

## Recent developments in electronic money

The use of electronic money in non-banks' payments poses a series of questions to monetary policy. These issues were already presented in detail and discussed in an earlier Monthly Report of the Deutsche Bundesbank.<sup>1</sup> This article is a follow-on to the earlier Report and deals with current trends in electronic money. In the meantime, initial experience has been gained concerning its use in over-the-counter (OTC) trade in Germany; it has not been used as frequently as was originally expected. However, with the development of electronic commerce on the Internet, new uses for electronic money are emerging. Theoretical considerations indicate that electronic money will most likely assume the role of a payment medium for small amounts.<sup>2</sup> However, one cannot rule out the possibility that, in the foreseeable future, the potential for the use of electronic money will be capitalised on more strongly than in the past. This is borne out by network effects in OTC trade and the lack of alternative payment instruments with similar features on the Internet. Thus, electronic money may potentially present new challenges to monetary policy. It is therefore appropriate to set clear rules governing the issuance of electronic money.

---

1 Deutsche Bundesbank, Monetary policy and payment systems, Monthly Report, March 1997, pages 33 to 46.

2 See: G. Kabelac (1999), Network money as a medium of exchange, Discussion paper 5/99, Economic Research Group of the Deutsche Bundesbank, to be published shortly.

## Possible applications of electronic money

*Issues of  
definition*

"Electronic money is broadly defined as an electronic store of monetary value on a technical device that may be widely used for making payments to undertakings other than the issuer without necessarily involving bank accounts in the transaction, but acting as a prepaid bearer instrument."<sup>3</sup> According to this definition it is not considered to be electronic money if the issuer and the acceptor are identical and the money units are an advance payment on certain goods and services (single-purpose schemes). This applies to prepaid telephone cards, for example. Furthermore, electronic money should be distinguished from "access products" which provide electronic access to standard forms of money such as sight deposits. In Germany, it is particularly eurocheque cards, equipped with a debit card function, which enjoy widespread use as payment instruments.

*Two forms of  
electronic  
money  
products*

In general, one can distinguish between two forms of electronic money. One is money units on prepaid cards which the European Central Bank (ECB) calls "card-based products" and defines as "plastic card[s] which contain[s] real purchasing power, for which the customer has paid in advance ...".<sup>4</sup> The other form is "software-based products" which transmit electronically stored money units through telecommunications networks such as the Internet.

*Whereas only  
card-based  
money is being  
used in OTC  
trade ...*

Electronic money stored on cards was initially designed for use in traditional OTC trade. This refers to all trading locations which are not part of electronic commerce on the Inter-

net, such as traditional retail trade, but also including vending machines. In this trade sector, a single nation-wide scheme for payment with money on prepaid cards has since been introduced in Germany.

Basically, card-based products can also be used to make payments over the Internet with the aid of card readers linked to the PC of a payer. Thus, electronic commerce, from a technical standpoint, can use both types of electronic money products. Hence, electronic money on the Internet, which will be described in the following as network money or cyber money, includes card-based and/or software-based e-money. For Germany, though, there is no significant practical experience of network money at present.<sup>5</sup> Regarding software-based products, network money issued in Germany has not yet gotten past the pilot stage. As regards card-based products, their use is currently limited to OTC trade. The Central Credit Committee (*Zentraler Kreditausschuß*), the federation of the central associations representing the German banking industry, pointed out at the end of May 1999 that once the appropriate terminals have been approved, the German banking industry's card-based product can be used to make payments on the Internet, too.

*... both card-  
based and  
software-based  
products can be  
used on the  
Internet*

<sup>3</sup> European Central Bank (1998), Report on Electronic Money, Frankfurt am Main, page 7.

<sup>4</sup> European Central Bank (1998), loc. cit.

<sup>5</sup> The statements made here refer to network money issued in Germany. The state of the art makes it possible for both the payer and the recipient of an Internet payment to use network money issued abroad for transaction purposes.

## An international comparison of structural data of payment systems

Countries	Per-capita <sup>1</sup> currency in circulation in ECU				Number of ATMs per 1 million inhabitants <sup>2</sup>				Number of POS terminals per 1 million inhabitants <sup>2</sup>			
	1994	1995	1996	1997	1994	1995	1996	1997	1994	1995	1996	1997
Belgium	988	1,065	1,092	1,069	313	360	414	492	4,941	5,513	5,973	6,284
Denmark	737	799	798	840	142	207	239	253	4,624	5,016	7,966	11,923
Germany	1,441	1,552	1,578	1,532	361	437	459	504	768	858	1,404	1,984
Greece	563	588	607	672	155	129	185	209	1,085	1,082	1,796	2,831
Spain	1,152	1,179	1,258	1,284	600	680	775	863	10,224	12,275	14,650	16,691
France	663	674	680	673	355	393	420	462	9,343	9,340	9,353	9,555
Ireland	584	632	684	823	241	257	290	286	–	–	1,213	1,402
Italy	863	791	890	969	321	371	422	444	1,786	2,634	3,741	4,896
Luxembourg	980	1,006	1,017	1,072	374	456	537	613	9,071	8,146	11,218	11,071
Netherlands	1,148	1,177	1,151	1,121	325	355	373	410	3,094	4,747	6,184	7,715
Austria	1,229	1,343	1,355	1,310	381	420	479	533	300	419	632	1,652
Portugal	409	434	446	393	337	372	541	631	3,311	3,862	4,990	6,022
Finland	343	425	455	480	836	474	448	445	9,434	9,593	9,952	10,506
Sweden	853	828	959	972	260	266	269	268	2,908	6,139	6,945	7,778
United Kingdom	414	410	435	571	343	358	376	393	5,997	8,635	9,354	8,984
EU average	909	935	974	972	369	408	448	488	4,577	5,544	6,417	7,146
United States <sup>3</sup>	1,126	1,097	1,202	1,464	418	466	524	616	1,320	2,009	3,296	4,853
Japan <sup>3</sup>	3,037	2,947	2,985	3,244	978	1,013	1,051	1,115	227	200	183	155
Canada <sup>3</sup>	516	504	539	612	576	595	617	645	4,073	6,394	8,408	10,873
Switzerland <sup>3</sup>	2,427	2,582	2,496	2,565	481	532	587	678	2,379	3,499	4,747	5,803

Countries	Number of cards <sup>4</sup> per 1,000 inhabitants <sup>2</sup>				Number of card transactions <sup>5</sup> per inhabitant				Use of card payments (number of transactions) as a % of the total number of cashless payments			
	1994	1995	1996	1997	1994	1995	1996	1997	1994	1995	1996	1997
Belgium	881	933	1,043	1,116	19	21	25	28	18.0	19.2	21.3	23.4
Denmark	543	563	584	583	41	47	54	59	–	–	60.5	62.6
Germany	582	910	982	1,038	4	5	6	6	3.1	3.6	4.2	4.1
Greece	103	136	246	293	3	2	3	2	–	–	78.0	74.0
Spain	819	810	842	897	6	8	7	9	18.1	20.6	19.3	20.9
France	385	406	437	473	29	32	36	39	17.5	19.2	20.2	21.6
Ireland	273	341	272	397	6	8	9	9	8.0	9.0	8.5	8.7
Italy	313	351	393	426	2	2	3	5	5.2	6.6	8.6	11.2
Luxembourg	1,044	1,183	1,286	1,378	–	–	–	–	–	–	–	–
Netherlands	82	97	119	163	13	24	24	31	7.9	15.6	15.1	18.2
Austria	501	548	591	662	2	3	4	5	3.0	3.6	4.4	5.8
Portugal	684	720	787	915	12	14	20	25	25.0	29.4	33.9	38.9
Finland	620	625	638	693	45	48	53	57	34.4	35.4	37.2	38.2
Sweden	1,375	535	636	691	11	13	14	20	13.0	14.1	14.8	19.3
United Kingdom	934	1,012	1,133	1,271	28	33	39	45	23.3	25.9	28.9	31.1
EU average	580	659	722	786	13	16	19	21	12.2	14.9	16.8	18.2
United States <sup>3</sup>	–	2,475	2,556	2,628	57	63	70	78	18.7	20.1	21.5	23.0
Japan <sup>3</sup>	1,830	1,891	1,864	1,945	3	3	4	5	–	–	–	–
Canada <sup>3</sup>	519	533	552	577	46	56	67	80	35.3	40.0	44.8	48.8
Switzerland <sup>3</sup>	800	847	921	988	11	13	15	19	16.2	18.4	20.7	22.8

Sources: European Central Bank, Payment Systems in the European Union, various editions; Bank for International Settlements, Statistics on Payment Systems in the Group of Ten Countries, various editions. — <sup>1</sup> Currency in circulation in the United States, Japan, Canada and Switzerland based on US\$ data, recorded as year-end figures, converted into ECU at year-end rates. EU figures also year-end figures, converted into ECU at annual average rates (exception:

United Kingdom). — <sup>2</sup> Year-end level. — <sup>3</sup> Information on these countries from the BIS publication, information on the EU countries from the ECB publication. — <sup>4</sup> Credit or debit cards. — <sup>5</sup> Credit, debit or bank customer cards. In some cases (non-EU G-10 countries) Bundesbank calculations. Japan: credit cards. Switzerland: credit, debit and prepaid cards.

## Card-based payment schemes and electronic money in OTC trade

*Cash still predominates*

Credit card and debit card payments have risen sharply in Germany over the past few years. All the same, in comparison to some other European countries, these payment forms – in terms of their number – account for a relatively low share of cashless payment transactions, the figure for 1997 being just over 4% (the EU average amounted to just over 18%; see table on page 43 with country data).<sup>6</sup> The use of cash continues to dominate in OTC trade. By international standards, the volume of currency in circulation<sup>7</sup> and the number of ATMs per one million inhabitants are both higher than average. So is the number of cards issued; however, that is probably due to the function of the eurocheque card as a cash card in ATMs and, up to now, as a guarantee card for the eurocheque. The fact that eurocheque cards and bank customer cards equipped with microchips are widespread indicates a great potential for debit card payments and for the use of electronic money.

*Scarce statistical data*

In the following, the card-based cashless payment instruments in Germany will be examined in some more detail. An overview of the number of transactions and the amounts involved is contained in the table on page 46. However, these data are in some cases estimates, since there are no statistical reporting requirements. They are based mainly on information provided voluntarily by the associations.

*Debit card schemes*

Regarding the debit card procedures, whereas the two schemes being operated by the bank-

ing industry, electronic cash (PIN<sup>8</sup>, payment guarantee) and POZ (German abbreviation for Point of Sale Without Payment Guarantee, with signature and security check) are relatively well covered in statistical terms, this is not the case for electronic direct debiting.<sup>9</sup> Chip card technology now makes “electronic cash offline authorisation” possible, whereby, for payments at OTC terminals, the debit card can be “opened” in advance by PIN for a given total amount of DM worth of transactions.<sup>10</sup> This should make the debit card faster and more comfortable to use than in the electronic cash procedure (PIN must be entered for each transaction).

By contrast, the statistical recording of electronic money stored on cards (card-based e-money) in Germany is relatively simple, since prepaid card and network money business is restricted exclusively to banks, which must submit reports on their prepaid card loading values in the monthly balance sheet statistics. This reporting requirement has been in effect since the beginning of 1996. Once the German banking industry's Geld-Karte project left the pilot stage to go into operation at the beginning of 1997, e-money was included in the money stock. The total volume of electronic money rose moderately up to mid-1998 and has been virtually stag-

*Statistical recording of electronic money*

<sup>6</sup> More up-to-date, internationally comparable information is not available at present.

<sup>7</sup> The high volume of currency in circulation is also attributable to its use for transactions abroad and to hoarding.

<sup>8</sup> PIN: Personal Identification Number.

<sup>9</sup> Scheme developed by the trade (debit authorisation via signature, without PIN, security check and payment guarantee) which triggers a debit on the basis of the data on the card.

<sup>10</sup> Authorisation does not contain a transfer from the customer's cheque account but shortens the duration of the verification procedure at the retailer's terminal.

nant since then. In April 1999 this figure amounted to roughly € 60 million. The sluggish trend up to now corresponds to that in other countries, where the use of electronic money has likewise not quite lived up to expectations.

*Determinants  
of the use of  
electronic  
money*

The reasons generally cited for the relatively sluggish development of electronic money up to now are the fees charged by the banking industry, which merchants still consider to be too high,<sup>11</sup> the fact that potential users have been provided with insufficient information, and apparently also the lack of diversity of possible and additional uses. Furthermore, a certain inertia on the part of customers in their willingness to change their payment habits, and also network effects, probably play a role. The term "network effects" is used to describe the experience that an innovation will be more beneficial to a potential user the more widespread this innovation already is and the more it is used by third parties. In this context, the apparently still insufficient proliferation of loading terminals and GeldKarte terminals in trade, which depends particularly on the concomitant costs and additional revenue opportunities, plays a key role.

*Potential  
increase in the  
use of the  
GeldKarte*

The expectation voiced in the market that nonetheless the use of the GeldKarte will probably increase sharply is primarily based on the fact that card phones are now being outfitted with the GeldKarte function, that the GeldKarte is increasingly being tried out and used in public commuter transport, and that the date for the introduction of euro notes and coins and the concomitant adapta-

### Value of electronic money stored on prepaid cards

Figures in DM million; from 1999 in € million

Month	1997	1998	1999
January	13	92	59
February	16	96	61
March	23	101	61
April	28	102	60
May	34	100	.
June	39	101	.
July	46	100	.
August	48	112	.
September	51	103	.
October	58	108	.
November	72	110	.
December	83	113	.

Deutsche Bundesbank

tion of vending machines is approaching. Furthermore, it is expected that the significance of additional functions of the GeldKarte will increase (e. g. electronic transport ticket that automatically calculates the fare and credits it to associated public transport authorities, bonus points, identification card function, etc.). The GeldKarte is likely to receive additional impetus from the possibility of its cross-border use based on the open standard CEPS (Common Electronic Purse Specifications). As the banking industry is still charging fees for the exchange of national currency in the euro area, and will probably do so until

<sup>11</sup> Bibow and Wichmann cite the study of a chain of retailers according to which the overall cost of a payment by GeldKarte totals 1.7 % of the turnover, as opposed to around 1 % in the case of cash payment. See J. Bibow and T. Wichmann (1997), Elektronisches Geld: Funktionsweise und wirtschaftspolitische Konsequenzen, in: RWI-Mitteilungen, Vol. 47, pages 115–139, here: page 129.

### Structure of card-based payment systems in Germany

Item	1991	1992	1993	1994	1995	1996	1997	1998
Cash dispensers and ATMs (thousands)	13.8	19.0	25.0	29.4	35.7	37.6	41.4	44.0
Purchase terminals in retail trade and the like (thousands)	34.7	51.8	28.0	62.5	70.0	115.0	160.4	204.7
E-money loading machines (thousands)	–	–	–	–	–	4.8	20.3	22.0
E-money purchase terminals (thousands)	–	–	–	–	–	1.0	50.0	60.0
Number of cards in circulation (millions)								
Debit cards <sup>1</sup>	27.4	31.9	35.9	37.1	62.6	66.9	71.0	...
Memo item: eurocheque cards	30.3	33.4	35.3	36.6	37.7	39.3	40.8	43.1
Credit cards	6.1	7.4	8.9	10.2	11.7	13.5	14.2	15.2
Retailer cards	1.5	–	–	–	–	3.0	–	3.9
E-money cards (eurocheque cards, bank customer cards)	–	–	–	–	–	25.0	35.0	50.0
Credit card transactions								
Number (millions)	150.1	186.0	224.4	246.5	266.7	289.9	303.4	...
Value (DM billion)	28.2	33.8	42.1	46.4	45.1	49.2	52.7	...
Debit card transactions <sup>2</sup>								
Number (millions)	20.2	28.0	69.1	104.0	149.4	214.2	225.8	360.7
Value (DM billion)	1.8	1.9	6.2	10.8	20.5	32.7	29.0	56.7 (110)
Number of e-money transactions at loading machines (millions)	–	–	–	–	–	0.08	1.6	2.2
Value of e-money transactions at loading machines (DM million)	–	–	–	–	–	10.3	–	229.2
Number of e-money transactions at purchase terminals (millions)	–	–	–	–	–	0.22	4.2	12.1
Value of e-money transactions at purchase terminals (DM million)	–	–	–	–	–	5.7	85.0	159.9

Source: Bundesbank surveys (see also "Payment Systems in the European Union") and information provided by associations. — 1 Eurocheque cards which can be used as debit cards if they are issued with a personal identification number (PIN). Including bank customer cards after 1993. — 2 In 1991 and 1992 electronic cash and other

debit card procedures. In 1993-6 and 1998 electronic cash and "POZ" procedures. In 1997 only electronic cash procedure. All information not including electronic direct debiting (estimated at around DM 52 billion for 1998; overall, including electronic direct debiting, value estimated at just under DM 110 billion).

Deutsche Bundesbank

euro notes are issued, the GeldKarte and other debit cards that can be used across borders ("edc") are likely to constitute attractive alternatives.

As regards credit and debit cards, which, unlike electronic money on the GeldKarte, are not a new form of money but only products providing access to scriptural money, particularly the significance of the debit card has risen sharply. Whereas the number (300 million) and value (just over DM 50 billion) of credit card payments roughly doubled between 1991 and 1997,<sup>12</sup> the number of debit card transactions (electronic cash and POZ) went up by a factor of 18 between 1991 and 1998, rising from 20 million to over 360 million; the value of those transactions, at an estimated DM 57 billion, was 30 times the 1991 figure. If

debit card payments in electronic direct debiting are also included, the numbers grow even larger (the value of all debit card transactions for 1998 is estimated at a total of slightly less than DM 110 billion).<sup>13</sup> By contrast, the number and value of electronic money transactions in 1998, at 12 million transactions and a turnover of around DM 160 million, are much lower (in 1997, this figure only amounted to around DM 85 million, given just over 4 million transactions).

<sup>12</sup> No figures are available for 1998 at present.

<sup>13</sup> According to information provided by Source magazine, No. 5, of May 15, 1999, page 6, signature-based debiting schemes involving eurocheque cards (POZ and electronic direct debiting) accounted for a retail turnover of DM 72 billion altogether, or around 10 % of total retail turnover. According to Bundesbank calculations, electronic direct debiting alone accounted for DM 52 billion, and POZ for just under DM 20 billion.

*Market  
segmentation*

If it is assumed that those credit institutions participating in card-based payments are striving towards a certain vertical market segmentation in the transaction amounts paid using their products, the credit card should tend towards the top, and the GeldKarte towards the bottom, of the spectrum. The available figures actually do point to a type of specialisation. Between 1991 and 1997 the average amount per credit card transaction went down slightly from around DM 180 to DM 170. In the case of debit cards (electronic cash and POZ), these figures rose between 1991 and 1998 from around DM 90 to an average of roughly DM 155. Within the various debit card schemes, electronic direct debiting is likely to be used for smaller payments, on average. In the case of the GeldKarte, in 1998 an average of DM 104 per loading procedure was stored on the electronic purse; between the beginning of 1997 and the end of 1998 the average amount per transaction dropped from DM 33 to just under DM 10 and, as envisaged by the banking industry, approached the area of low-value payments which had previously been made using cash.

### On the expected use of network money

*Payment  
instruments on  
the Internet ...*

There is no broadly based empirical evidence on the use of network money for Germany at present. However, that does not imply that the spread of network money will remain muted over the long run. Its use in Internet trade will depend not only on whether a satisfactory security solution is found but also, and in particular, on which alternative pay-

ment instruments are available to customers. This raises the question of the payment system on the Internet.<sup>14</sup>

Analogously to the way the payment system for OTC trade is usually presented in the literature, the payment system on the Internet can be basically classified as shown by the chart on page 48.<sup>15</sup> In the literature, the different payment instruments are classified by the point in time when the liquidity effect sets in from the point of view of the payer, i. e. the purchaser of a good or service. In that sense, network money is a "pay before" type of payment instrument. From the point in time when electronic money units are obtained, i. e. before the time of the actual purchase, the payer forfeits the opportunity to invest his funds in an alternative interest-bearing manner. As opposed to cash, though, electronic money basically offers the issuer the technical wherewithal to pay interest on balances. This is true at least in a system where the operator centrally records the balances of all participants. Part of the yield

*... can be  
classified  
analogously to  
those in OTC  
trade*

---

<sup>14</sup> For a more detailed description of the payment system on the Internet see, for example: A. Furche and G. Wrightson (1997), *Computer Money*, Heidelberg; R. Schuster, J. Färber and M. Eberl (1997), *Digital Cash*, Berlin; M. Stolpmann (1997), *Elektronisches Geld im Internet: Grundlagen, Konzepte, Perspektiven*, Cologne; or A. Weisshuhn (1998), *Digitale Zahlungsverfahren im Internet*, Wiesbaden.

<sup>15</sup> See, for example, H.-E. Büschgen (1998), *Bankbetriebslehre*, Wiesbaden, 5th edition, page 432 for a description of the payment system in OTC trade. When describing the Internet payment system, it must be borne in mind that not all goods or services purchased on the Internet are necessarily paid within this medium. For instance, in Internet mail order trade, most payments are probably made by invoicing or c.o.d. By contrast, the chart only shows instruments which can be used for payments on the Internet. Furthermore, it must be pointed out that not all payment schemes described are operated by German companies. Since domestic consumers can also use payment services provided by foreign issuers, it seems appropriate to include them in this survey.





net will not be executed until small amounts can be paid finally and definitely and at low cost. This applies mainly to purchases of low-priced electronic products. A typical example in this context is trade in information or the selling of software on the Internet.

*Opportunity costs of various payment instruments*

In view of the alternative payment instruments available on the Internet, the future spread of network money will basically depend on the relative costs and benefits of its use.<sup>16</sup> From the payers' perspective, classifying the payment into one of the three categories of payment instruments reflects a major part of the costs of a transaction. If the liquidity effect sets in prior to receipt of the good, the buyer incurs opportunity costs in the form of lost interest income. If the good is paid for after receipt, interest gains should be taken into account. To the providers of payment services, classification into the three liquidity effect categories also plays a key role. Thus, a prepaid payment instrument enables the issuer to invest the funds at interest, whereas the use of a payment instrument where the liquidity effect sets in only after the transfer of the good involves a deferral or a loan to the buyer.

*Different risks of payment instruments*

In addition, a decision on one of the available payment instruments must take fees (if any) into account. Finally, it should be borne in mind that the use of each payment instrument may harbour a different degree of risk. Unlike other payment instruments, the use of network money as a prepaid bearer instrument involves transferring purchasing power in the form of stored money units via the Internet. As in a cash payment, this type of

transaction also (at least in general) carries the risk of loss, theft and counterfeit<sup>17</sup>.

The aforementioned costs of network money transactions contrast with the benefits resulting from the special features of electronic money. As a bearer instrument, network money is the only payment instrument on the Internet which involves definite and final settlement of a payment. In addition, the anonymity of the transaction (to be ensured by cryptographic methods) which is particularly associated with software-based network money may promote the use of cyber money as a payment instrument.

*Benefits of payments using network money*

The question as to the potential effects of the special costs and benefits associated with electronic money on its spread has been the subject of several theoretical studies.<sup>18</sup> Basically, they all expect payment instruments in OTC trade to become specialised according to the transaction value.<sup>19</sup> Electronic money is likely to be used primarily in the segment of small-value payments. As stated above, these findings are confirmed by initial experience of

*Theoretical considerations ...*

---

<sup>16</sup> See, for instance: Bank for International Settlements (1996), Implications for Central Banks of the Development of Electronic Money, Basle, page 3.

<sup>17</sup> Besides, other risks may arise in banks' network money business such as special operational or legal risks.

<sup>18</sup> For a general analysis of the cost-benefit structure of electronic money and its role, see, for instance: H.-E. Büschgen (1998), Innovative elektronische Zahlungssysteme, Finanzierung – Leasing – Factoring, Vol. 45, No. 3, May 1998, pages 106–112; D. Dickertmann and R. Feucht (1997), Zahlungskarten: Erscheinungsformen, Funktionen und Bewertung aus einzelwirtschaftlicher Sicht, Das Wirtschaftsstudium, Vol. 26, 1/97, pages 65–70; or D. K. Herreiner (1997), Die volkswirtschaftliche Bedeutung elektronischen Geldes, Datenschutz und Datenverarbeitung, Vol. 21, No. 7, pages 390–395.

<sup>19</sup> For a comprehensive model which includes all decision-makers, see: O. Shy and J. Tarkka (1998), The Market for Electronic Cash Cards, Bank of Finland Discussion Papers, 21/98.

the use of electronic money in German OTC trade.

*... indicate that network money will be used for low-value payments*

Similar considerations hold for electronic commerce. A simple model with two payment instruments shows that on the Internet electronic money will likewise probably play the role of a payment instrument for small-value payments (see the Annex, page 54 ff.). This is due mainly to the fact that major cost components of network payments rise as the transaction amount increases. This applies both to the risks associated with network money payments and to the opportunity costs of holding network money. Compared to alternative payment instruments with constant costs per transaction, using network money becomes more and more unattractive as the transaction value increases. If payers seek to minimise their costs, the result will be a vertical market segmentation: small amounts will be paid with network money, while credit cards, for instance, will be used to pay large amounts. However, since network money issuers can pay interest on the stored value, they are able to influence the extent to which their product is used. If the interest paid on network money balances increases, the opportunity costs of holding them will decrease. In that case, the payment amount above which alternative payment instruments are used will rise. However, for the issuers, this extension of the market for network money will reduce the profit per stored money unit. The revenue from the interest-bearing investment of the float is passed on at least in part to the network money holders. If the network money issuers in the model seek to maximise their profits, they will remu-

nerate the stored value of the network money below the market rate, thus limiting the use of electronic money on the Internet.

### Implications of electronic money for monetary policy

---

Realising that electronic money may become widespread in payments by non-banks, the central banks studied the implications for monetary policy and described them in detail at an early stage.<sup>20</sup> Whereas those studies initially focused on the use of electronic money in OTC trade, more recent studies also include the phenomenon of network money. This was one of the reasons why the ECB presented its Report on Electronic Money last year.<sup>21</sup> According to this report, the findings regarding the monetary policy implications of a general, more widespread use of electronic money, which were described in an earlier Monthly Report<sup>22</sup>, also apply to network money. These findings are of special relevance to monetary policy strategy and money market management. For instance, one of the problems in this area is how to effectively distinguish between monetary aggregates and liabilities of non-banks which also wish to issue electronic money but are not supervised as strictly and are not subject to statistical reporting requirements. In addition, the economisation of transaction balances may be enhanced by the payment of interest on

*Implications of electronic money for monetary policy*

---

20 See: European Monetary Institute (1994), Prepaid Cards, Frankfurt/Main; Bank for International Settlements (1996), loc. cit.; or Deutsche Bundesbank (1997), loc. cit.

21 European Central Bank (1998), loc. cit.

22 See: Deutsche Bundesbank (1997), loc. cit., here: page 43 ff.

the electronic money issued. The resulting increase in the specific interest of the money stock is likely to make it more difficult to control monetary aggregates owing to lower negative interest rate elasticity. Finally, money market management could also become somewhat more complicated if a significant amount of the currency in circulation were replaced by electronic money. This would result in a drop in the refinancing volume of the banking industry provided by the central banks. Influence on the money market rate would decrease, and the transmission of monetary policy stimuli via the banking system could change.

*Network money poses additional challenges to monetary policy*

Furthermore, network money poses additional challenges to monetary policy, first of all due to the possibility of the cross-border use and issuance of network money. It is conceivable, particularly with software-based products, that residents will use money issued by a non-resident for domestic purchases. If such transactions increase significantly and if they coincide with rising holdings of money abroad, the link between the domestic money stock and the domestic transaction volume is likely to become less pronounced. Consequently, monetary aggregates would probably lose some of their predictive power regarding future inflation trends. In addition, one cannot rule out the possibility of network money circulation becoming independent of monetary policy. This is all the more likely if network money schemes are not subject to minimum reserve requirements and electronic money is not issued in exchange for traditional forms of money such as sight deposits, but in connection with lending.<sup>23</sup> Against the background

of the theoretical studies on the decision between various payment instruments, such a scenario does not seem very likely, since the extent to which customers are expected to use network money for payment purposes is limited to small-value payments in electronic commerce. However, exact forecasts of the evolution of this market segment in electronic commerce are hardly possible.

### The legal framework for electronic money

---

The monetary policy analyses described above call for a certain legal framework for electronic money which, however, has not yet been clearly defined. Minimum requirements drawn up by the EU central banks were published in the reports by the European Monetary Institute (May 1994) and the European Central Bank (August 1998). According to these reports, issuers of e-money should, for instance, be subject to banking supervision; it should be possible to impose minimum reserve requirements on them; they should be required to submit statistical reports; and they should be obligated to redeem electronic money against central bank money. Further objectives mentioned in the ECB's report are the interoperability of e-money schemes and the introduction of adequate guarantee and insurance schemes to protect e-money holders.

*The ECB's minimum requirements*

---

<sup>23</sup> Given the assumptions mentioned above, it can be shown that the money multiplier, i.e. the ratio, say, of the broad monetary aggregate M3 (which must include electronic money) and the base money issued by the central bank, is infinite. See, for instance: F. Söllner and A. Wilfert (1996), *Elektronisches Geld und Geldpolitik*, List Forum für Wirtschafts- und Finanzpolitik, Vol. 22, No. 3, pages 389-405, here: page 401.

*International  
coordination  
desirable*

In addition, increased international coordination is desirable since it is technically possible to geographically delocate the issuance of money, particularly as regards software-based network money. This also applies to matters such as payment systems oversight and banking supervision.<sup>24</sup>

*German  
legislation*

Legislation in Germany largely complies with the ECB's minimum requirements. The Sixth Act Amending the Banking Act, much of which entered into force on January 1, 1998,<sup>25</sup> extends the list of banking business to include prepaid card and network money business. Pursuant to section 1 (1), sentence 2, Nos. 11 and 12 of the Banking Act, banking business also comprises "... 11. the issuance of prepaid cards for payment purposes, unless the card issuer is also the service provider and hence the recipient of the payment made using the card (prepaid card business), and 12. the creation and administration of units of payment in computer networks (network money business)". At the same time, section 2 (5) of the Banking Act specifies that in the event of limited use and dissemination, this business may be exempt from several – in some cases, key – provisions of the Banking Act.<sup>26</sup> In Germany, e-money is therefore issued exclusively by credit institutions, pursuant to the provisions of the Banking Act.

*EU legislation*

Credit institutions based in other EU countries as defined by European law which issue e-money and conduct deposit and lending business pursuant to Article 1 (1) of the First Banking Co-ordination Directive also largely comply with the ECB's minimum requirements, since they are subject to banking

supervision and minimum reserve requirements. Apart from that, there are no supervisory regulations governing e-money business at the Community level as yet. Therefore, both banks and non-banks may conduct cross-border business with electronic money unless it contravenes national regulations such as Germany's Banking Act. As regards e-money issued by credit institutions, the influence of monetary policy has even grown since the start of Stage Three of European monetary union, because now minimum reserves must be held on e-money, too; since then these reserves are interest-bearing.<sup>27</sup>

Regarding e-money issued by non-banks outside Germany, it should be noted that they are not classified as "European credit institutions" and hence are not subject to banking supervision pursuant to Community law. On July 29, 1998 the European Commission adopted a proposal on this subject for a "Directive on the taking up, the pursuit and the prudential supervision of the business of electronic money institutions" ("E-money Direct-

*Draft EU  
directive*

---

<sup>24</sup> See: European Central Bank (1998), loc. cit., here: page 35 f.

<sup>25</sup> For a critical assessment of these prudential provisions in the Banking Act, see: H. Godschalk (1999), E-Geld aus Sicht der Regulatoren, Eine kritische Würdigung der 6. KWG-Novelle, in: M. Erlei et al. (eds.), Beiträge zur angewandten Wirtschaftstheorie, Regensburg, pages 255–276.

<sup>26</sup> Section 2 (5) of the Banking Act states that: "The Federal Banking Supervisory Office may rule in particular cases, in consultation with the Deutsche Bundesbank, that an enterprise which solely conducts prepaid card business is not subject to the provisions of sections 10 to 18, 24, 32 to 38, 45, 46 to 46c and 51 (1) of this Act or of section 112 (2) of the Composition Code (Vergleichsordnung), taken as a whole, if the prepaid cards have a limited use and dissemination which suggests that they are unlikely to pose a threat to the payment system."

<sup>27</sup> The minimum reserve provisions applicable in Germany up to the end of 1998 did not permit the inclusion of money units stored on prepaid cards in the minimum reserves.

ive") which is still being discussed by the relevant advisory committees.<sup>28</sup>

*Equal treatment  
of non-bank  
issuers and  
credit institu-  
tions in super-  
visory and  
monetary terms*

In the end, the Commission chose the option preferred by the ECB, according to which the issuance of e-money is to be restricted to credit institutions as defined by European law. Although the draft E-money Directive is addressed to non-banks issuing e-money ("e-money institutions"), these non-banks are put on the same footing as traditional credit institutions through the planned simultaneous extension of the definition of banks provided by the First Banking Co-ordination Directive, which will then include e-money institutions. This means that non-banks which intend to issue e-money pursuant to the E-money Directive are subject to banking supervision. However, the draft directive provides for a derogation in the light of their limited business, or it envisages special provisions for e-money business. Therefore, as "credit institutions" under Community law, they would be subject to minimum reserve requirements but would also have access to central bank refinancing. In practice, the extension of the First Banking Co-ordination Directive's definition of banks would create two categories of credit institutions: "traditional credit institutions" subject to comprehensive banking supervision, and "e-money institutions" subject to the provisions of the E-money Directive.

*Redemption  
commitment*

Another issue still being debated is whether e-money issuers should be legally obliged to redeem e-money at the holder's request against central bank money at any time. This redemption commitment, which could also

be limited to scriptural money subject to the customer's consent, would improve the link between e-money and central bank money and would facilitate the central bank's control of the money market. In addition, this commitment would reduce the potential threat which could be posed to the unit-of-account function of money if the issuers did not exchange e-money at par. In the final analysis, the monetary function of e-money, like that of the banks' scriptural money, will probably depend on the possibility of exchanging it against cash at any time.

Another legal aspect of the issuance of e-money is the regulation of the involved parties' relationships under private law. For instance, when paying with an electronic purse in the form of the German GeldKarte, the applicable rights and obligations of the credit institutions involved are governed by an inter-bank agreement, those between the merchants and the banking industry in the respective terms and conditions for merchants, and those between the credit institutions and their customers by the terms and conditions of the eurocheque cards. So far, the literature on this subject has largely described the legal characteristics of the contractual relationships created by using the GeldKarte by falling back on the principles developed by established case law and literature for other card-based payment schemes.

*Private-law  
aspects*

---

<sup>28</sup> See: Deutsche Bundesbank, Annual Report 1998, page 131 ff. ("Electronic money") and European Central Bank (1999), Annual Report 1998, page 105 f. ("Report on electronic money").

## Annex

### Network money in a model with two payment instruments

Based on a simple theoretical model, this Annex deals with the role network money plays in Internet payments.<sup>29</sup> The analysis takes into account both the cost calculations of e-money holders and the profit considerations of the providers of these innovative payment products.

Demand for payment media is largely modelled along the lines of Whitesell (1992).<sup>30</sup> It is a simple cash-in-advance model where, at the beginning of a period, the payers must decide which payment instruments to hold. The payment instruments differ as to the costs they involve. Each individual in the model in question is provided with a fixed income which is evenly spent on all types of goods (Y per type of good). The goods have different prices. Given the equal shares of expenditure on each good, they also differ as to their trading frequency (n): during the period, expensive goods are purchased less often (low trading frequency) than low-priced products (high trading frequency). In the model considered here, the individual's decision problem is reduced to minimising the transaction costs associated with purchasing these goods.

For simplicity, only two payment instruments will be discussed here: credit cards and network money. The costs per type of good are specified as follows:

	Transaction costs per period	Opportunity costs per period
Network money	kY	(r-r <sub>E</sub> )Y
Credit card	β <sub>K</sub> n	–

where k represents the risk of loss, theft or counterfeit (at least generally) associated with network money payments, β<sub>K</sub> the fixed transaction costs (fees) of a payment by credit card and r-r<sub>E</sub> the difference between the market rate and the interest paid on holdings of network money.

If N denotes the maximum trading frequency and μ the borderline between payments by credit card and network money for which 0 ≤ μ ≤ N, the consumer then faces the following optimisation problem:

$$\text{Min} \int_{\mu}^{\mu} (\beta_K n) dn + \int_{\mu}^N (k + (r - r_E)) Y dn$$

The first-order condition yields the following borderline which minimises transaction costs:

$$\mu = \frac{kY + (r - r_E)Y}{\beta_K}$$

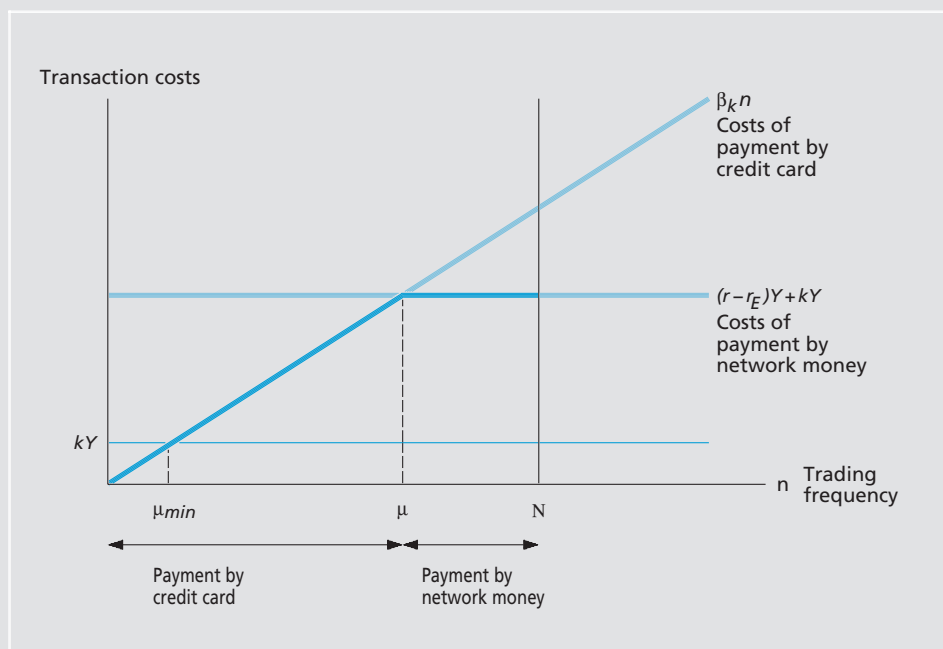
The optimisation problem faced by individuals can be portrayed in the form of the chart on page 55.

μ<sub>min</sub> is the lowest possible borderline of the segment of transactions settled using network money, which is not undershot if a positive risk of loss, theft and counterfeit k exists. For r=r<sub>E</sub>, depending on the fee levied for the credit card transaction, this borderline is:

<sup>29</sup> For a detailed description of the model, see: G. Kabellac (1999), loc. cit.

<sup>30</sup> W. C. Whitesell (1992), Deposit Banks and the Market for Payment Media, *Journal of Money, Credit and Banking*, Vol. 21, pages 483–498.

### Distribution of payment media



Deutsche Bundesbank

$$\mu_{\min} = \frac{kY}{\beta_K}$$

In the following, a credit card issuer and a network money issuer on the supply side will be considered, both of whom have a monopoly in their respective market. As far as the issuers' optimisation problem is concerned, the simplest cost structure possible is assumed. The credit card issuer produces his services at constant costs of  $c_K > 0$  per transaction. No further costs exist. By contrast, the costs of issuing network money are negligible ( $c_E = 0$ ).

Hence, the credit card issuer's profit, depending on the value of  $\mu$  is:

$$\Pi_K = \int_0^{\mu} ((\beta_K - c_K)n) dn$$

The profit equation for the issuer of network money is:

$$\Pi_E = \int_{\mu}^N ((r - r_E)Y) dn$$

The credit card issuer can maximise his profit by choosing a value for  $\beta_K$ . The network money issuer maximises his profit by choosing a value for  $r_E$ . A (Nash) equilibrium is reached in the model if neither of the two has an incentive to change his decision parameter in response to the other's choice. The equilibrium fee per credit card transaction maximises the credit card issuer's profit if the network money issuer selects the equilibrium rate of interest, and vice versa. Therefore, the next step is to derive the best decision parameter a monopolist can select in response to the other's decision parameter choice. We obtain the following response

functions of the two monopolists depending on the other's strategy variable:

$$\beta_k = 2c_k$$

$$r-r_E = \frac{1}{2} \left( \frac{\beta_k N}{Y} - k \right)$$

It turns out that the credit card issuer selects the fee to be charged regardless of the behaviour of the network money issuer. By contrast, the lower the fee per credit card transaction, the higher the rate of interest on network money holdings or the lower the spread  $r-r_E$  selected by the network money issuer will be. Furthermore, the interest on e-money holdings will rise in line with an increase in the transaction volume per type of good  $Y$ , a decline in the transaction segment  $N$ , and a rise in the risk parameter  $k$ . This means an indirect compensation for a rising loss risk. In addition, it proves to be worthwhile for the network money issuer to strive for a greater market share as expenditure per type of good rises, despite the fact that he will have to hand over a larger percentage of the (then rising) interest income from the float to the e-money holders. Ultimately, the issuer reacts to a reduction in the transaction segment being analysed here by making his payment instrument more attractive to customers so as not to let the remaining market share become too small.

The equilibrium results as:

$$\beta_k^* = 2c_k \quad \text{and} \quad r-r_E^* = \frac{c_k N}{Y} - \frac{1}{2} k$$

which yields the following borderline  $\mu$  between the segments of the two payment media:

$$\mu = \frac{1}{2} \left( N + \frac{1}{2} \frac{kY}{c_k} \right) = \frac{1}{2} (N + \mu_{\min})$$

Consequently, in equilibrium, a division of the market occurs in this simple model such that both issuers each serve exactly half of the market for payment media when the loss risk of network money is negligible. Otherwise, this risk then leads to the market share of network money being less than half of the market. However, it accounts for half of the remaining market when taking into consideration the fact that the segment up to  $\mu_{\min}$  is left to the credit card issuer anyway. This segment is determined by the transaction fee chosen by the credit card issuer and is hence not exogenous.

Even if the loss risk is negligible, the network money issuer in this model has no incentive to cover the entire market through the choice of his cost parameter. To this end he would have to offer his customers an interest rate that does not maximise his profit. So, even in this case, the result remains a segmentation of the market for payment services such that network money assumes the role of a medium of exchange for small-value payments.



## Glossary of technical terms used in this article

**Acceptor:** any trading or service establishment that accepts, on its own behalf or on behalf of its network, the payment of goods or services via an electronic money instrument.

**Access products:** payment instruments that allow customers to access their deposit accounts and to transfer the deposits therein. These include electronic funds transfers at the point of sale and home banking facilities. In a broader sense they also include all cashless payment instruments, since they provide access to an account (e.g. cheques, transfers, debits, credit and debit cards).

**Authentication:** the process of checking and verifying authorisation to conduct a transaction.

**Card-based e-money:** e-money stored on a portable DP medium issued to the customer, typically a smart card equipped with a microchip.

**Cash card:** card used to obtain cash from an automated teller machine (ATM). The vast majority of cards used as cash cards in Germany are eurocheque cards (used also as debit cards) and cards issued by banks to customers. Credit cards may generally be used for this purpose as well.

**Charge card:** credit card with a limited deferral period prior to the final debiting of the cardholder's account.

**Cryptography:** the application of mathematical theory to develop techniques and algorithms to encrypt data so as to ensure confidentiality and data integrity.

**Debit card:** card enabling the holders to make payments directly from their deposit accounts, e.g. by directly charging a purchase at the point of sale (POS) or withdrawing cash from an ATM. Debit card procedures in Germany include electronic cash with PIN numbers, the POZ procedure, electronic direct debiting and electronic cash offline.

**electronic cash:** a debit card procedure devised by the German banking industry in which authorisation to make a payment is verified at the purchase terminal using a personal identification number (PIN) through a direct link with a corresponding file. The banking industry then guarantees the acceptor that payment of the amount thus settled will be made.

**Electronic direct debiting:** a method developed by merchants themselves whereby a debit is triggered using the data on the card. Through their signature, the customers give the merchant a once-only authorisation to withdraw the amount to be paid by debiting the customer's account. The merchant does not check whether the card is blocked, and the banking industry does not guarantee payment.

**Network money:** e-money transmitted via telecommunication networks such as the Internet.

**Offline authentication:** verification of the authorisation to execute a transaction (e.g. electronic cash offline) is carried out not by directly accessing a remote file (online authentication) but at the point of sale by checking the authorisation (to conduct the transaction) previously stored in the microprocessor itself, e.g. by having used a PIN.

**PIN:** personal identification number used to verify authorisation. It acts as a signature for electronic transactions.

**POS:** Point of Sale: retail location where a card is used for payment. Payment information is captured by means of a paper voucher or electronic terminals. If the payment data are forwarded electronically, the term "electronic funds transfer at the point of sale" ("EFTPOS") is used.

**POZ:** (German abbreviation for) Point of Sale Without Payment Guarantee. This is a debit card procedure where cardholders give authorisation to debit their account through their signature at the merchant. A check is run to see whether the card is blocked, yet the acceptor receives no guarantee of payment from the issuing institution.

**Prepaid single-purpose card:** a memory card where the card issuer and the merchant (card acceptor) are identical. The money units stored are an advance payment for certain goods or services offered by the issuer.

**Software-based e-money:** a form of electronic money which is based on a special form of software stored on a PC and which is characterised by the transfer of electronically stored money units via telecommunication networks such as the Internet.

Sources: European Central Bank (1998), loc. cit., here: Annex 1, page 37 ff.; European Central Bank (1999), Payment

Systems in the European Union, Addendum Incorporating 1997 Figures, Annex 2.