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## Cash usage in Finland: How much can be explained?

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# BANK OF FINLAND DISCUSSION PAPERS

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10 • 2002

Heli Paunonen – Hanna Jyrkönen

Financial Markets Department

5.6.2002

## Cash usage in Finland – How much can be explained?

Suomen Pankin keskustelualoitteita  
Finlands Bank diskussionsunderlag

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The views expressed are those of the authors and do not necessarily correspond to the views of the Bank of Finland.

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# Cash usage in Finland – How much can be explained?

Bank of Finland Discussion Papers 10/2002

Heli Paunonen – Hanna Jyrkönen  
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## Abstract

The electronification of retail payments has been rapid in Finland. The use of payment cards and credit transfers is very common. However, cash is still used quite widely, especially for small value purchases. There are no statistics available on values or numbers of cash payments, because cash is in open circulation and so it is impossible to trace all cash transactions. In this study we investigate cash usage during the period 1995–2000 and assess the share of cash usage that cannot be explained. According to our findings, the share of unexplained cash usage amounted to about one-half of currency in circulation in 2000. However, with the recent conversion to euro cash, we have additional information on cash usage. Using this new information, we find that the unexplained share of cash usage was less than one-third in 2000. Cash usage has recently been examined by the central banks of Norway and Sweden. We thus compare the results of three central bank studies. In addition, we discuss the euro cash changeover and the extra information now available on cash usage.

Key words: cash usage, euro cash changeover

# Käteisen käyttö Suomessa

Suomen Pankin keskustelualoitteita 10/2002

Heli Paunonen – Hanna Jyrkönen  
Rahoitusmarkkinaosasto

## Tiivistelmä

Vähittäismaksujen maksaminen elektronisesti on lisääntynyt Suomessa nopeasti. Etenkin maksukortit ja tilisiirrot ovat suosittuja maksutapoja. Käteisellä maksaminen on kuitenkin edelleen yleistä etenkin, kun on kyse pienistä maksuista, mutta tilastoja käteismaksujen arvoista tai lukumääristä ei ole olemassa. Käteinen on ainoa täysin anonyymi maksutapa ja avoimessa kierrossa, joten kaikkia maksutapahtumia ei voida jäljittää. Tässä tutkimuksessa selvitämme käteisen käyttöä Suomessa vuosina 1995–2000. Tuloksemme mukaan käteisen käytöstä jää selittämättä noin puolet vuonna 2000. Käteisen euron käyttöönotto tarjoaa kuitenkin poikkeuksellista lisätietoa käteisen käytöstä, ja tämän tiedon pohjalta käteisen käytöstä jää selittämättä alle kolmasosa vuonna 2000. Samankaltainen tutkimus on tehty myös Norjan ja Ruotsin keskuspankeissa. Vertaamme työssämme näiden kolmen tutkimuksen tuloksia sekä luomme katsauksen eurokonversion käteisen käytöstä tarjoamaan lisätietoon.

Asiasanat: käteisen käyttö, eurokonversio

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# 1 Introduction

In Finland the electronification of retail payments has progressed rapidly during the past decades. The ratio of currency held by the public to GDP is the lowest among the EU countries, ie 2.3% in 2000. However, it is clear that cash is still widely used, as the flow-through rate<sup>1</sup> is quite high. An interesting question here is whether cash will continue to play an important role in our society in the future. If there were cost-effective and easy-to-use payment methods to substitute for cash, the use of cash would probably decrease. However, since cash is in open circulation and is the only truly anonymous means of payment, there will remain a demand for cash for use in certain kinds of transactions.

The value of currency in circulation has been increasing over the years and the share of large-denomination notes is quite high. The two largest notes, FIM 500 and FIM 1000, accounted for ca 50% of the value of currency outstanding at end-2000. This is somewhat surprising, because the electronification of retail payments has been very rapid since the beginning of the 1980s. Consumers and merchants are very familiar with card payments, debit cards being particularly popular for retail payments. Bill payments too are mostly cashless in Finland, and credit transfers via ATMs and Internet are very popular. In 1999 the number of credit transfers per capita was 100 and the number of card payments was 63. Corresponding averages for EU countries were 45 credit transfers and 29 card payments. Also hoarding, ie storing money at home, is thought to be at a low level in Finland (Boeschoten 1991 and 1992; in Snellman, Vesala and Humphrey 2000). Since they are presumably not commonly used in retail payments, one might wonder what large-denomination notes are used for.

The aim of this paper is to study cash usage in Finland in 1995–2000 – more specifically, to determine the distribution of cash across various activities as well as the part that cannot be explained. The total value of currency in circulation minus the known or estimated cash stocks is the part that cannot be directly attributed to particular activities. This ‘unexplained cash stock’ apparently includes such activities as legal person-to-person transactions, hoarding and use of cash in illegal activities. The known or estimated stocks are eg cash held by banks, companies and consumers, cash used in point-of-sale (POS)<sup>2</sup> transactions and cash held abroad. We have also estimated some stocks for which data are not available.

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<sup>1</sup> The flow-through rate gives the number of times notes in circulation on average flow to the Bank of Finland during one year. This rate, which was 6.8 in 2000, varies a lot for the different notes. In 2000, the FIM 100 banknote had the highest rate (9.4) and the FIM 1000 note the lowest (0.8).

<sup>2</sup> POS can be defined as a place (eg a supermarket or restaurant) where goods or services are delivered in return for payment - typically via cash, card or cheque. We use ‘POS sales’, ‘POS payments’ and ‘POS transactions’ interchangeably.

In connection with the euro cash changeover, special information on cash usage has become available, which makes this type of study more interesting. Markka denomination notes and coins ceased to be legal tender at the end of February 2002. Although markka notes and coins can be changed to euro at the central bank until the end of February 2012<sup>3</sup>, it is interesting to see what portion of markka notes and coins in circulation was not returned to the central bank after the transition period. It is also of interest to study the difference in values of euro vs markka notes in circulation, as this enables estimation of money that has been held abroad or hoarded. Of course, some money is lost, destroyed or held by collectors and will probably never be returned to the central bank. After studying all possible cash stocks and information available, we arrive at the value of the unexplained cash stock.

Cash usage has also been studied recently, using a similar approach, in Norway and Sweden. In the Norwegian study by Humphrey, Kaloudis and Øwre (2000), the share of illegal cash usage is estimated at about 67% in 1999, and it is felt that this will increase in the future. This study has been updated by Gresvik and Kaloudis (2001), who find that unexplained cash usage amounted to 53–63% in Norway in 2000. The Swedish study by Andersson and Guibourg (2001) finds that 45–65% of cash usage cannot be explained in 1999. According to our results, the share of unexplained cash usage seems to be quite high in Finland too – ca one-half of the total value of currency in circulation in 2000. Compared to the Norwegian and Swedish studies, the euro cash changeover provides extra information on cash usage in Finland. Using this information, the unexplained share totals less than one-third of currency in circulation.

The structure of the paper is as follows. In section 2 we describe the data that are directly available on the various cash stocks and assess certain cash stocks, eg the value of Finnish currency held abroad and the value of cash held by households. After this, we estimate the value of cash used in POS payments. Section 3 explains the additional information available in connection with the euro cash changeover. Subtracting all explained cash stocks from currency in circulation, we obtain the residual, ie unexplained cash usage. Reliability of results and possible similarities and differences between the Norwegian, Swedish and Finnish results are discussed in section 4. Conclusions are given in section 5.

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<sup>3</sup> Also some commercial banks have promised to change markkaa to euro at least until the end of 2002.

## 2 Cash usage

In this section we analyse cash usage by dividing the total cash stock into component parts. First, we present all the information available directly from databases and analyse this data. Because certain data are lacking, we assess the value of currency abroad and the value of cash held by households. In section 2.2 we estimate the share of cash used in POS payments. On the basis of these figures, we evaluate the amount of unexplained cash usage and study also the information available in connection with the euro cash changeover. Currency in circulation consists of various cash stocks, as seen from figure 1.

**Figure 1.**

### Composition of cash in circulation

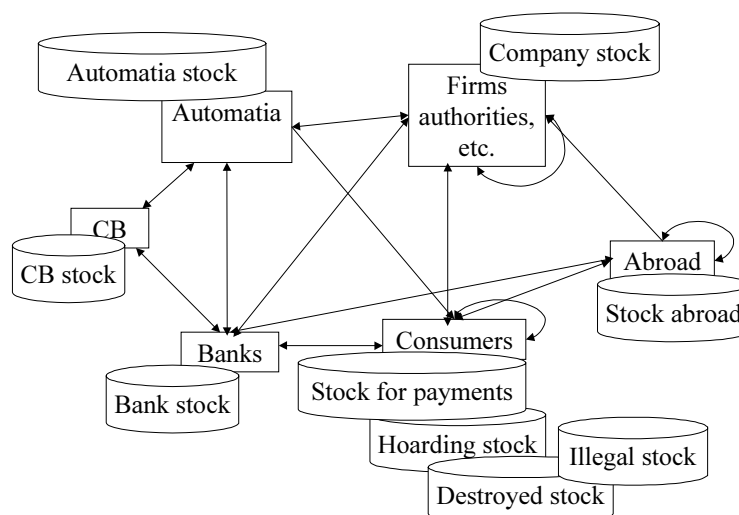
Cash in circulation (from Bank of Finland database)	Cash held by banks and Automatia Ltd	From Bank of Finland database
	Cash held by public authorities, municipalities, charities and public companies	From Statistics Finland database
	Cash held by private firms	Estimated by Statistics Finland
	Cash held by households	Calculated in section 2.1
	Cash held abroad	Calculated in section 2.1
	Consumer POS cash	Estimated in section 2.2
	Information from euro conversion	Discussed in section 3
	Unexplained residual	Unexplained residual = Total - stocks above

All of these cash stocks will be later discussed.

## 2.1 Decomposition of the measurable cash stock

In this paper certain terms are used repeatedly, so we start with a discussion of terminology. ‘Stock’ and ‘flow’ are key concepts in talking about cash. In this paper a stock refers to the total value of currency at a point in time and includes the value of notes and coins in circulation. Flow, on the other hand, refers eg to the value of POS cash payments during one year. In other words, a stock is a figure at a point in time and a flow refers to a period of time, eg the annual cumulative use of cash. To be able to compare such figures, one needs to convert flow variables to stock variables. This can be done by dividing the flow figure by an estimated turnover ratio. Figure 2 shows how cash flows from one stock into another.

**Figure 2. Cash flows between various cash stocks**



From the central bank money flows either to banks or Automatia Ltd<sup>4</sup>, which handle cash supplies in Finland. From these institutions cash flows eg to companies, authorities and consumers. Part of the money goes abroad, via either Finnish customers or foreign tourists. Consumers use cash for payments and part of the cash may be hoarded or destroyed. Part of the total cash stock cannot be explained, and part of this unexplained share may be used in illegal activities such as tax evasion and drug trade.

We have collected all the data available on the different cash stocks. This data and estimated figures for certain other cash stocks are presented in table 1.

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<sup>4</sup> Automatia Ltd is a company jointly owned by the three largest Finnish banks and it takes care of cash management and ATM network. Since October 2001 Automatia Ltd has handled all cash supplies in Finland. However, during the observation period 1995–2000 money flew from the central bank both to Automatia Ltd and banks.

**Table 1. Composition of cash in circulation, FIM m**

	1995	1996	1997	1998	1999	2000
Cash in circulation (1)	15 247	16 532	17 466	17 025	19 266	19 187
Cash held by banks and Automatia Ltd (2)	3 627	4 033	4 171	3 801	4 372	3 987
Cash held by charities, public authorities, municipalities and public companies (3)	607	585	486	514	760	225
Cash held by private firms* (4)	1 766	1 952	2 079	2 094	2 313	2 399
Cash held by households* (5)	1 413	1 425	1 435	1 453	1 459	1 464
Cash held abroad* (6)	107	116	122	119	135	134
Consumer POS cash* (7)	2 309	2 223	2 202	2 190	2 135	2 046
<b>The sum of (2) - (7)</b>	<b>9 829</b>	<b>10 334</b>	<b>10 496</b>	<b>10 170</b>	<b>11 174</b>	<b>10 255</b>

\*Estimate

The first row of table 1 gives each year's currency in circulation. These figures, as well as those in the second row, are taken from the Bank of Finland database. The second row gives the values of cash held by banks and Automatia Ltd. The third and fourth rows include data from the Statistics Finland database. Statistics Finland has collected data on various cash stocks, eg holdings of cash for each year since 1995 by government authorities, municipalities and charities. Because this is the best information available, we have chosen to limit our study to the period 1995–2000. The fourth row shows the estimated cash holdings of private companies. Statistics Finland has estimated these figures on the basis of the study by Hirvonen and Virén (1996). Statistics Finland (2000) has also studied cash holdings by households in 1998. According to their results, the average amount of cash held by a household was FIM 617 in 1998. We have multiplied this figure by the number of households in 1995–2000 and the results are presented in the fifth row of table 1.

Information is not available on markka notes and coins held abroad. According to Humphrey, Kaloudis and Øwre (2000), the stock of Norwegian cash held abroad is thought to be very small, ie about 0.7% of currency in circulation. Using the same figure, the stock of Finnish cash abroad comes to about FIM 140 million in 2000. Because of the lack of data, we have used this assumption; the values are shown in row (6). This figure may, however, underestimate the value of Finnish cash held abroad, because the flow of the Finnish cash to Russia and Estonia might have been much greater than the flow of the Norwegian cash abroad. According to Goldberg and Karimov (1992), US dollars and Finnish markkaa have been popular currencies in the former Soviet Union.

Some cash stocks may be stored at home, ie hoarded. The amount hoarded is thought to be quite small eg in Norway and Finland (Boeschoten 1991 and 1992; in Snellman, Vesala and Humphrey 2000). Because of a lack of information, we have not approximated the value of this stock. Some part of hoarded money may be included in the cash stock held by households but some part of it is included in the unexplained residual. We discuss this stock later when studying the information available from the euro cash changeover. Furthermore, we have estimated the value of cash used for POS payments, as seen in the seventh row. This will be further discussed in the next section.

## 2.2 Cash usage in POS payments

The value of cash used in annual POS payments can be evaluated by direct calculation. This same method was used with Norwegian data by Humphrey, Kaloudis and Øvre (2000) and with Swedish data by Andersson and Guibourg (2001).

POS payments consist mainly of card and cash payments. Cheque payments are rare in Finland. POS payments can be expressed by the following equation:

$$\text{cash} + \text{card} + \text{cheque} = \text{POSsales}$$

where

*cash*= annual value of POS payments via notes and coins

*card*= annual value of debit and credit card payments

*cheque*= annual value of cheque payments

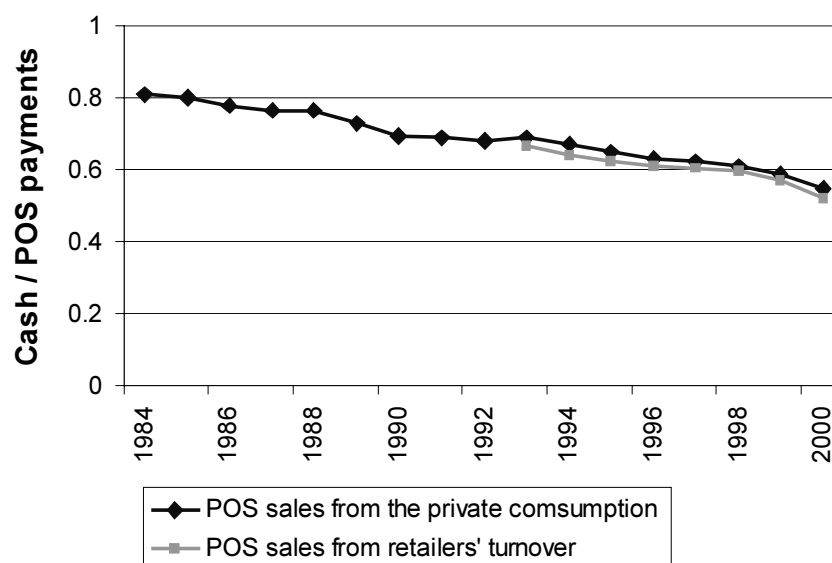
*POSsales*= annual value of POS payments

The annual value of card and cheque payments is subtracted from the value of POS payments to get the value of POS cash payments. The value of *POSsales* is not available directly from databases; we calculated it in two ways, as in the Norwegian study by Humphrey, Kaloudis and Øvre (2000). The first method is to estimate POS sales from the turnover statistics for retail sales, hotels and restaurants and transportation and the second is to estimate POS sales from private consumption in the national accounts. Both of our estimates include those parts of consumption that are likely to be paid for by cash, payment cards or cheques: retail sales, services, gasoline sales, public transportation, etc. Transactions typically paid by credit transfers, eg purchases of housing and motor vehicles, were subtracted to get the most reliable estimate of the value of POS payments. However, *POSsales* may include also some transactions paid by credit transfers, but these payments cannot be separated in the statistics. The value of credit transfers at POS is presumably small, because commodities such as furniture and household appliances are usually paid by card. Furthermore, POS payments may include payments made by e-money or vouchers, but the value of such transactions is probably very small.

Data on card payments is readily available from the Finnish Bankers' Association statistics. The variable *card* is the annual value of debit and credit card payments. The variable *cheque* turned out to be problematic. In the mid-1980s cheques were used quite commonly for POS payments, but they almost disappeared in the late 1980s. Cheque usage was free of charge in Finland until 1988, when banks decided to charge for cheque writing. By pricing cheques, banks attempted to encourage customers to use debit cards, which were made available free of charge. Cheques vanished almost immediately from retail usage, as people turned increasingly to debit cards and other payment methods. Today cheques are still used to a small extent for large payments, but these transactions are not relevant in this context, because cheques are not used as a substitute for cash in retail payments. Because of this, we cannot use the value of cheque transactions for the value of cheque payments at POS. Instead, we use an estimate of cheque payments derived by multiplying the value of an average payment card transaction by the number of cheques written in a year. This is the method used by Humphrey, Kaloudis and Øvre (2000) for estimating the value of cheques used for POS payments in Norway. For Finland, this approximation probably overestimates the value of cheques used for POS payments, especially toward the end of the period. However, the total values of cheque and voucher payments have been so small that these do not effect the estimated POS cash payments during the period 1995–2000. This is further discussed in appendix 1.

The share of cash payments in all POS payments was calculated via both of the above-mentioned POS payment estimating methods, and the results are compared in figure 3.

**Figure 3. Estimated ratio of cash payments to value of POS payments**





As seen from figure 3, the share of cash payments is almost the same for both methods. The longer curve depicts the share of cash payments in total POS payments as estimated from private consumption in the national accounts. The other curve describes the share of cash payments in total POS payments as estimated from the turnover statistics. The share of cash payments in total POS transactions decreased steadily from ca 80% to 54% over the period 1984–2000. This seems reasonable, because the use of payment cards has increased considerably during this period.<sup>5</sup>

Above, we calculated the value of POS cash payments as annual flows. In other words, cash flow at POS is the total value of POS transactions paid by cash during one year. Next, we need to convert the flow estimate to a stock estimate because all the other estimates of the cash usage are expressed as stocks. To convert cash flow to a stock, we must evaluate the consumers' cash usage turnover ratio. The turnover ratio is difficult to estimate because cash is in open circulation and money transactions between consumers cannot be traced. One estimate of this is the number of cash withdrawals per customer during a year. We calculated the Finnish turnover ratio by dividing the number of annual cash withdrawals at ATMs by the number of persons over age 14. This is the method used in the Swedish study by Andersson and Guibourg (2001). The alternative is to divide cash withdrawals at ATMs and bank branches by the number of persons over age 14. We did not use this turnover ratio, because there is no data available on withdrawals at bank branches. According to Automatia Ltd, 85%<sup>6</sup> of cash withdrawals occur at ATMs, and so we decided to use the turnover ratio based on ATM withdrawals. The estimated cash flow at POS is divided by this turnover ratio to obtain

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<sup>5</sup> The value of POS cash payments can also be estimated with an econometric model. This method is discussed in Humphrey, Kaloudis and Øvre (2000) for the Norwegian data; the original model is presented in the paper by Snellman, Vesala and Humphrey (2000). Using the same econometric model, we obtained estimates of the values of POS cash payments for the observation period that were quite similar to the values estimated by direct calculation. We did not use the results of the econometric model later in this paper, because there are some problems associated with the estimation, one being a lack of data. We obtained data for only 16 years, and there are many variables to estimate in the model. Furthermore, there is some specification uncertainty because the stationarity properties of different time series vary considerably and it is not clear what kind of cointegration relationships there are. A simple solution would be to use an estimating equation in first differences. Then one should know the value of cash variable for the base year. This base value should be estimated by directly subtracting the value of cheque and card payments from POS sales in 1984. This is exactly the same method used in the direct calculation and so the results could be quite similar. In addition, there are obvious endogeneity problems in the model. Basically one should have some sort of demand system for all means of payment in terms of the truly exogenous variables like technical change, level of income and so on. Unfortunately, building such a model is not possible with existing data.

<sup>6</sup> Talouselämä 31.8.2001

the stock of cash used for POS payments. Appendix 1 gives further details on the calculation of the turnover ratio and the conversion of POS cash flow to stock.

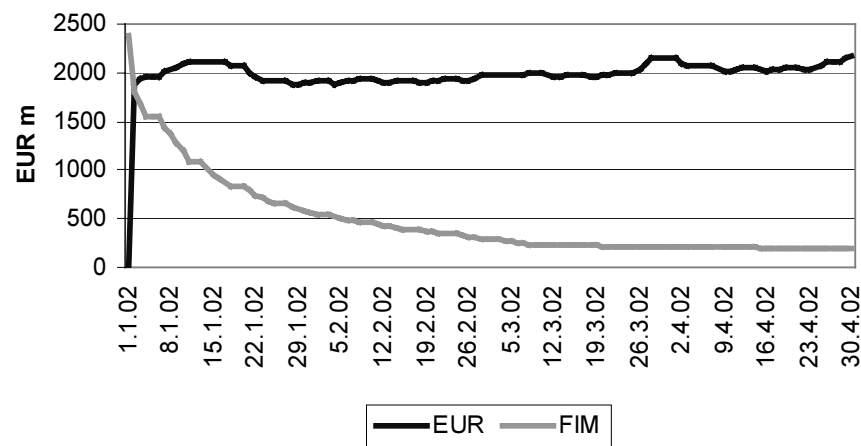
So far we have explained cash usage as far as possible using the available data. We get the unexplained residual by subtracting the other cash stocks discussed in this section from the total value of currency in circulation. The unexplained cash usage seems have increased from 36% to 47% during 1995–2000. However, there are problems with certain stocks. In connection with the euro changeover, we obtained further information on the most-difficult-to-estimate cash stocks such as the value of hoarded money or markka notes held abroad. The euro cash changeover and related matters are discussed in the following section.

### 3 Euro cash changeover

The euro cash changeover is a historical event that is of great interest in a study of cash usage. Euro notes and coins<sup>7</sup> have been in use since 1 January 2002 and markka notes and coins ceased to be legal tender at the end of February 2002. In this section we study the value of markka notes returned to the central bank up to end-April 2002. It is interesting to see how much markka cash remains outside the central bank after the transition period. This money can be returned to the central bank, at full compensation, until the end of February 2012. We look at the value of euro notes in circulation at the end of April 2002 and compare this to the value of markka notes in circulation before the changeover. We also discuss the share of notes that have earlier ceased to be legal tender and have not yet been returned to the central bank. Furthermore, we examine the shares of various euro and markka notes and coins in circulation and discuss possible similarities and differences between these shares.

Figure 4 depicts the value of markka and euro notes in circulation in January-April 2002.

**Figure 4. Markka and euro notes in circulation, EUR m**



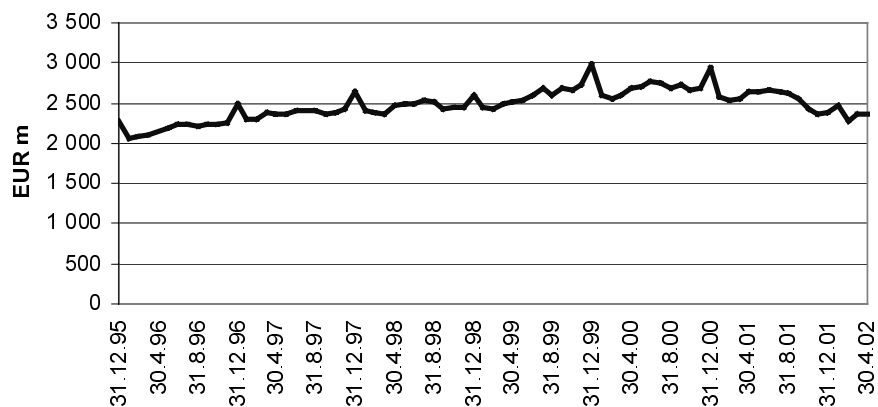
As can be seen from figure 4, the value of markka notes in circulation has decreased rapidly since the start of January 2002. On the other hand, the value of euro notes in circulation has been quite stable. Consumers quickly started to use euro instead of markkaa, because most ATMs distributed only euro from the beginning of 2002 and shops gave change mostly in euro. The smallest denomination notes, EUR 5 and EUR 10, went into circulation mainly for making change in

<sup>7</sup> EUR 1 = FIM 5.94573  
FIM 1 = EUR 0.168188

shops, as cash withdrawal ATMs distribute only EUR 20 and EUR 50 notes in Finland.

It is interesting to compare the values of euro and markka notes in circulation. Figure 5 shows the value of legal tender notes in circulation at the end of each month, ie the value of markka notes between end-1995 and end-February 2002 and the value of euro notes between January-April 2002.

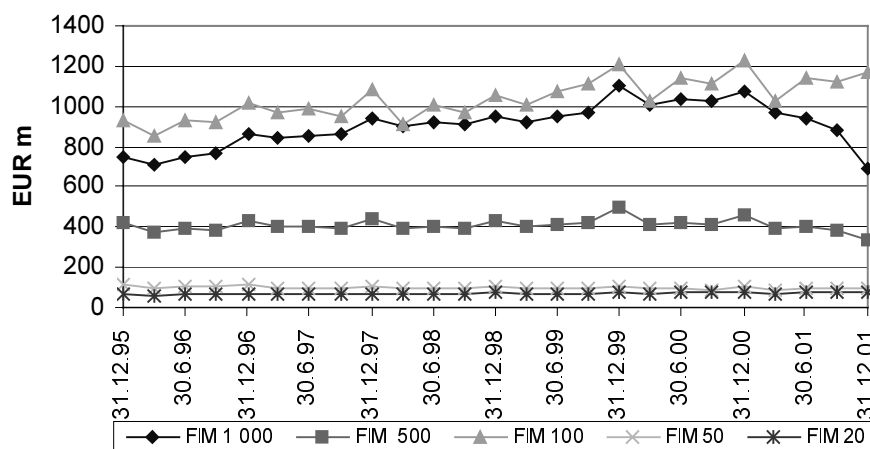
**Figure 5. Value of markka and euro notes in circulation, EUR m**



As shown in figure 5, the value of markka notes in circulation has usually increased at the end of year, largely in connection with Christmas shopping. However, in 2001 the value of markka notes in circulation decreased steadily during the latter half of the year.

Figure 6 depicts how the values of various denomination notes in circulation have evolved over the years.

**Figure 6. Values of selected markka notes in circulation, EUR m**



As can be seen from figure 6, five different markka notes were used in Finland. The value in circulation of the largest denomination note, FIM 1000, decreased substantially during 2001.<sup>8</sup> This could indicate eg that hoarded money was returned to the central bank. Also some of the notes may have been used for illegal activities and people may have spent this money on consumption or saved it in bank accounts because of the forthcoming euro cash changeover.

We could compare the value of euro notes at end-April 2002 in circulation to the value of markka notes in circulation at the end of 2001. However, this would be somewhat misleading, because of annual trends and the decreased value of markka notes in circulation in 2001. Therefore, it is better to compare the value of euro notes in circulation to the value of markka notes in circulation at the same time two years before. Figures 4 and 5 show that the value of euro notes in circulation at end-April 2002 is ca 513 million euro less than the value of markka notes in circulation at end-April 2000. Also the value of coins in circulation has decreased. The value of euro coins in circulation was ca 93 million euro less at the end of April 2002 than the value of markka coins in circulation at the end of April 2000.

The value of still outstanding (missing) markka notes was apparently ca EUR 193 million at the end of April 2002, as can be seen from figure 4. At the same time, the value of markka coins not returned to the central bank totalled ca 160 million euro. Part of the stock still outstanding can be returned to the central bank until the end of February 2012. The missing cash includes destroyed and lost money, as well as markka notes and coins collected by numismatists and others. On the other hand, the value of lost coins may be quite large, because people may just not bother to return the smallest coins to the central bank. At the end of April 2002, 57% of the smallest coins, 10 penniä (FIM 0.1), and 25% of the largest coins, FIM 10, were still missing compared to the values of these coins at the end of 2000. An estimate of missing money could be obtained from information on notes that have previously ceased to be legal tender. In 1994, notes worth FIM 343 million (ca EUR 58 million) ceased to be legal tender. These notes had been partly replaced by new notes a few years earlier, when new-design notes were issued in November 1991. Based on our calculations, the share of those notes still missing has levelled off at about 1.8%. If we assume the share to be the same for notes and coins that ceased to be legal tender at the end of February 2002, the value of missing money could stabilise at FIM 344 million (ca EUR 58 million). Naturally, this is only a rough estimate of missing money. The value of markka notes and coins kept by people is presumably larger this time than it was earlier, because this time we completely ended the use of markkaa. This calculation is discussed further in appendix 2.

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<sup>8</sup> Also according to the ECB (2002), currency in circulation, especially the largest denomination notes, decreased considerably in the euro area during 2001.

Some interesting information about possible changes in cash usage can be seen from the shares of various denomination notes and coins in circulation. According to our calculations, the share of the largest markka denomination notes, FIM 1000, totalled ca 38% of the total value of notes in circulation at the end of April 2000. The largest euro notes, EUR 500 and EUR 200, totalled 22% of the total value of euro notes in circulation at the end of April 2002. One possible reason for the decreased share of the largest notes is decreased hoarding. The shares of notes usually available at ATMs seem to have increased slightly. The share of FIM 500 and 100 notes totalled ca 56% at end-April 2000 and the share of EUR 50 and EUR 20 notes was ca 62% at end-April 2002. Also the shares of the largest coins seem to have increased a little. The share of FIM 10 and FIM 5 totalled ca 59% of the total coin stock value at the end of April 2000. The share of the largest euro coins, EUR 2 and EUR 1, was about 67% at the end of April 2002. The share of FIM 1 coins seems to be quite similar to the share of EUR 0.5 and EUR 0.2 coins. Based on these figures, the demand for the largest notes seems to have decreased substantially since the euro cash changeover. The calculation of shares is further discussed in appendix 3.

In conclusion we could say that the value of euro notes and coins in circulation at end-April 2002 was ca EUR 606 million less than the value of markka notes and coins in circulation at end-April 2000. This figure gives us an estimate of cash stocks that have been previously hoarded, held abroad, lost, destroyed or collected. However, there are some factors that may affect the demand for euro notes and, therefore, the information from the euro cash changeover has to be interpreted carefully. All euro notes and coins can be used in all euro countries, ie euro used in Finland can be issued in other euro countries, and vice versa. This will further complicate the study of cash usage in the future. However, we assume that euro notes and coins of different origin were not mixed very much during the first months of 2002. Part of the new euro notes issued in Finland may already be held abroad or hoarded, but this is probably a very small amount. Also the change in payment habits may reduce the demand for euro. Consumers may have paid more by payment cards because of wide campaigns launched by banks and card companies. There are, however, no statistics yet available on card payments in 2002. Also the increased use of coins could explain the decreased demand for notes. The value of euro coins in circulation is less than the value of markka coins was. However, large amounts of markka coins are still being returned to the central bank. Overall, the euro cash changeover gives us extra information about cash usage in Finland. In the next section we round up this information with earlier results discussed in section 2.

## 4 Discussion of results

We discussed the different cash stocks in sections 2 and 3. When we subtract these from currency in circulation, we get the unexplained residual. In this section we conclude our results and compare them with those of the Norwegian and Swedish studies. In section 4.3 we briefly discuss future cash usage.

### 4.1 Unexplained cash usage

The unexplained cash usage can be calculated by subtracting the explained cash stocks from currency in circulation. The unexplained cash usage for the period 1995–2000 is presented in table 2.

**Table 2. Unexplained cash usage, FIM m**

	1995	1996	1997	1998	1999	2000
Cash in circulation	15 247	16 532	17 466	17 025	19 266	19 187
Sum of explained cash stocks	9 829	10 334	10 496	10 170	11 174	10 255
Residual (= cash in circulation - sum of explained cash stocks )	5 418	6 198	6 970	6 854	8 092	8 932
<b>Residual / cash in circulation</b>	<b>36 %</b>	<b>37 %</b>	<b>40 %</b>	<b>40 %</b>	<b>42 %</b>	<b>47 %</b>
Information from the euro conversion	2 863	3 105	3 280	3 197	3 618	3 603
Adjusted residual	2 661	3 209	3 812	3 776	4 609	5 463
<b>Adjusted residual / cash in circulation</b>	<b>17 %</b>	<b>19 %</b>	<b>22 %</b>	<b>22 %</b>	<b>24 %</b>	<b>28 %</b>

The third row in table 2 shows the value of unexplained cash usage based on the discussion in section 2. In other words, the second row gives the sum of explained (as per section 2) cash stocks, and this sum is subtracted from currency in circulation. As seen from the fourth row, unexplained cash usage seems to have increased from 36% to 47% during the period 1995–2000. We have also made alternative calculations because of the uncertainty in some variables. If we suppose the value of cash held abroad to be much greater, even 10% instead of 0.7%, the share of unexplained cash usage decreases very much. According to these calculations, the share of unexplained cash usage was 37%–47% in 2000. Naturally, this is quite a rough estimate of cash held abroad.

On the other hand, the information available in connection with the euro cash changeover can also be used for estimating cash stocks that have been hoarded, held abroad, lost, destroyed or collected. The fifth row gives the estimates of these stocks based on information obtained in connection with the euro cash changeover. As discussed in section 3, eg changes in payment habits or euro notes from other euro countries may have influence on the demand for euro notes

issued in Finland. However, these effects can be assumed to be quite small during the first months of 2002. As discussed in section 3, the value of euro notes and coins in circulation at the end of April 2002 was ca EUR 606 million less than the value of markka notes and coins in circulation at end-April 2000. This figure is divided by currency in circulation in 2000 in order to get the share of currency held abroad, hoarded, lost, destroyed or collected in 2000. Assuming this share remains constant, we can estimate the value of these cash stocks for the period 1995–2000. By subtracting this new figure and other cash stocks<sup>9</sup> from currency in circulation, we get the adjusted residual in the sixth row. The last row shows that unexplained cash usage increased from 17% to 28% during the period 1995–2000.<sup>10</sup> All cash stocks are shown as a diagram in appendix 4.

In conclusion, the share of unexplained cash usage seems to have been 28%–47% at the end of 2000. At first sight, such a large share of unexplained cash usage may seem somewhat surprising. However, there are some points that support the result that the explainable amount of currency in circulation is quite low. The electronification of retail payment systems is at a high level in Finland, eg payment cards and credit transfers are used very commonly. Despite this wide electronification, the value of the largest denomination notes in circulation (FIM 1000 and FIM 500) totalled over 50% of the total value of notes in circulation at the end of 2000. The proportion of large value notes has been steadily increasing during the estimation period. In addition, hoarding is assumed to be at a low level in Finland.

Because of the above results, we could ask for what other purposes cash is needed. The unexplained residual includes eg person-to-person payments that are legal transactions but cannot be traced, because cash is in open circulation. Furthermore, this calculation may be capable of explaining only a part of the total cash usage. The unexplained residual may also include cash stocks used for illegal activities, such as tax evasion and drug trade. Cash demanded for illegal purposes can be supposed to be quite large in value for at least two reasons: Typically, transactions in the grey economy can be assumed to be larger in value than legal

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<sup>9</sup> Other cash stocks (2) - (7) can be seen from table 1. The stock of cash held abroad (6) is excluded, because the information from euro cash changeover includes this stock.

<sup>10</sup> We have also used an alternative method to study the difference between the values of euro and markka notes and coins in circulation. We cannot know what the value of markka notes and coins in circulation at end-April 2002 would have been absent the euro cash changeover. We have estimated this value by calculating the trend based on values up to June 2001. June is the last observation, because the value of markka notes and coins has notably decreased during the latter half of 2001 due to the forthcoming euro cash changeover. According to this calculation, the part of markka notes and coins held abroad, hoarded, lost, destroyed or collected would have been as high as 25%. In other words, the unexplained share of cash usage would have been only 22% in 2000. However, we have not used this result, because with this method eg payment habits are assumed to remain unchanged over the period.



retail payments in cash. Secondly, one must use cash for illegal transactions, because credit transfers via bank accounts are traceable and cannot be used for illegal purposes. However, we have to avoid drawing too definite conclusions based on these calculations. We cannot say how much of the unexplained share of currency in circulation is used for illegal activities, if any.

As discussed earlier, there are some problems in analysing the cash usage, and therefore the final result must be interpreted with caution. Despite these problems, a similar method was used in Norway and Sweden in order to find the share of unexplained cash usage. Results from these three studies will be compared in the next section.

## 4.2 Comparison of Norwegian, Swedish and Finnish results

Cash usage has also been studied in the central banks of Norway and Sweden. According to Humphrey, Kaloudis and Øwre (2000), in 1999 the ratio of unexplained cash usage (incl. hoarding and illegal activities) to currency in circulation was 71% in 1999. According to the authors, the level of hoarding is low in Norway. They estimate the share of cash used for illegal purposes at ca 67% of currency in circulation. Humphrey, Kaloudis and Øwre have also forecasted future developments. Over the period 1999–2005, illegal cash usage is estimated to increase from 67% to 80%. These results are surprising, as they suggest that the central bank provides cash mainly for illegal purposes. In other words, most of the seignorage comes from the grey economy, which is projected to grow in importance in the future. Based on these results, the authors raise the question whether the large denomination notes should be withdrawn from circulation. These notes are presumably the most suitable for illegal activities, eg tax evasion and drug trade. The Norwegian study was later revised by Gresvik and Kaloudis (2001), who can explain 37%–47% of total cash usage for 2000. Thus the level of unexplained usage remains quite high. Cash usage has been studied in Sweden using the same method by Andersson and Guibourg (2001). According to their results, unexplained cash usage in Sweden amounted to 45%–65% in 1999.

The results are fairly similar for all three countries. This is reasonable, since the main features of retail payments in Norway, Sweden and Finland are similar. In all three countries, retail payments are highly electrified, ie the use of credit transfers and payment cards is very popular. Cash is mostly used for POS payments and very seldom in transactions such as bill payments and wage disbursements. Cheques have almost disappeared from the retail payment system. The value of hoarded cash is thought to be low in all countries. The value of the cash holdings abroad is presumably somewhat higher for Finnish than for Norwegian and Swedish currency, because Finnish markkaa were apparently used a great deal

in Russia and Estonia. In spite of the wide electrification of retail payments, the value of the largest denomination notes has remained high. Thus it is not surprising that the share of unexplained cash usage is quite high in all three countries. On the other hand, one should be cautious in interpreting the results, because the same method has been used for all these countries and therefore possible problems related to the method may have an effect on all the related studies. Compared to Norway and Sweden, the euro cash changeover provides extra information on cash usage in Finland.

### 4.3 Future developments

The future of cash usage is also interesting, because payment habits change with the times. New retail payment solutions are constantly being developed. Even though smart-card-based e-money solutions have been on the market for some time already, they are not widely used. Recently there have been developments in small payment applications using mobile phones. Such experiments can be considered natural to Finland, as mobile phone market penetration is among the highest in the world and Finns remain enthusiastic adopters of technological advances. It will be interesting to see how these challenges to present retail payment systems are met and whether or how extensively the innovations can survive and flourish at the national or even international level. Also changes in consumption habits, eg notable growth of Internet shopping, would probably add to the spread of electronic payment transfers. New payment innovations could produce cash substitutes and so reduce the use of cash. Using different payment instruments depends also on pricing. According to Van Hove (2002), a true price of using cash has been hidden from consumers and this makes it difficult for new payment instruments to gain ground. However, since cash is the only truly anonymous payment method, it would seem likely that for the foreseeable future there will always be some demand for cash in our society.

## 5 Conclusions

In this paper we have studied the use of cash in Finland. First, we collected the directly available data on various cash stocks and estimated the value of POS cash payments. Then we analysed the information available from the euro cash changeover, which provided some estimates for the value of markka currency hoarded, held abroad, lost, destroyed or collected. Finally, we subtracted the total of these stocks from currency in circulation to get the unexplained cash usage.

According to our results, the unexplained share of cash usage increased during the observation period, 1995–2000. The unexplained share seems to have been between ca one-half and one-quarter in 2000, depending on the assumptions. The lower limit makes use of extra information obtained in connection with the euro cash changeover. At first, the result may seem quite surprising. However, Finnish retail payments are highly electronified, and the use of payment cards and credit transfers, in particular, is very common in Finland. Despite the continuous electronification of retail payments, currency in circulation increased during the observation period. Moreover, the large denomination notes comprised ca 50% of the total value of currency in 1995–2000. So one can well want to know how much of currency in circulation is needed for legal activities. On the other hand, we must avoid drawing too definite conclusions. Because of the open circulation, cash usage cannot be totally traced and the unexplained residual includes eg legal person-to-person payments. Cash usage has been recently studied using this similar method in the Norwegian and Swedish central banks. According to these studies, the unexplained share of cash usage is high in both Norway and Sweden. We compared the results and discussed the differences and similarities between these studies in section 4.

The future of cash usage is also interesting. Perhaps some new payment innovation will reduce the demand for cash. However, it is quite improbable that the use of cash would totally cease in the foreseeable future. The main reason for this is that cash, being the only truly anonymous payment method, will probably continue to attract some interest in our society.

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## Appendix 1

In this appendix we show in detail how cash usage at POS has been calculated. Table 1 includes the value of POS payments during one year calculated by two methods, the value of card and cheque payments during one year, the value of POS cash payments during a year, and the ratio of cash payments to total POS payments.

**Table 1. Value of POS payments, FIM m**

	1995	1996	1997	1998	1999	2000
POS household consumption (FIM m) (1)	172 976	179 547	188 503	197 418	205 296	215 877
Consumer POS sales (FIM m) (2)	161 592	169 323	180 638	190 393	196 486	204 306
Card value at POS (FIM m) (3)	59 930	65 092	70 646	76 803	84 586	97 964
Cheque value at POS (FIM m) (4)	936	874	680	456	337	287
Cash use at POS (FIM m) (5)=(1)-(3)-(4)	112 111	113 581	117 177	120 159	120 373	117 626
Cash use at POS (FIM m) (6)=(2)-(3)-(4)	100 726	103 357	109 313	113 134	111 564	106 055
Cash use at POS % (7)=(5)/(1)	65 %	63 %	62 %	61 %	59 %	54 %
Cash use at POS % (8)=(6)/(2)	62 %	61 %	61 %	59 %	57 %	52 %

The first row shows the value of POS payments estimated on the basis of private consumption in the national accounts. The second row shows the value of POS payments estimated from the turnover statistics. The data was obtained from the Statistics Finland database. Both rows include those parts of consumption that are presumably paid for with cash, payment cards or cheques. This kind of consumption is thought to consist of retail sales, services, gasoline sales, public transportation, etc. Transactions typically executed via credit transfers, eg purchases of housing and motor vehicles, were subtracted. The third row shows the value of card payments and the fourth row the value of cheque payments during a year. The value of cheque payments was calculated by multiplying the average value of card payment by the number of cheques written in a year. These data were obtained from the Finnish Bankers' Association statistics. The value of POS cash payments was calculated by subtracting the value of card and cheque payments from the total value of POS transactions. As can be seen from the last two rows, the share of POS cash payments is similar for POS transactions calculated either from private consumption or turnover figures.

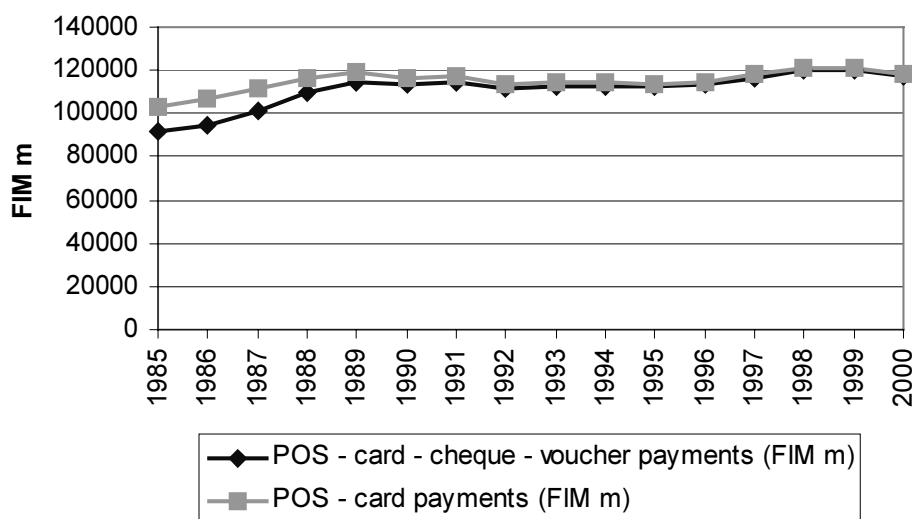
As stated in section 2.2, cheques have almost vanished from the retail payment system. Therefore, we could estimate the value of POS cash payments by subtracting the value of card payments from the total value of POS payments. Furthermore, there are small batches eg of vouchers that are included in POS transactions. Table 2 shows the value of cheque and lunch voucher payments.

**Table 2. Influence of cheque and voucher payments on POS cash payments**

	1995	1996	1997	1998	1999	2000
POS household consumption (FIM m) (1)	172 976	179 547	188 503	197 418	205 296	215 877
Card value at POS (FIM m) (2)	59 930	65 092	70 646	76 803	84 586	97 964
Cheque value at POS (FIM m) (3)	936	874	680	456	337	287
Voucher value at POS (FIM m) (4)		350	387	440	496	559
POS-card-cheque-voucher payments (FIM m) (5)	112 111	113 231	116 790	119 719	119 877	117 067
POS-card payments (FIM m) (6)	113 046	114 455	117 857	120 615	120 710	117 913

The value of lunch vouchers was obtained from Luottokunta's annual report 2000. As can be seen from figure 1, the value of cheque and voucher payments do not have much effect on POS cash payments during 1995–2000.

**Figure 1. Estimated value of POS cash payments**



In order to compare POS cash payments to other stocks of cash, we have to express the above flow figures as stocks. This can be done by dividing the value of POS cash payments during a year by a turnover ratio, as discussed in section 2.3. The turnover ratio is calculated by dividing the volume of ATM cash withdrawals during a year by the over-age-14 population. The data on ATM withdrawals is from the Finnish Bankers' Association statistics and that on population is from the Statistics Finland database. Calculation of the turnover ratio and conversion of POS cash flows to stocks are shown in table 3.

**Table 3. POS cash payments - flow and stock**

	1995	1996	1997	1998	1999	2000
Number of cash withdrawals at ATMs (millions) (1)	201.22	212.77	222.72	230.92	238.44	244.00
Population over 14 years (millions) (2)	4.15	4.16	4.19	4.21	4.23	4.24
Turnover ratio (3)=(1)/(2)	48.54	51.10	53.21	54.87	56.39	57.48
Cash usage at POS in one year, (FIM m) (4)	112 111	113 581	117 177	120 159	120 373	117 626
POS stock of cash, (FIM m) (5)=(4)/(3)	2 309	2 223	2 202	2 190	2 135	2 046



## Appendix 2

The next table deals with notes that have ceased to be legal tender but are still missing. Notes worth FIM 343 million ceased to be legal tender at the start of 1994 and were replaced by newly designed notes. These new notes were issued from November 1991 and thus we must compare the value of missing notes to the value of notes in circulation at end-1990. As can be seen from table 1, the share of notes still missing at end-2000 was 1.8%.

**Table 1. Share of missing notes**

	1994	1995	1996	1997	1998	1999	2000
Ceased to be legal tender on 1 Jan 1994, FIM m	303.0	252.8	249.5	243.5	237.4	232.6	229.9
Value of notes in circulation at end-1990, FIM m	12 809	12 809	12 809	12 809	12 809	12 809	12 809
The share of missing notes	2.4 %	2.0 %	1.9 %	1.9 %	1.9 %	1.8 %	1.8 %

The share for year 2000 could provide an estimate of the share of markka notes that will be forever missing. This includes destroyed, lost and collected money. If we use the 1.8% as an estimate, the value of missing money would stabilise at  $1.8\% * 19187 = \text{FIM } 344 \text{ million (EUR } 58 \text{ m)}$ . Naturally, this is a rough estimate of missing money. People may be collecting more markka notes now than earlier, because all markka notes have forever ceased to be legal tender.

## Appendix 3

The shares of different euro and markka notes and coins are shown in tables 1-4. The values of euro notes and coins are per 30 April 2002 and the values of markka notes and coins are per 30 April 2000. Data is from the Bank of Finland database.

**Table 1. Values and shares of euro notes in circulation**

EUR	Values of euro notes in circulation, EUR m	Shares of various notes in total value of euro notes in circulation
500	308	14 %
200	177	8 %
100	180	8 %
50	600	28 %
20	745	34 %
10	101	5 %
5	67	3 %
total	2 179	100 %

**Table 2. Values and shares of markka notes in circulation**

FIM	Values of markka notes in circulation, FIM m	Shares of various notes in total value of markka notes in circulation
1000	6 017.1	38 %
500	2 471.8	15 %
100	6 512.9	41 %
50	576.6	4 %
20	426.5	3 %
total	16 005.0	100 %

**Table 3. Values and shares of euro coins in circulation**

EUR	Values of euro coins in circulation, EUR m	Shares of various coins in total value of euro coins in circulation
2	74.92	42 %
1	44.22	25 %
0.5	23.08	13 %
0.2	18.34	10 %
0.1	10.25	6 %
0.05	5.95	3 %
0.02	0.08	0.05 %
0.01	0.04	0.02 %
total	176.87	100 %

**Table 4. Values and shares of markka coins in circulation**

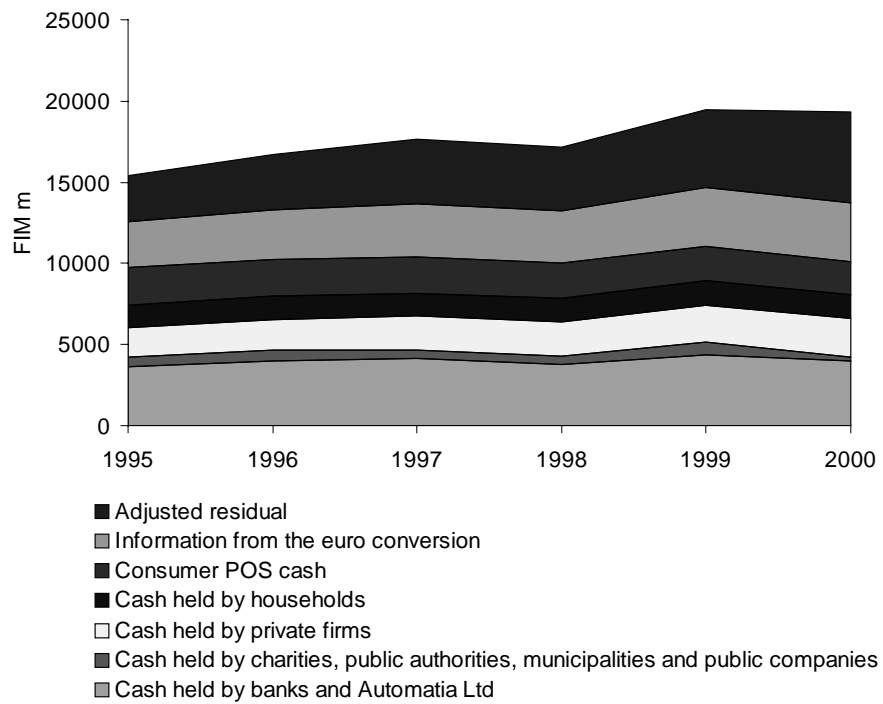
FIM	Values of markka coins in circulation, FIM m	Shares of various coins in total value of markka coins in circulation
10	468.9	33 %
5	368.8	26 %
1	340.6	24 %
0.5	107.2	8 %
0.1	128.3	9 %
total	1 413.8	100 %

As stated in section 3, the shares are quite similar. Only the share of the largest notes in circulation has decreased during the euro era. This may indicate eg that the value of hoarded money has decreased.

## Appendix 4

Figure 1 depicts the development of cash stocks during 1995–2000. This composition includes all explained cash stocks and the unexplained use of cash.

**Figure 1. Composition of cash in circulation**



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