circulation rose by roughly one quarter during this time.

If, as an expedient, the seasonal influences on the coin circulation are smoothed with the seasonal factors observed during the D-Mark era, we can see a slight levelling off of the very rapid growth in the number of German euro coins in circulation. This trend is expected

to strengthen in the coming months. The growth rate also appears relatively high compared to the developments in the rest of the euro area. Since May 2002, the monthly increases in the amount of German coins in circulation have, on average, been more than twice as high as increases in the euro area excluding Germany. Consequently, the proportion of German euro coins in circulation to all euro coins circulating, which had fallen perceptibly in the first months after the introduction of euro banknotes and coins, increased to approximately 29%.

A comparison of the German euro coin circulation with the D-Mark era indicates a shift in trend. Whilst the average value of a D-Mark coin in circulation after reunification, adjusted for estimated coin losses, was approximately 33 Pfennig, at 30.1 cent (59 Pfennig) the mean value of euro coins in circulation at the end of March 2003 was almost twice as high, although the trend was downwards. By contrast, at 6.2% the ratio of coins in circulation in Germany to the currency stock for every-day transactions (banknotes and coins in circulation less €100 to €500 notes), has already reached the corresponding ratio observed during the D-Mark era of approximately 6¼% (in relation to the coin circulation which was adjusted for lost and recalled coins).

Finally, it is also worth noting the development of the remaining D-Mark coins in circulation which, alongside the sample survey mentioned, provided a further yardstick of the ultimate D-Mark coin losses. By the end of March 2003 D-Mark coins (less special issue and commemorative coins) at an estimated value of close to €2.0 billion had still not returned from circulation. This corresponds to approximately 32½% of the total value or 50% of the total number of D-Mark coins in circulation in 2000.

2 Attitudes and behavioural patterns after the introduction of euro banknotes and coins: results of a public opinion survey

The transition from the D-Mark to the euro was met with a very positive response from the general public. The question therefore arises of whether, and if so to what extent, this watershed will affect the population's payment habits. In order to investigate this question the Deutsche Bundesbank commissioned a representative survey of public opinion, the results of which are explained in this study.

This survey showed that the majority of people questioned accepted the new currency. This is particularly the case with regard to banknotes, with which 75% of those questioned are satisfied, whereas only 57% accept coins. Only a minor section of less than 14% continue to have difficulty identifying with the new currency. The criticism expressed of the currency relates primarily to the external features of the coins. Many of those questioned stated that they still had problems telling the coins apart. Other external criteria are more commonly stated as reasons for rejection, such as too thick, too heavy, too quickly worn - the latter also in the case of banknotes. In contrast, those questioned are very satisfied with the variations in denomination, both for banknotes and coins. A minority - less than 4% - regretted the absence of a €5 coin. A negligible minority of less than 1 percent would like a €1 or €2 note.

The answers given to questions about paying the exact amount cast doubt on any lasting behavioural change in payment habits. Although the majority of people questioned on this issue answered in the affirmative, the retail trade estimates that just as many payments are made in the exact amount as previously. Nor does the group which endeavours to pay with "exact change" carry significantly fewer coins, in terms of number and value, than those who do not. Consequently there is much to indicate that the answers are, in part, determined by what is assumed to be socially desirable behaviour.

The number of hoarders has increased slightly in comparison with the D-Mark era. However, whilst D-Mark coins were often taken out of wallets to make them lighter, the main reason is now one of saving. Considerably fewer people said they collected coins than saved them. The majority of those who collect coins are aiming to put together an entire set of all euro coins. When they have achieved this aim, they intend to stop collecting. The proportion of people who intend to continue collecting coins in the long term is very small.

Of the people surveyed, those who hoard coins more often consider it difficult to tell them apart and apparently have problems using them for payment transactions. This group is particularly dissatisfied with the smaller denominations. Such coins are then "compulsorily" hoarded.

The question about when people dissolve their hoards produced three different answers. One-third dissolves the stock collected within a year, one-third at irregular intervals and the last group within a period of three months or less. In this context, the results indicate a connection between the size or the value of the hoard and when it is dissolved. The greater the value of the coins or the number of small coin denominations hoarded, the more often the stocks are dissolved.

Whilst those surveyed state that they tend to carry fewer banknotes, the opposite appears to be so in the case of coins. It is, however, unclear whether this is a subjective impression resulting from the greater weight or whether more coins really are carried due to a particular unwillingness to use small coins in payment transactions. However, there is no evident intentional reduction in the number of coins held. Nevertheless, this might occur in the future when those who currently only pay in cash increasingly use card-based payment instruments. Whilst there was hardly any difference in the number and value of coins carried by the groups using their cards with varying frequency, those who pay in cash carried significantly more coins on them.

3 Consequences of the development of card-based payment instruments for coin requirements

In chapter 3 we discuss the medium-term impact of the use of credit and debit cards, as well as card-based electronic money (GeldKarte in Germany), on coin requirements. For one thing, the transaction-related need for coins ensues from the payment of low-priced goods or services and at vending machines; in such cases coins can be substituted by electronic money. The average value of a payment with electronic money is already approximately €2.15 and therefore corresponds to a typical payment with coins. For another, a demand for coins arises from the uneven retail prices which definitely result in a need for coins, whether it be on the part of the customer (payment in the exact amount) or the retailers (change). Payments made by credit, debit or electronic money cards are always in the exact amount and therefore no coins are needed.

In Germany there is still a strong preference for cash payments. Alongside the public's "inertia" with regard to changes in payment habits and the anonymity of paying in cash, the main reason probably lies in the fact that the costs of cash payment transactions in the

retail and banking industry are not passed on directly to the customers. The customers' preference for paying in cash could change accordingly if the retail trade and banking industry were to pass on to the customers directly the costs incurred in cash and non-cash payment transactions depending on the amount and the payment instrument.

Nevertheless, measured in terms of retail trade turnover, cash payments went down from just over 76½% to almost 67% between 1997 and 2002 (source: EHI-EuroHandelsinstitut, Köln). In the same period card-based instruments as a whole (credit, debit and retailer cards) increased their share from 14½% to 29½%, the rise being due almost exclusively to debit cards (their share increased from 10½% to over 23%). In 2001 a total of around 1.2 billion payments at a value of approximately €90 billion were made in Germany using debit cards; in both respects this is almost double the amount in 1998. Continued high, albeit gradually decreasing, growth rates can be expected. In the last few years there has been a comparatively moderate increase in the use of credit cards in the retail trade, as well as other areas where cash payments do not appear to be suitable (hotels, rental cars).

Chapter 3 highlights the most important supply and demand determinants of payments with credit and debit cards and presents an international comparison of the use of these cards. It is worth noting that the number of transactions per inhabitant is distinctly less than the international average for both credit cards and debit cards. If one considers the spread of cards and accepting respective POS terminals as possible reasons for this below-average transaction frequency, one arrives at a conflicting picture: the number of credit cards is below the international average and the relative number of accepting terminals - in relation to the EU average³ - is above it, whereas the opposite is the case for debit cards. According to empirical analyses, the spread of debit card terminals has had a significantly negative effect on the circulation of banknotes and coins.

At the same time, the average value per credit and debit card transaction is above average. If the German figures were moving towards the international averages, we can expect a fall in the overall number of cash payments, as well as in the amount of change required as a result of card payments in the exact amount.

Electronic money, which is effectively only available on a card basis, is stagnating at a low level. At the end of 2002, the equivalent of approximately €70 million in electronic money was stored on cards in Germany (in the euro area the figure was €240 million). As debit cards in the form of ec cards were very often also equipped as electronic money cards, by international comparison electronic money cards are also more widespread in Germany than on average. In contrast, the density of purchase terminals for electronic money in Germany - like that of debit card terminals in Germany – is significantly behind that of other comparable countries. We cannot expect to achieve a “critical mass” and reach a general breakthrough in the short term. Security concerns, inadequate information and insufficient opportunities for use have so far had a visibly dampening effect on the use of e-money. However, increasing familiarity with card payments in general and the on-going adaptation of vending machines (eg in the course of the planned introduction of an age-verification system for cigarette vending machines by 2007 at the latest) and other terminals in the retail trade mean that we can also expect sharp rises in electronic money over the next few years.

4 The impact of hoards and transactions on coin requirements

In the long term the development of coin holding habits in Germany can primarily be explained by transaction motives, the substitution processes between cash and non-cash payment transactions and certain replacement needs for lost coins. The short-term surge since the introduction of euro banknotes and coins is primarily being driven by private households replenishing coin hoards that were depleted in the wake of the currency changeover from D-Mark to euro. Alongside this, other factors also play a potential role, in particular other countries (coin migration within the euro area and out of the euro area) and coin losses which have gradually begun to occur. These factors are examined more closely in chapter 4.

Determining how many coins are being hoarded involves considerable estimation risks. Nevertheless, on the basis of the survey carried out on behalf of the Bundesbank, a reference variable can be calculated for their impact on euro coin requirements. An extrapolation of the survey results using models shows that at the end of a saturation

³ The average of the CPSS countries (G-10 plus Hong Kong and Singapore, see chapter 3) is unduly high because of the USA. If the USA is discounted, the average in Germany should largely correspond to the

period roughly 7 billion euro coins with a total value of close to €1.7 billion could be held in temporary coin hoards. In addition, there is the inflow to permanent hoards that will virtually never be dissolved. On the basis of the survey, an approximate amount of €40 million a year is estimated, with this conclusion being based on a small number of answers. In this context one must also bear in mind that the large amount of coins currently put aside will probably be returned in the long term.

By modelling the inflows and outflows of the hoards over time, it can be seen that the dynamics of the euro coin circulation has primarily been determined by the accumulation of hoards. However, in the coming years this factor is expected to make a far smaller contribution to growth as stocks of coins were dissolved and returned to the flow of money via banks or other channels. According to this indicative model calculation, at the end of 2002 the value of the total stock of coins set aside (temporarily and permanently) was close to €1.2 billion. It is estimated that this amount could increase by roughly €400 million by the end of 2003 and by approximately another €150 million by the end of 2004. In the following years, the temporary accumulation of hoards is expected to have hardly any impact as the transfer of coins to hoards is increasingly offset by the dissolution of hoards.

In the long term the transactions motives are likely to have the greatest impact on coin requirements. Based on an extrapolation of the survey results, it is also possible to estimate the amount of euro coins demanded by private households in Germany for transaction purposes. According to this calculation, on average the German population (from the age of 14) carries coins to the value of €5.62 per capita. For the German population aged 14 and above this works out at close to €400 million or 11½% of the coin circulation in November 2002. If short-term stocks of hoarded coins are added to this, the value of coins required by private households for transaction purposes, extrapolated on the basis of the survey, increases by approximately €160 million. It would then account for roughly one-sixth of the coin circulation.

This does not take into account the transaction needs of the retail trade, vending machine sector, banks, the public sector and private companies. As no statistics have been collected for these stocks in Germany, the amount of the aggregate transactions balance has been estimated with the aid of the "seasonal procedure". However, it was only possible

"adjusted" CPSS average.

to apply this method for the D-Mark era. The results showed that until approximately the mid-1980s the estimated value of the transactions balance was relatively stable, whereas after German reunification the weight of the transactions balance tended to increase, particularly in respect of larger denominations (DM2 and DM5 coins). The main reason behind this change appears to have been diminishing hoarding habits, particularly in eastern Germany. The estimated D-Mark transactions balance findings can only be broadly applied to the demand for euro coins. Ultimately such an extrapolation confirms the hypothesis that the coin circulation observed in April 2002, taking into account a certain proportion of coins which have already been hoarded, was very close to the requirements for macroeconomic transaction purposes in Germany.

5 Econometric study of the demand for coins

An econometric approach is indispensable for the quantitative forecast for coin circulation. This analysis was carried out in several stages. As the demand for coins in Germany was also shaped by extraordinary events - in particular reunification - an internationally comparative panel study for the period from 1990 to 2000 was initially carried out for other euro-area countries.

The analysis of the demand for coins in the other euro-area countries confirms the theory that, over the medium to longer term, the demand for coins can primarily be explained by the volume of transactions. Although the coin hoards accumulated over the course of time, alongside coins which have disappeared, constitute a considerable proportion of the aggregate coin circulation, ultimately it would appear that the formation of hoards is also a phenomenon related to the transactions balance. The longer-term growth in coin circulation is primarily determined by the nominal economic development, represented by private consumption or gross domestic product, with both the increase in the price components as well as the actual rise in the real transaction volume leading to increased circulation. However, the need for coins for the transactions balance falls as the number of cash payments decreases. Thus the rising number of card payments replaces the use of both banknotes and coins. Short-term opportunity costs only play a minor role in the holding of coins both for transaction and hoarding purposes.

Using the results of the panel study as a basis, an econometric model for the demand for D-Mark coins was developed. This model also serves as the basis for the medium-term forecast for the German euro coin circulation. The first stage was a range of pre-test estimates based on annual data used to investigate the particular features of coin holding in Germany. In addition to the panel approach, in view of the more comprehensive statistical material available for Germany, an investigation was also carried out into the role of other possible influences, such as retail trade turnover or cigarette sales, for which a longer estimation period (1972 to 2000) was available. Private consumer spending has also proved to be a highly significant transaction variable in this respect, albeit limited to areas where cash payment (still) dominates or is widespread. In contrast to the aggregate consumer spending, this does not include spending on rent, household energy and other items which are almost entirely settled in non-cash form and which tend to account for an increasingly large share of consumer spending.

In the area of electronic payment media, the impression gained from the panel survey that card payments are having a considerably negative effect on the demand for currency has been confirmed. The evaluation of alternative estimates showed that the negative impact on coin circulation can best be quantified with the aid of the number of card transactions and that the transaction turnover was only of minor value in explaining this.

After selecting the main explanatory factors (nominal private consumption, sum of credit and debit card and Geldkarte transactions) and taking into account temporary special factors, this study ultimately specifies an error correction model for the D-Mark coin circulation that illustrates both the long-term structural relationships and the short-term dynamic adjustment processes. This econometric model is based on seasonally adjusted quarterly data for the reference period from 1972 to 2000. An ex-post forecast carried out for the 5-year period from 1996 to 2000 as a crosscheck for the model specification emphasised the model's positive explanatory and forecasting properties. The overall conclusion to be drawn from the econometric study is that the sharp downturn in the growth of the D-Mark coin circulation in the 1990s primarily reflects the slowdown in consumer spending and the widespread proliferation of card-based payment forms, particularly debit cards.

6 Forecast for the German euro coin circulation up to 2007

The long-term forecast for the circulation of German euro coins was developed in a two-stage procedure. The first stage consisted of producing a forecast for the aggregate coin circulation up to 2007 with the aid of the econometric model developed in chapter 5. This econometric-based projection is partly based on the optimistic and pessimistic assumptions concerning the development of nominal consumer spending and payment transactions with credit and debit cards and Geldkarte. In addition, various structural breaks as a result of the transition from D-Mark to euro were incorporated, including revisions of the ultimate D-Mark coin losses, the change in coin denominations and the impact of coin collections. Taking into account a margin of uncertainty for the forecast, the conclusion of the estimate is that by the end of 2007 the coin circulation will be within the range of €4.5 to €5 billion. The long-term trend growth is expected to lie within a range of roughly 1% to 3%.

However, this econometric-based projection only presents a medium-term frame of reference for the aggregate value of the coins in circulation. Moreover, at the present juncture, coin circulation is still widely off this corridor. The main reason for this is that the accumulation of temporary and long-term coin hoards is still prompting rapid growth in the number of coins in circulation. Thus, in a second stage of analysis, with the aid of a special growth curve (the Brody growth curve) for each coin denomination and assuming a long-term trend growth of between 1% to 3% in the value of coins in circulation, a specific path of development was calculated up to the end of the forecast period. The result showed a corridor of between €4.6 and 4.9 billion for the value of coins in circulation in 2007. This narrows down the econometrically calculated forecast variation range. The projection shows a forecast interval of 17.7 to 18.6 billion for the number of German coins in circulation in 2007. In comparison to the situation in March 2003, this corresponds to a growth of 5.6 billion to 6.5 billion (46% to 54%) in the number of coins. The value of coins in circulation is expected to increase by €1.0 to 1.3 billion (27% to 34%).

The table below provides an overview of the forecast figures broken down according to the individual denominations. This shows that coin circulation growth is still expected to be in double figures in 2003 and 2004. The main reason for this is the rapid accumulation of private hoards of coins. However, as these hoards become increasingly saturated, the growth rate is expected to slow down significantly. As a result of the adjustment model, the long-term trend growth (1% to 3%), which is derived from the econometric estimate and

which underlies the projections, will not quite be reached by the end of the projection period. However, the growth in value of the aggregate euro coin circulation is expected to fall to a range between 1.8% and 3.6% (coins in circulation: +2.6% to 4.4%) by the end of 2007, and will probably continue to fall thereafter. Over the next few years there will be a shift in the denomination structure towards smaller coin denominations.

Forecast development of the circulation of German euro coins up to 2007

Development of the value of euro coins in circulation, broken down by denomination
in €million, annual averages*

	total		2		1		0,5		0,2		0,1		0,05		0,02		0,01	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to
2002	3221	3221	1,479	1,479	823	823	417	417	237	237	140	140	74	74	33	33	18	18
2003	3827	3833	1,754	1,757	970	972	464	465	297	298	171	171	97	97	46	46	28	28
2004	4224	4263	1,926	1,945	1,079	1,087	494	500	326	330	195	196	112	113	55	56	36	36
2005	4435	4532	2,013	2,059	1,143	1,165	510	523	337	347	210	213	120	122	60	62	41	42
2006	4556	4731	2,062	2,144	1,182	1,222	519	541	343	359	218	225	124	129	63	65	45	46
2007	4637	4902	2,094	2,218	1,208	1,270	526	559	347	371	224	235	127	134	64	68	46	49

Annual percentage growth rates, annual averages

	total		2		1		0,5		0,2		0,1		0,05		0,02		0,01	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to
2003	18.8%	19.0%	18.6%	18.8%	17.8%	18.1%	11.1%	11.4%	25.3%	25.5%	22.4%	22.5%	30.0%	30.2%	41.0%	41.2%	51.2%	51.3%
2004	10.4%	11.2%	9.8%	10.7%	11.2%	11.9%	6.6%	7.5%	9.7%	10.8%	14.1%	14.7%	15.8%	16.6%	20.7%	21.5%	29.7%	30.3%
2005	5.0%	6.3%	4.5%	5.9%	5.9%	7.1%	3.1%	4.6%	3.5%	5.1%	7.4%	8.5%	7.0%	8.3%	9.0%	10.3%	14.5%	15.6%
2006	2.7%	4.4%	2.4%	4.1%	3.4%	4.9%	1.8%	3.6%	1.7%	3.6%	4.2%	5.6%	3.5%	5.1%	4.3%	6.0%	7.5%	9.0%
2007	1.8%	3.6%	1.6%	3.4%	2.2%	3.9%	1.3%	3.2%	1.2%	3.2%	2.6%	4.3%	2.1%	3.9%	2.4%	4.2%	4.2%	5.9%

Development of the number of euro coins in circulation, broken down by denomination
in million pieces, annual averages*

	total		2		1		0,5		0,2		0,1		0,05		0,02		0,01	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to
2002	9941	9941	739	739	823	823	834	834	1186	1186	1397	1397	1488	1488	1629	1629	1845	1845
2003	12991	13008	877	878	970	972	927	929	1485	1488	1710	1712	1935	1937	2297	2300	2790	2792
2004	15242	15361	963	972	1079	1087	988	999	1630	1650	1951	1963	2240	2257	2771	2794	3618	3638
2005	16512	16836	1007	1030	1143	1165	1019	1045	1687	1734	2096	2130	2398	2445	3020	3081	4142	4206
2006	17235	17842	1031	1072	1182	1222	1038	1083	1716	1796	2184	2250	2482	2571	3149	3265	4453	4584
2007	17681	18623	1047	1109	1208	1270	1051	1118	1736	1854	2240	2346	2533	2671	3224	3403	4640	4853

Annual percentage growth rates, annual averages

	total		2		1		0,5		0,2		0,1		0,05		0,02		0,01	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to
2003	30.7%	30.9%	18.6%	18.8%	17.9%	18.1%	11.1%	11.4%	25.3%	25.5%	22.4%	22.5%	30.0%	30.2%	41.0%	41.2%	51.2%	51.3%
2004	17.3%	18.1%	9.8%	10.7%	11.2%	11.9%	6.6%	7.5%	9.7%	10.8%	14.1%	14.7%	15.8%	16.6%	20.7%	21.5%	29.7%	30.3%
2005	8.3%	9.6%	4.5%	5.9%	5.9%	7.1%	3.1%	4.6%	3.5%	5.1%	7.4%	8.5%	7.0%	8.3%	9.0%	10.3%	14.5%	15.6%
2006	4.4%	6.0%	2.4%	4.1%	3.4%	4.9%	1.8%	3.6%	1.7%	3.6%	4.2%	5.6%	3.5%	5.1%	4.3%	6.0%	7.5%	9.0%
2007	2.6%	4.4%	1.6%	3.4%	2.2%	3.9%	1.3%	3.2%	1.2%	3.2%	2.6%	4.3%	2.1%	3.9%	2.4%	4.2%	4.2%	5.9%

*2002: April-December 2002 average

The additional demand for coins arising in Germany up to 2007 is largely, but not exclusively, determined by the increase in coin circulation. Replacement requirements for coins that have been withdrawn by the Deutsche Bundesbank because they are no longer fit for circulation must also be taken into account. On the basis of experience from the D-Mark era, this is estimated at close to a total of 200 million coins by 2007.

The forecast figures shown here are subject to a range of assumptions and risks. The main factors which could lead to higher circulation include the possibility, which is unlikely but

nevertheless cannot be excluded, of a cross-border net outflow of German euro coins. International cooperation in the form of an analysis of representative surveys and studies on the cross-border migration of coins is required; without it, a reliable estimate of this impact is not possible. In addition, massive immigration in the wake of the eastward enlargement of the EU could lead to an increased demand for coins in Germany. On the other hand, the downside risks of the forecast arise, in particular, from the potential for substitution by card-based payment forms. Although the corridor specified for the projections attempts to account for the risks in both directions, it cannot cope with unforeseeable, severe structural breaks such as repeatedly occurred during the D-Mark era. These structural risks and the fact that, a year after the introduction of euro banknotes and coins, coin hoarding and usage habits (and their determinants) in the euro era can still not be reliably empirically measured, mean that it will be necessary to update the projected requirements at regular intervals. For the first two years a short interval of six months would seem to make sense to us. This could then be followed by annual updates.

For the period after 2007 a comprehensive reassessment of coin requirements will be necessary because, from this year on, all publicly accessible cigarette vending machines nationwide should be equipped to accept alternative non-cash means of payment. Moreover, by this time a decision should have been reached about a possible change in the banknote or coin denominations (introduction of a €1 and €2 banknote and/or a €5 coin). However, irrespective of this, we should work towards structuring coin planning and production more flexibly so that we can react quickly to any fluctuations in requirements which may emerge.