

PAYMENTS ARE NO FREE LUNCH

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ABSTRACT

Total costs of the payments system to society are considerable. These costs can be higher or lower depending on the use of payment instruments that are less or more cost efficient. Empirical evidence is provided by a survey on the costs of POS payment instruments in the Netherlands. The overall costs involved in POS payments amount to 0.65% of gdp or, equivalently, EUR 0.35 per transaction. The e-purse is most cost-efficient, irrespective of the size of a transaction, while if the choice is between cash and the debit card, the former is most economical for purchases below EUR 11.63 and the debit card is to be preferred for larger purchases. From a cost perspective, credit cards should not be used at all. The distorting effect caused by the use of public resources to finance the expenses made by central bank to maintain the cash circulation is found to be limited. It is argued that a less-cash society has better chances of success than a cashless one, at least in the medium term.

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Section 1 Introduction

For centuries, cash constituted the only way to pay for people's regular purchases. Cheques were also used, but mostly for higher-value purchases. The second half of the last century witnessed the arrival of credit cards, while cheques were used more and more for smaller purchases. Technological developments have provided a further stimulus towards the use of 'plastic', more particularly the debit card and the e-purse, to make Electronic Fund Transfer for Point Of Sales (EFTPOS) payments. These electronic payment devices offer great advantages in terms of costs, safety and convenience, and are now commonly used. The more traditional payment instruments are, however, still generally used as well. Thus a range of payments instruments is nowadays available.

The availability of various payment instruments raises interesting questions for policy makers, payments service providers and users. As payment instruments differ with respect to their cost profiles and inherent characteristics such as safety and user convenience, the question arises which payment instrument is the most efficient. With respect to costs one would like to know how large the relative cost differences between payment instruments are, whether one of them is most efficient across the whole range of transaction sizes, and if not, which payment instrument should be preferred for which transactions. Important issues are how costs are recovered and how incentives could be structured to influence payment behaviour. Another element of debate concerns the level playing field conditions for the different payment instruments. The electronic payment instruments are basically products of the banking industry, at least in developed countries. With respect to cash, however, the central banks are in the position of (sole) issuers, although the private sector provides most of the distribution infrastructure. The central banks' role is related to the public good characteristics of cash and has historical roots because of the necessity to provide a uniform and reliable medium of exchange. Concerning the need to create a level playing field for the payment instruments, the question arises whether cash money offers unfair competition to the electronic instruments, since the central bank's costs involved with cash money are funded out of public resources. A more general, almost philosophical issue is whether a cashless society would be practically feasible and/or theoretically possible. Since the introduction of the credit card, this option of a cashless society has been a source of tempting speculation (see e.g. Garcia Swartz, Hahn, Layne-Farrar, 2004).

The present paper addresses all of the above issues. The results of a cost survey on POS payments in the Netherlands were used, along with other studies, to yield empirical evidence on the questions raised. The cost survey for the Netherlands was conducted in order to quantify the social costs of generally used payment instruments, viz. cash, the debit card, the e-purse and the credit card. In the Netherlands, cheques are not used in POS situations; they were discontinued

when the euro banknotes and coins were introduced at the start of 2002. The cost survey was one of the recommendations made by the 2002 report of the Wellink Working Group (DNB, 2002). This Working Group evaluated the Netherlands' payments system and concluded that it was characterised by an efficient infrastructure with a relatively intensive usage of computerised and therefore low-cost payment instruments. In its recommendations to the report of the Wellink Working Group, the Nederlandsche Bank explicitly noted that this conclusion did not imply that no further improvements were possible. With respect to Point of Sale payments, it was recommended to explore the social costs of the commonly used POS payment instruments in quantitative terms, in order to create a generally accepted basis for decisions on further action to enhance the efficiency of retail payments. The established Working Group on Costs of POS Payment Products published its results in 2004.² They will be discussed in this paper and used as a vehicle to yield empirical evidence on the above issues.

The costs involved in payment transactions have been analysed in a number of recent studies, see e.g. Garcia Swartz, Hahn, Layne-Farrar (2004), Guibourg and Segendorf (2004), Gresvik and Øwre (2003). The survey conducted for the Netherlands has certain advantages compared to the other studies, with respect to both scale and scope. Firstly, it considers in a fairly comprehensive way the social costs of the commonly used POS payment instruments: a) it includes the costs for the banking industry, the retail sector and the central bank, not only those for the banking sector, and b) unlike many other studies, it includes the costs of cash. Secondly, the central bank, the banks and the merchants all supplied their cost data for the survey. The results and assumptions were extensively discussed within the Working Group. Thus the expertise of the individual parties was exploited optimally while the discussions provided the necessary checks and balances, e.g. in avoiding misinterpretations of (the scope of) cost items. Thirdly, the survey distinguishes in a consistent way between fixed and variable costs and with respect to the latter, between the costs of carrying out the transaction and costs related to the size of the transaction. With these distinctions one can account for the fact that for some transaction sizes one payment instrument is most cost efficient, while another instrument is best suited for other purchases. With the available information, one can also calculate the so-called break-even transaction amounts, i.e. those amounts for which the costs of two payment instruments are equal.

The report is structured as follows. The next section will present some stylised facts on the Netherlands POS payments market, providing useful background information for the interpretation of cost figures and the discussion on, for instance, the incentive structure of POS payments. Section 3 discusses the conceptual framework of the survey. This section goes into the

² The complete report, entitled 'The Costs of Payments – Survey on the Costs involved in POS Payment Products' can be found on the website of the Nederlandsche Bank. For a summary see also DNB (2004).

differences and relationships between social and private costs and benefits. Section 3 also explores the differences between fixed and variable costs, assessing various criteria for comparing the costs involved and discussing the costs and revenues of relevant actors in the payment chain on a general level. In the actual survey, the conceptual framework has been made operational further. Therefore, section 4 discusses the actual data collected and presents some tentative outcomes. Section 4 reports the empirical results, including those of some scenario analyses to quantify possible savings if high cost payments are replaced by low cost ones. Section 5 contains a further discussion of the results. Among other things, this section assesses the feasibility of a cashless society and the possible ingredients of an incentive structure that would effectively stimulate the use of efficient payment instruments. Finally, section 6 concludes with a summary of the main results. The main text discusses the cost items on a general level. In the actual survey, the conceptual framework has been made operational. The annex discusses the actual data that were used.

Section 2 POS payments in the Netherlands

This section discusses some stylised facts on POS payments in the Netherlands, providing necessary background information for the interpretation of the results of the POS cost survey. Cash and electronic payment instruments are commonly used to make payments at points of sale. The debit card (brand name ‘PIN’), the electronic purse (brand name ‘Chipknip’) and the credit card are the most generally used electronic instruments.

Internationally, large differences exist between types and functionalities of e.g. debit cards. The *debit card* used in the Netherlands is a PIN type one. Identification takes place via a P(ersonal) I(dentification) N(umber), removing the need for a signature. The POS terminal establishes a connection with the bank account of the consumer via the central processor Interpay. The consumer’s bank checks the consumer’s account, and provided the balance is sufficient, authorises the transfer. Next, the consumer’s account is debited. The merchant’s account is credited after the clearing and settlement process, usually within one day. Thus, authorisation and debiting is effected on an on-line basis. By contrast, authorisation is entirely absent in case of an *electronic purse* transaction (except for loading (e-)money on to the purse). The payment is made out of the prepaid balance stored on the card. The merchant transfers the e-purse receipts (via Interpay, after clearing and settlement) to his bank account, for instance once a day. The range of *credit cards* on the Dutch market is rather heterogeneous with respect to the services provided by the different schemes. The credit cards commonly used in the Netherlands are actually deferred-debit cards. The cardholder’s account is usually debited once a month, so the consumer enjoys a period of free credit. Debiting can take place later, but then interest is due. Credit cards include a PIN, but it is used only for ATM cash withdrawals. In POS situations no PIN is used; identification is established with the consumer’s signature.

ATM cash withdrawals with the credit card are infrequent because of the high fees levied. Nearly all ATM withdrawals are effected with debit cards. Consumers in the Netherlands are not explicitly charged for these services, even if a bank’s customer uses another bank’s ATM. The latter cash withdrawals are processed through the network of the central processor Interpay. The absence of per-transaction fees holds more generally: as a rule, consumers are not explicitly charged for POS payments. However, an increasing number of merchants charge a small fee (EUR 0.10 – 0.20) for debit card payments of purchases below an certain amount, often EUR 10.

To give an impression of the relative importance of the individual payment instruments and their development over time, Table 2.1 presents numbers of transactions and amounts for the three electronic payment instruments. The use of electronic payment products, in terms of both numbers of transactions and amounts concerned, has increased strongly. This applies especially to

the debit card, which since 1996 has shown a 20% average annual increase in the number of transactions. In 2002, the number of debit card transactions first exceeded the one billion level and the amounts involved exceeded 50 billion euro in value. The number of e-purse transactions has remained relatively low. The strong increase in 2002 of e-purse use was driven partly by the introduction of the euro. Table 2.1 also shows that the use of cheques was very substantial in the mid-nineties, but declined gradually later on. On January 1st 2002, cheques were taken off the market.

Table 2.1 Key figures for electronic POS payments

	1996	1997	1998	1999	2000	2001	2002	2003	2004
Millions of transactions									
Debit card	371	486	595	700	802	954	1,069	1,157	1,247
Credit card	32	39	42	44	47	48	46	44	49
E-purse	1	6	17	22	25	31	87	109	127
Cheques	86	67	48	29	14	5	0	0	0
Total	490	598	702	795	888	1,038	1,202	1,310	1,423
Sales, EUR billions									
Debit card ¹	17.4	22.3	27.4	32.2	37.3	43.4	50.6	58.2	56.7
Credit card	2.7	3.4	3.9	4.4	5.2	5.3	5.3	4.9	5.3
E-purse	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.4
Cheques	6.1	4.7	3.5	2.2	1.1	0.5	0.0	0.0	0.0
Total	26.2	30.5	34.9	38.9	43.7	49.3	56.1	63.4	62.4

Source: DNB

¹ Unadjusted for cash-back transactions. In 2002, about EUR 3.4 billion was withdrawn through cash-back facilities.

Though the number of electronic payments has increased strongly, the bulk of POS payments is made in cash. The number of cash payments is not accurately known, in contrast to electronic transaction numbers. A large variety of sources, including e.g. surveys among merchants (see e.g. HBD, 2002), has led to an estimate of about 7,000 million cash payments in 2002.³ Hence about 85% of all POS transactions is paid with cash. The share of debit card transactions in 2002 was 13%. In terms of the amounts involved, however, the share of the debit card was much larger. As

³ This number concerns the POS cash payments. In addition to these payments, there are about 900 million P2P cash payments. These transactions also involve social costs. In the survey, these costs were accounted for by using only 89% of the costs of DNB, and the ATM costs of the banking industry, since cash in circulation is used for these P2P payments. All cost figures in the report exclude the costs of P2P payments.

total retail sales ran to 120 billion euro in 2002, about 40% of total POS purchases were paid with debit cards, reflecting that cash is mostly used for smaller purchases.

The continued buoyant growth in the number of electronic payments is an indication that they are increasingly replacing cash payments. Further evidence on this hypothesis is provided by the number of cash withdrawals and the amounts involved. In 2002, the number of cash withdrawals from ATMs and at bank counters decreased for the first time ever, while in 2003 the amounts thus withdrawn began to decline, also for the first time (Table 2.2). Other indicators, like the development of banknotes in circulation, confirm the decline in cash use⁴. Cash is also increasingly withdrawn in shops. In a cash-back transaction, the consumer pays a larger amount than the actual purchase with his debit card and receives the difference in cash from the cash-register attendant. Recent studies have shown that some 13% of all cash withdrawals are made through cash-back transactions. In 2002, the number of such transactions was estimated at 75 million, totalling EUR 3.4 billion, of which EUR 3 billion was accounted for by supermarkets. No time series data are available on cash-back.⁵

Table 2.2 Cash withdrawals by consumers

	1996	1997	1998	1999	2000	2001	2002	2003	2004
Millions of transactions									
Counter	88	76	67	61	53	43	32	25	20
ATM	372	380	418	440	454	467	470	450	446
Total	460	456	485	501	507	510	502	475	466
Value in EUR billions									
Counter	27	26	24	25	25	21	22	14	11
ATM	33	33	35	38	40	44	51	47	47
Total	60	59	59	63	65	65	73	61	58

Source: DNB

⁴ Data on the banknote circulation are only available for the guilder area, i.e. until 2001. Leaving aside 2001 where circulation data were distorted in the run-up towards the introduction of euro banknotes, the ratio of the value of the banknote circulation (excluding the DFL 1000 and 250 notes that were hardly used for payments transactions) to nominal private consumption showed a steady decline.

⁵ Since 2000, the central bank of Norway has published data on cash-back transactions (Norges Bank, 2004). From 2000 to 2003 the number has increased strongly, from 102 million (43% of all cash withdrawals) to 150.6 million (56% of all cash withdrawals). The average cash-back withdrawal is about one third the size of an ATM cash withdrawal (NOK 351 versus NOK 1117).

Section 3 Conceptual framework

The focus in this study is on the social costs of payment transactions. In the first subsection, we elaborate on the exact definition of the social cost concept used, and go into the differences between social and private costs. The latter are relevant for the decision by payers to use a specific payment instrument or the decision by a merchant to offer specific payment facilities. In this context, private revenues are relevant also, since the above decisions depend on cost/benefit analyses. Besides social costs there are social benefits, which will also be briefly addressed in the first part of this section.

The second subsection addresses the distinction between fixed and variable costs. An efficiency ranking of the payment instruments usually depends on the size of the purchases. For instance, cash may be most cost effective for small transactions, whereas for larger ones the debit card should be preferred. These differences can be readily understood if a proper distinction is made as to the nature of the costs involved, viz. fixed and variable costs. With respect to the latter, one may distinguish between the variable costs of carrying out the transaction (which are independent from the size of the transaction amount) and those variable costs which relate to the transaction amount. This distinction is useful in explaining why a cost efficiency ranking depends on the size of the actual transaction.

3.1 Social versus private costs and revenues

Social costs are defined as the costs of the resources, in terms of capital and labour, that are put into the production of payment services. This concept amounts to the sum of all internal costs made by the relevant parties in the payment chain in order to carry out POS transactions. The parties considered are the central bank, the banking sector, the retail sector and consumers, while the payment instruments considered are cash, debit card, electronic purse and credit card.

In addition to social costs, one can look at private costs and revenues, and at social benefits. In the present study, the following definitions are used:

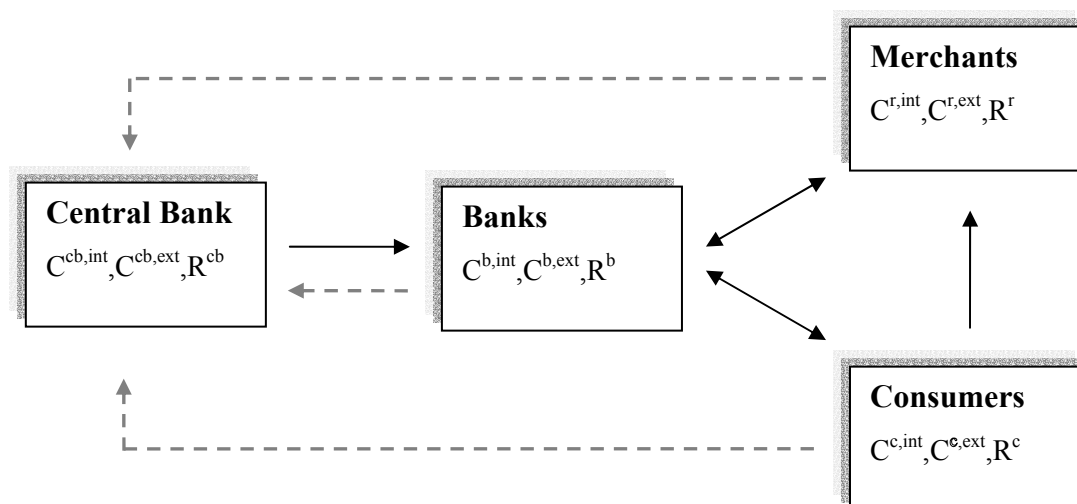
- external costs = payments (fees/tariffs etc.) charged to other parties in the payment chain
- internal costs = all other costs, roughly the costs of value added payment services⁶

⁶ Payments to third parties, viz. those companies not present in Chart 3.1 (e.g. telecom companies, insurance companies, printing companies (e.g. for banknotes), etc.) are considered as internal costs. In the

- total costs = $C^{\text{int}} + C^{\text{ext}}$
- revenues = payments (fees/tariffs etc.) received from other parties in the payment chain
- total net costs = total costs minus revenues
- social costs = sum of internal costs of all parties in the payment chain.

In order to illustrate the differences and relationships between these concepts, Chart 3.1 presents, in four boxes, the parties active in the payment chain with their internal and external costs (denoted with capital C and superscript int or ext, respectively) and their revenues (denoted by capital R). We use the term revenue instead of benefits to emphasise that aspects like user convenience and safety are not considered. They are addressed briefly in the discussion on social benefits.

Chart 3.1 Parties in the payment chain and their costs and revenues



Transfers between parties are denoted by the arrows between the boxes. The dotted arrows indicate a specific transfer, viz. seigniorage. Central banks circulate notes and coins, but do not pay interest on these debt instruments. Hence, all agents holding cash money bear opportunity interest costs. Seigniorage constitutes an implicit transfer from banks, merchants and consumers to the central bank. The solid arrows indicate more explicit transfers. They will be discussed below. The Chart shows that, apart from seigniorage, the retail sector and consumers do not make transfers to the central bank.

cost calculations, the actual price paid is used for these items. This may lead to some bias in the outcomes, unless the profit margin on the services delivered by these third parties is nil.

General description of cost and revenue items

In the Netherlands, the *central bank* has the statutory duty to maintain the supply of banknotes, while the Ministry of Finance is responsible for coins. In this respect, cost items include the cost of producing notes and coins, distribution costs, costs pertaining to departments organising and managing logistical processes, product development costs (design and technical requirements for banknotes, counterfeit detection equipment etc.), costs involved in checking banknotes for genuineness and fitness for recirculation (including audit & control departments, logistics, transportation), and storage and security (vault) costs. The banks have to pay for specific services provided by the central bank. Seigniorage constitutes a less visible transfer from the banks and the public (both merchants and consumers) to the central bank.

The *banking sector* has a pivotal role in the distribution of cash. In this context ATMs and branch offices are important distribution channels for both consumers and merchants. Periodically, surplus cash is deposited at the banks by merchants. This requires the presence of several facilities such as night safes, sealed bag deposit boxes etc. Also involved here are staff costs, e.g. for handling and processing sealed bags and for administrative work. The transactions need to be processed in accounting systems and customers must be informed via account statements. The Netherlands' large commercial banks operate cash centres, where banknotes deposited at the banks' branches are collected and counted, checked for counterfeits and packaged before being transported to the central bank. With respect to the electronic payment instruments, the banks' activities relate to the development of the interbank network processing the electronic transactions, the production and distribution of the cards, product development including safety measures, administrative activities (including auditing & control departments and customer information) etc.

The external costs of the banks relate to the above-mentioned transfers to the central bank, and to transfers to consumers and merchants, e.g. in the form of interest payments on sight account balances. Banks also derive revenues from their payment system activities, distinguished into direct and indirect revenues. The direct revenues, defined as those revenues directly related to payment system activities, are:

- Tariffs
 - Fixed periodic contributions e.g. for the debit or credit card.
 - Per-transaction fees charged to merchants, both in the form of fixed amounts per transaction (e.g. a debit card transaction) or a percentage of the transaction amount (common for credit card transactions)
- Revenues from value-dating, arising when the interest-bearing date differs from the date of entry in the account

- Float revenues, arising when, in the case of a transfer between two customers, the dates of debiting one account and crediting the other do not match.

The tariff revenues can be labelled as visible costs to customers, since they are informed by the bank about the amounts involved. By contrast, value dating and float constitute invisible costs.

Apart from direct revenues, banks also receive indirect revenues, defined as income which is indirectly related to a bank's payment system activities. For customers, these costs are also invisible and consist of e.g. opportunity interest costs of holding sight account balances. Banks generally do not pay interest on sight account balances, and hence they are an attractive source of funding the banks' credit activities. A point for debate is whether such retained interest income should be attributed fully to the cost of payments. If the sight account balances are held purely for transaction purposes, they should, but customers may of course also hold such balances for hoarding and/or savings purposes. Another debatable issue is which interest rate should be used in the calculation of the opportunity costs. The banks use their customers' balances as funding for e.g. loans. The long-term rate is less appropriate as a measure for the opportunity costs, as banks' income from lending should be attributed to their credit activities, at least partly, not to their payment system activities. With respect to the specific choice of the appropriate short-term interest rate, however, there is ample room for discussion.

In the case of the *retail sector*, internal costs ensue from all activities necessary to facilitate and receive payments made with the payment instruments considered. Investments in technical facilities like POS terminals and cash registers are important in this respect. A significant cost item concerns the length of time, expressed in terms of staffing costs, involved in processing a payment transaction. Garcia Swartz, Hahn and Layne-Farrar (2004) label these costs the 'tender time costs'. The time spent by a cash-register attendant in, say, a supermarket ringing up individual items is not included, since these activities, though necessary to complete a transaction, are not payment activities.⁷ On the other hand, the activities involved in depositing surplus cash at the banks do constitute internal payment costs for the merchant, including the time spent counting banknotes and coins, packaging them (e.g. in sealed bags) and transporting them to the bank's branch office.

The external costs for the merchants concern their payments to the banks for the services rendered (see above). Merchants' revenues from the payment services they provide to consumers are e.g. the fees levied on small debit card payments or on credit card transactions. Some

⁷ The time spent on shopping is also an element necessary to complete the transaction, but, of course, this duration is not part of the paying process.

merchants charge fees on cash-back transactions.⁸ Another source of merchants' revenues is e.g. the interest receipts relating to their sight account balances.

The internal payments system costs for *consumers* constitute the length of time spent paying for their purchases, by the same argument that applies to merchants. External effects in the form of waiting in the check-out lane can also be included, at least in principle. Thus a more accurate picture emerges of the benefits provided by time-saving payment instruments: not only the payer and payee enjoy these benefits, but also the other consumers in the check-out lane. Garcia Swartz, Hahn and Layne-Farrar (2004) call these cost items 'processing time' and 'queue time' costs. In the case of cash, one may also consider the travelling time necessary to make a trip to an ATM, and the queue time if one has to wait until other customers have completed their withdrawals. Recharging one's electronic purse involves similar costs. A point of attention is the wage rate to be applied in translating time durations into money (see e.g. Shaw, 1992). Consumers' external costs concern their payments to the banks and to the merchants discussed above. With respect to consumers' revenues one can think of interest rate receipts for balances on the sight account, of 'free' credit in case of credit card payment or float income in case one's account is debited one or more days after the date of the purchase. Especially in the case of cheques, float considerations can be important in the individual decisions on the use of a specific payment instrument (see e.g. Humphrey & Berger, 1990).⁹

From the above discussion it follows that external costs and revenues are closely related. With $P_{i \rightarrow j}$ a transfer of size P from sector i to sector j , we have

$$R^{cb} = P_{b \rightarrow cb} + P_{r \rightarrow cb} + P_{c \rightarrow cb}$$

$$C^{b,ext} = P_{b \rightarrow cb} + P_{b \rightarrow r} + P_{b \rightarrow c}$$

$$R^b = P_{r \rightarrow b} + P_{c \rightarrow b}$$

$$C^{r,ext} = P_{r \rightarrow b} + P_{r \rightarrow cb}$$

$$R^r = P_{b \rightarrow r} + P_{c \rightarrow r}$$

$$C^{c,ext} = P_{c \rightarrow cb} + P_{c \rightarrow b} + P_{c \rightarrow r}$$

$$R^c = P_{b \rightarrow c}$$

Social costs

The social cost perspective chosen in this report focuses on the resource costs to the economy of enabling and processing all POS transactions and is similar to the approach adopted by De Grauwe, Buyst and Rinaldi (2000). As mentioned before, these costs are the sum of the internal

⁸ Merchants will of course discount all their costs, not only the payment services costs, in their sales prices, if possible. From that perspective, consumers will always pay all costs involved.

⁹ In cheque countries, electronic payments have gained strongly in popularity. In the US for instance, 2003 was the first year the number of electronic payments exceeded the number of cheque payments.

costs borne by the parties in the payment chain. The external cost items constitute revenues for another party in the payment chain and therefore are not part of the social costs. An alternative definition of social costs is the sum of all parties' net costs (total costs minus revenues). Because bilateral transfers are cancelled out against each other, these definitions yield the same outcome.¹⁰ For every payment instrument the total net costs C^{tot} are equal to

$$\begin{aligned}
& C^{\text{cb,int}} + C^{\text{cb,ext}} - P_{\text{b} \rightarrow \text{cb}} - P_{\text{r} \rightarrow \text{cb}} - P_{\text{c} \rightarrow \text{cb}} + C^{\text{b,int}} + P_{\text{b} \rightarrow \text{cb}} + P_{\text{b} \rightarrow \text{r}} + P_{\text{b} \rightarrow \text{c}} - P_{\text{r} \rightarrow \text{b}} - P_{\text{c} \rightarrow \text{b}} + C^{\text{r,int}} + P_{\text{r} \rightarrow \text{cb}} + \\
& P_{\text{r} \rightarrow \text{b}} - P_{\text{b} \rightarrow \text{r}} - P_{\text{c} \rightarrow \text{r}} + C^{\text{c,int}} + P_{\text{c} \rightarrow \text{cb}} + P_{\text{c} \rightarrow \text{b}} + P_{\text{c} \rightarrow \text{r}} - P_{\text{b} \rightarrow \text{c}} = \\
& C^{\text{cb,int}} + C^{\text{cb,ext}} + C^{\text{b,int}} + C^{\text{r,int}} + C^{\text{c,int}} = \\
& C^{\text{cb,int}} + C^{\text{b,int}} + C^{\text{r,int}} + C^{\text{c,int}}
\end{aligned}$$

if $C^{\text{cb,ext}} = 0$. Since the central bank does not pay tariffs/fees etc. to the banking sector, the retail sector or consumers, $C^{\text{cb,ext}} = 0$.

Social benefits

Within the social costs framework, these costs are viewed as a burden borne by society as a whole: if they could be reduced without any performance loss, social welfare would increase because the production means becoming available could be explored in an alternative way. This approach can be justified (at least to some extent) by arguing that the demand for payment instruments follows from the demand for real and financial transactions, and the means of payment as such do not add value to the corresponding transactions. However, this ignores the fact that the payment system itself generates social benefits as well. For instance, improvements of payment instruments will impact positively on the performance of both financial and real markets. An extreme example is the difference between an economy based on barter trading and one using a modern money-based system. The latter type of economy involves costs related to the payment instruments, but these will be easily outweighed by the social benefits of the resulting vastly more efficient economy. Improvements in the availability of the payment instruments may improve social welfare, e.g. because economic transactions are facilitated that might otherwise not have taken place. The universal availability of POS terminals and ATM infrastructures, for instance, is almost certain to have caused retail transactions to take place, which in the past were impossible, for instance in cases where consumers found their purse empty and the banks closed. At least, the ample availability of ATMs has made life easier for many people, e.g. because cash may be withdrawn from ATMs 24 hours a day. Other examples are the development of novel products/services such as downloadable music via the internet, unmanned fuel stations (thanks to

¹⁰ Bilateral payments within a sector, e.g. interchange fees between commercial banks, constitute a cost for one and a benefit for the other, and also cancel each other out in a social cost framework.

the debit card) and more fraud-proof and vandal-proof parking meters (thanks to the electronic purse). The problem with all these examples of social benefits is that they are very difficult to measure.

Another type of social benefit concerns the differences in functionality and characteristics of payment means used in POS sales. These are in fact a subset of the effects that lead ultimately to the macro level social benefits described above, but which are considered here from a micro level perspective. These benefits appear mainly in the form of enhanced safety and convenience.

Social versus private costs

Individual agents do not make their decisions on the basis of internal costs only. They take into account the external costs and their revenues and consider their private costs and benefits. As a result, the payment instrument that is most attractive from a social costs perspective may in practice not be a success (even if other factors like safety and user convenience are equivalent). These results can often be understood when due account is taken of the external costs and revenues relevant to the individual parties, since individual decisions have a decisive impact on the success of a particular payment instrument. After all, the banks decide about the development, production and distribution of payment instruments. Next, merchants are in a position not to offer the possibility of paying with a certain instrument (apart from costs, such a decision of course depends on other factors, like the usage density amongst consumers). They may for instance, decide not to accept credit cards, or not to install an electronic purse payment terminal. Either external cost items such as tariffs levied by credit card companies, or internal cost items, e.g. educating employees, may be prohibitive in this respect.

3.2 Fixed and variable costs

An alternative aspect of the costs involves the division of total costs into fixed and variable costs. This distinction is relevant for a proper understanding of the decisions made by individual parties. For instance, a merchant may need to make large initial investments, such as the purchase of a POS terminal. Once these initial investments have been made, the variable costs dominate his decisions. However, if the fixed, initial investments are very large, he may be reluctant to offer certain payment facilities.

The distinction between fixed and variable costs is of interest not only from the above private (net) costs perspective, but also from a social costs viewpoint. In many cases, there is no unequivocal answer to the question which payment instrument is most cost effective, since the answer depends on the transaction amount. Variable costs are those costs that relate to carrying

out the transaction. However, some of these costs depend only on whether the transaction is carried out or not, while others are related to the transaction amount involved. In case of a debit card transaction it does not make any difference whether EUR 50 or EUR 150 is paid, so the variable costs depend only on the fact that the transaction has to be processed. In the case of cash, the variable costs tend to fluctuate more with the transaction amount (counting bank notes and coins, safety-related costs etc.). Thus cash can be the most cost efficient payment instrument for small transactions, whereas for large transactions the debit card may be the most attractive one. This distinction is also relevant for discussions about the prospect of a cashless society. Focusing solely on costs, a cashless system would be desirable only if electronic payments were to be preferred in all cases, irrespective of the transaction amount to be paid (see also section 5).¹¹

Formally, we can define total costs C as breaking down into fixed costs F , and variable costs V , which can be either transaction-linked or sales-linked (V_{tr} and V_s , respectively). The fixed costs F relate to those cost items that are not affected by carrying out a specific transaction or by the sales amounts thus generated. Variable costs do have such a relation. For each payment product j , total costs equal the sum of these three types of costs:

$$C^{j, \text{int}} = F^j + V_{tr}^j + V_s^j$$

Each of these cost components equals the sum of the related internal costs of the central bank, the banking sector, the retail sector and the consumers:

$$F^j = F^{j, \text{cb}} + F^{j, \text{b}} + F^{j, \text{r}} + F^{j, \text{c}}$$

$$V_{tr}^j = V_{tr}^{j, \text{cb}} + V_{tr}^{j, \text{b}} + V_{tr}^{j, \text{r}} + V_{tr}^{j, \text{c}}$$

$$V_s^j = V_s^{j, \text{cb}} + V_s^{j, \text{b}} + V_s^{j, \text{r}} + V_s^{j, \text{c}}$$

If N_j is defined as the number of transactions made with payment product j , then

$$V_{tr}^j = \alpha_j N_j$$

where α_j represents the average transaction-linked variable costs per transaction made with payment product j . If we define S_j as the sales realised through payment product j , we get

¹¹ Even if this condition is fulfilled, however, one may prefer cash because of other considerations such as user convenience and safety. In this respect, it should be noticed that cash is unique in being the only payment instrument that guarantees full anonymity.

$$V_{S_j} = \beta_j S_j$$

where β_j represents the average sales-linked variable costs per euro in sales paid with payment product j .¹²

Criteria applied in comparing costs

Generally speaking, the total costs of the payment instruments cannot be compared directly, because the numbers of transactions carried out with each instrument differ (or the total value of sales generated with each differs). Of course, the total costs involved in 7 billion cash payments cannot be compared with the costs of about 100 million transactions with the electronic purse, unless some scaling method is applied. There are two different options for scaling total costs, viz. total number of transactions and total amount in sales. An alternative is to look at the costs of one additional transaction of a predetermined size s . Therefore, we have three criteria by which to compare the costs of the payment instruments.

Criterion 1 The costs of one single additional transaction of size s : $\alpha_j + \beta_j s$,

the variable costs of such a transaction, consisting of a component that depends only on the fact that the transaction is carried out and a component determined by the value of the transaction.

Criterion 2 (Total) costs per transaction: $K_j/N_j = F_j/N_j + \alpha_j + \beta_j S_j/N_j$

with S_j/N_j representing the average value of a transaction generated with product j .

Criterion 3 (Total) costs per euro of sales: $K_j/S_j = F_j/S_j + \alpha_j N_j/S_j + \beta_j$

with K_j/S_j (F_j/S_j) as the total costs (fixed costs) of each euro in sales, and N_j/S_j representing the number of transactions needed to generate EUR 1 in sales.

Criterion 1 is most appropriate for discussions on the efficiency of the individual payment instruments. The distinction between the variable costs relating to the mere fact of carrying out the transaction and the variable costs relating to the purchase's size enables us to calculate the so called break-even transaction amounts, i.e. those amounts for which the costs of using either

¹² N_j and S_j represent, respectively, the number of transactions made with, and the sales generated through, payment product j as used at point-of-sale. This is because we focus on the costs made in the entire payment chain in order to enable the final payments to be carried out.

product are equal (see also Ten Raa and Shestalova, 2004).¹³ For each pair of payment products i and j , the 'break-even' transaction amount follows from the equation $\alpha_j + \beta_j s = \alpha_i + \beta_i s$. The resulting value of s represents the transaction amount for which the costs involved in paying with product j are equal to the costs of using product i . If a smaller amount is paid, the one payment instrument will be more economical, while the other will be preferred for larger transaction amounts. Thus criterion 1 takes into account that for some transaction amounts one payment instrument will be most cost efficient, while for other amounts another instrument may be most economical. Because of this property, criterion 1 can be used to easily quantify the possible cost savings achieved by replacing transactions paid with a high-cost instrument by alternative, low-cost transactions.

Criterion 1 only includes marginal costs. Fixed costs can be considered if scaling is applied by either the number of transactions (criterion 2) or by sales generated (criterion 3). There is no unequivocal way to determine which scaling method presents the most accurate image of the cost structure. If the costs depend on whether or not a transaction is made, one should apply criterion 2; where the costs are, by contrast, related to the sales generated by the transaction, criterion 3 is to be preferred.

¹³ Discussions on the two types of variable costs are also influenced by the categorisation of fixed costs items, i.e. those costs that are not directly related to carrying out the transactions. The borderline between fixed and variable costs is not determined unequivocally and depends on the time horizon adopted.

Section 4 Empirical results

The previous section presented the conceptual framework of the cost survey and contained a general description of the cost items involved. The appendix elaborates on the actual data used and illustrates how the concepts were made further operational. The study focused on the social costs and, hence, on the internal costs borne by the individual parties in the payment chain. The costs of the Netherlands' central bank (De Nederlandsche Bank – DNB) and the Royal Dutch Mint (Koninklijke Nederlandse Munt - KNM), the banking sector and the retail sector were considered. No attempt was made to quantify costs to consumers, such as time spent in queues et cetera (sometimes labelled 'shoeleather' costs). In line with common practice in calculating, for instance, gross domestic product, private non-paid activities like housekeeping etc. were ignored, basically because it is impossible to obtain reliable data. This does not only hold for the duration of 'processing time' and 'queue time' but also for the appropriate wage rate to be used to translate the durations into money (see e.g. Shaw, 1992).

With respect to the data and in particular the breakdown into fixed and variable costs, a medium-term horizon of 3-5 years was applied. This horizon implies that a relatively large part of the costs is of a variable nature (see also the annex).

The first part of Table 4.1 summarises the total number of transactions with the respective payment instruments and the related sales. The ratio of these two figures gives the average transaction amount. The other entries in the table present the social costs involved, broken down into the cost categories 'fixed', 'transaction-linked variable' and 'sales-linked variable'. The costs accounted for by the banking industry, by the retail sector and by the central bank, respectively, are also reported separately, with the same categorisation.

The total costs of all POS payments in the Netherlands adds up to EUR 2.9 billion or, equivalently, 0.65 % of gdp. To put this amount into perspective, it may be useful to consider some indicators:

- the costs per POS transaction are EUR 0.35, since total costs concern a total of 8.3 billion POS transactions;
- the total costs account for 2.4% of the amount of purchases, since the POS sales generated with the payment instruments is almost EUR 119 billion;
- the total costs per household per annum are over EUR 400, since the total number of households equals 7 million.

Table 4.1 Summary of the payment products: transactions, sales and costs – 2002

EUR millions

	Cash	Debit card	E-purse	Credit card	Total
Total no. of transactions (millions)	7,066	1,069	87	46	8,268
Aggregate amounts	66,263	47,177	236	5,300	118,976
Average transaction amount (EUR)	9.37	44.13	2.72	115.22	14.39
Total costs	2,122	520	81	165	2,888
Fixed	878	310	78	115	1,381
Variable – transaction-linked	789	203	3	37	1,032
Variable – sales-linked	455	7	0	13	475
Costs to the retail sector	1,157	252	13	11	1,433
Fixed	497	99	11	4	611
Variable – transaction-linked	417	153	2	6	578
Variable – sales-linked	243	0	0	1	244
Costs to the banking sector^a,	895	268	68	154	1,385
Fixed	351	211	67	111	740
Variable – transaction-linked	350	50	1	31	432
Variable – sales-linked	194	7	0	12	213
Costs to DNB/KNM	70	-	-	-	70
Fixed	30	-	-	-	30
Variable – transaction-linked	22	-	-	-	22
Variable – sales-linked	18	-	-	-	18

Source: DNB

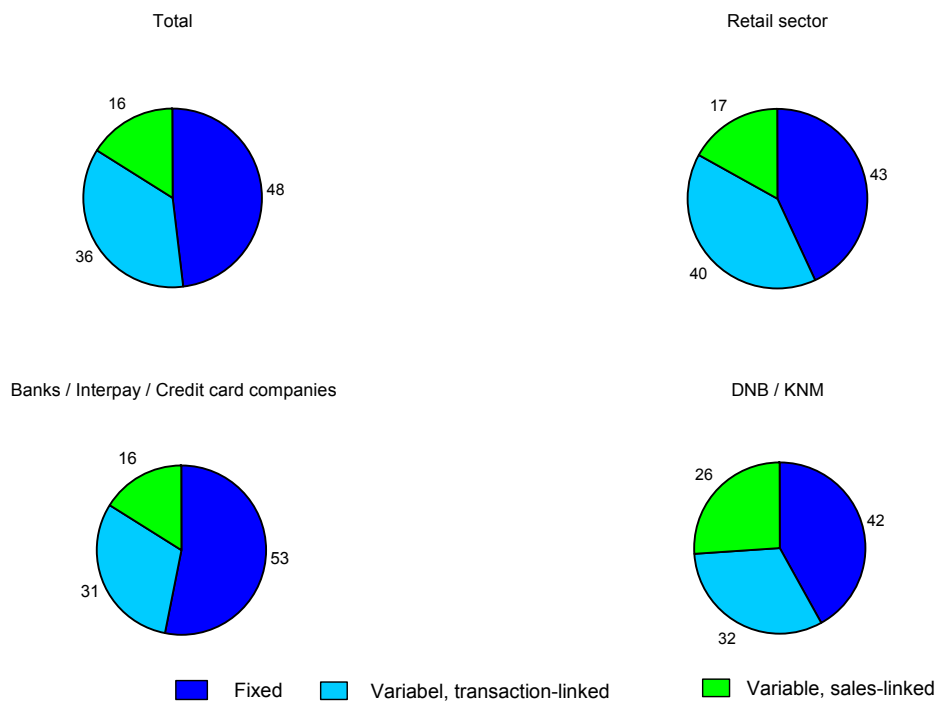
^a Banks, Interpay and credit card companies.

The EUR 2.9 billion of total costs involved in carrying out 8.3 billion POS transactions are shared in roughly equal parts between the banking industry and the retail sector. The costs related to cash payments are localised largely in the retail sector, whereas a relatively large share of the costs relating to the electronic POS payments is accounted for by the banking industry. The costs of the Dutch central bank amount to EUR 70 million and relate to cash, because the central banks'

electronic payment-related costs are nil.¹⁴ Further differences between the banking industry and the retail sector concern the shares of the fixed costs and of the two variable cost items in the total cost figures. These differences are shown in Chart 4.1, which gives this breakdown, not only for the sectors but also for the whole economy. The banking sector faces a relatively high level of fixed costs, while transaction-linked variable costs are relatively more important for the retail sector. Obviously, this relates to the stylized fact that fixed costs are relatively more important for the electronic payment instruments. The banking industry accounts for the larger part of these costs. The share of fixed costs for the electronic payment instruments is 66% (against 41% for cash), while the banking industry's fixed costs of electronic payment products constitute a larger share (compared to the retail sector) of the total costs of electronic payment products (79% against 41%). This is especially true of e-purse related costs for banks, which are almost entirely fixed.

Chart 4.1 Breakdown of fixed and variable costs

Percentage



¹⁴ In principle, part of the costs of the large value payment system of DNB for interbank funds transfers should be attributed to the POS payment instruments. However, these costs are relatively small and therefore are ignored here.

Table 4.2 Shares of cost items borne by the banking and retail sectors

Percentages

Cost items	Cash	Debit card	E-purse	Credit card
Banking sector				
<i>Back-office costs</i>	20.8	69.4	87.2	76.4
- Production costs	6.2	46.0	84.9	63.0
- Cash centres	7.0	-	-	-
- Other back office costs	7.6	23.4	2.3	13.4
<i>Front-office costs</i>	67.6	25.6	10.9	18.8
- branch offices	49.2	25.6	7.4	18.8
- ATMs & e-purse chargepoints	18.4	-	3.5	-
<i>Overhead costs</i>	9.0	5.0	1.9	4.8
<i>Armoured car services</i>	2.6	-	-	-
Total	100.0	100.0	100.0	100.0
Retail sector				
<i>Back-office costs</i>	43.0	13.9	0.6	14.8
<i>Front-office costs</i>	36.0	35.2	7.8	37.1
<i>Telecommunications</i>	-	21.3	42.0	21.0
<i>Cash Transport</i>	14.6	-	-	-
<i>POS terminal costs</i>	-	29.6	49.6	18.9
<i>Other</i>	6.4	-	-	8.2
Total	100.0	100.0	100.0	100.0

Supplementing the results in Table 4.1, Table 4.2 presents the shares of the specific items for the payment instruments, for both the banking and the retail sectors. With respect to the banks' costs, the table illustrates clearly the differences between cash on the one hand and the electronic payment instruments on the other. In the case of cash, the share of front office costs is relatively high, while for the other payment instruments the share of the back office costs is higher. This holds particularly for the electronic purse, where production costs account for 84.9% of banks' total related costs. A sharp distinction between the back-office costs of cash and of the other

payment instruments is also manifest in the retail sector, with cash carrying high back-office costs compared to electronic instruments. The back-office and front-office costs of the electronic purse are both relatively limited. The costs of terminals take up the largest part of the merchants' e-purse-related costs. Since most terminals accept both debit card and e-purse payments, terminal costs were attributed to these instruments according to the numbers of transactions made with each. Hence, if the e-purse becomes more popular, the terminal costs allotted to it will increase. However, even in the present situation, with a relatively modest number of e-purse transactions, terminal costs constitute its largest cost item. The cost shares of the credit card resemble those of the debit card. The share of POS terminal costs is somewhat smaller in the case of the credit card, because terminals are used in only part of credit card payments and because the other costs are relatively high. It should be noticed that the similarities between debit and credit card with respect to the shares of the cost items do not imply, of course, that the absolute cost levels (scaled with e.g. the numbers of transactions) are also the same. That this is, in fact, not the case will be shown below.

Results for the different cost measures

Table 4.3 presents the results for the various cost comparison criteria measures discussed in section 3. With respect to (total) costs per transaction and costs per euro in sales, the table shows a desaggregation into the contributions made to each item by the retail sector, the banking industry and the central bank.

In order to calculate the variable costs for a typical transaction, it is necessary to specify the transaction amount, as these costs consist of the transaction-linked variable costs (α) and those costs that relate to the transaction amount (β times s , with s the transaction amount). Here, we use the average transaction amounts for each payment instrument (see Table 4.1). Table 4.3 shows that the variable costs of an e-purse payment are lower than those of the other payment products. The large difference with the variable costs of a debit card payment reflects the complex processing of the latter product, especially the on-line authentication and authorization process. For the electronic payment instruments, the costs relating to the mere fact that the transfer is carried out are dominant. This holds in particular for the e-purse but also, though to a somewhat lesser extent, for the debit card. This is in line with expectations, since for these payment instruments it does not make much difference whether a purchase is for, say, EUR 50 or EUR 100. By contrast, the variable costs relating to the transaction amount are relatively important in the case of a cash payment.

Table 4.3 Cost measures for the payment products

	Cash	Debit card	E-purse	Credit card
Variable costs per average transaction (EUR) ¹	0.1764	0.1965	0.0333	1.0859
Costs of 1 additional transaction (α , EUR)	0.1117	0.1903	0.0333	0.7978
Costs for EUR 1 in additional sales (β , %/100)	0.0069	0.00014	0.00001	0.0025
Total costs per transaction (EUR)	0.300	0.486	0.931	3.587
Retail sector	0.164	0.236	0.149	0.239
Banking sector	0.126	0.250	0.782	3.348
DNB/KNM	0.010	-	-	-
Total costs per EUR in sales (%/100)	0.0320	0.0110	0.3432	0.0311
Retail sector	0.0175	0.0053	0.0551	0.0021
Banking sector	0.0135	0.0057	0.2881	0.0290
DNB/KNM	0.0010	-	-	-

Source: DNB

¹ $\alpha + \beta s$, where s is the average transaction amount, viz. EUR 9.37 (cash), EUR 44.13 (debit card), EUR 2.72 (e-purse) and EUR 115.22 (credit card).

The impact of the purchase's size on the costs of a payment can easily be assessed with the formula $\alpha + \beta*s$. The results are shown in Chart 4.2 for cash, the debit card and the e-purse. The credit card is not considered here. From a social cost perspective, the credit card is, however, less attractive than the debit card, irrespective of the transaction amount, as both the credit card's variable cost items relating to the mere execution of the transfer and those relating to the size of the purchase are larger.¹⁵ Chart 4.2 shows that the e-purse is most economical for any transaction amount. If one has to choose between cash and the debit card, the break-even transaction amount

¹⁵ Usually, credit cards also provide other services than the possibility of carrying out payments. These supplementary services, which include e.g. insurances and the possibility of spreading payments over time, may explain, at least partly, the credit card's higher cost level. Notice also that if the credit card is compared to cash, the former will be cheaper for large purchases, since its β is smaller than the β for cash, while its α is much larger than the corresponding measure for cash.

is EUR 11.63. Cash is more economical for purchases below EUR 11.63, while the debit card is to be preferred for larger transactions.¹⁶

Chart 4.2 Variable costs of Cash, Debit card , E-purse

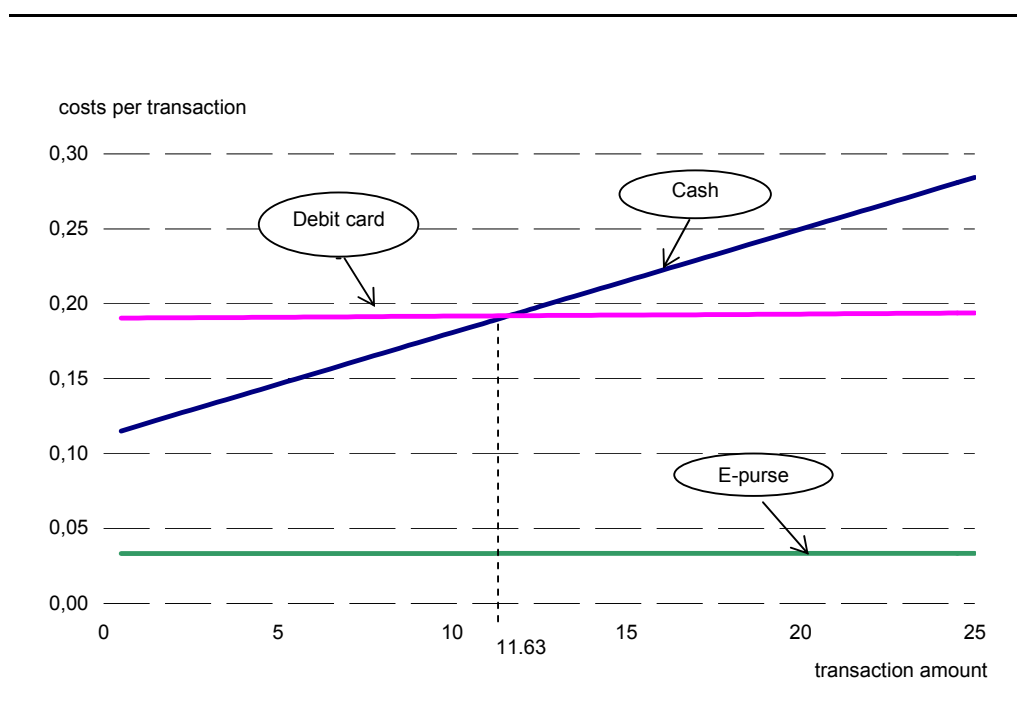


Table 4.3 also presents the total costs per transaction and per euro in sales, respectively. These measures include not only variable but also fixed costs. On average, a cash transaction costs EUR 0.30. More than half these costs are borne by the retail sector. The costs relating to the activities of the central bank constitute only 3 per cent of the total costs of a cash payment (EUR 0.01 of EUR 0.30). Of course, this does not necessarily imply that the Dutch central bank works efficiently. It does, however, indicate that the overall impact of central banks' operational activities on the cost level is rather small, since the bulk of the costs are borne by the merchants and, to a somewhat lesser extent, the banking sector. Another implication is that any distorting

¹⁶ The amount of EUR 11.63 is, of course, an average. The actual break-even amount may vary from one (sub)sector to the next. A disaggregated analysis shows that the cash-vs-debit-card break-even amounts are EUR 12.08, EUR 19.98 and EUR 7.48 for, respectively, the retail trade, hotels and catering, and fuel stations (see Working Group on Costs of POS Payment Products, 2004).

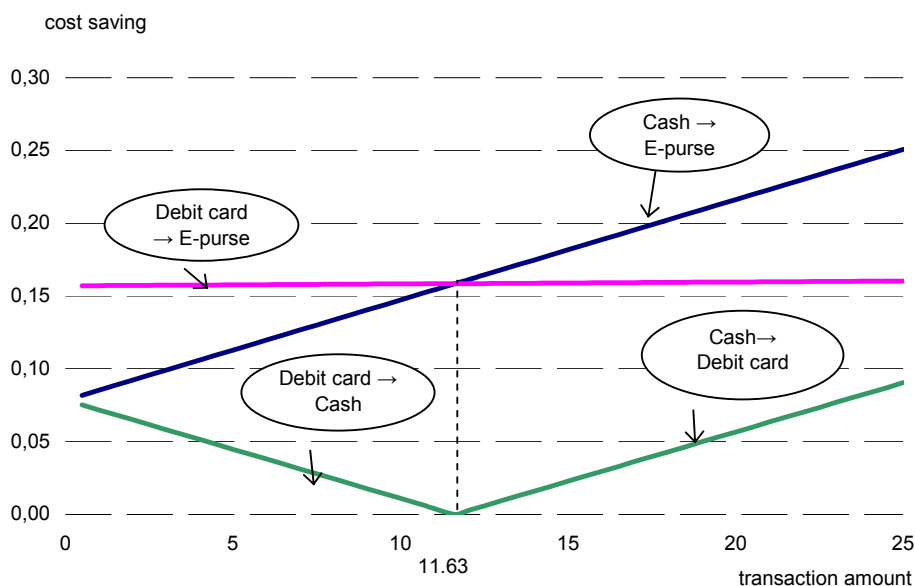
effect because of the central bank's costs of cash money being financed out of public resources can not be more than modest.

Debit card costs constitute 1.1% of the sales generated with this payment instrument, while the respective figures for cash and the credit card are 3.2% and 3.1%. For the e-purse total costs account for 34% of total sales paid with the e-purse. With respect to the costs of e-purse transactions, the high level of costs per transaction and costs per EUR in sales reflects the fact that the e-purse's fixed costs are relatively important while the number of transactions has remained limited. The available infrastructure is, however, able to process far greater numbers of transactions than the 87 million carried out in 2002. The additional costs if this number should increase to 500 million would be very limited, because of the largely fixed nature of the associated costs. Under the assumption that the additional costs involved in 500 million e-purse transactions are nil, the cost per transaction would fall to EUR 0.16, which is lower than the figures for the other payment instruments.

Cost savings by choosing low-cost payment instruments

Obviously, cost savings can be achieved by substituting low-cost payments for high-cost ones. Chart 4.3 presents the size of possible cost savings achieved by choosing an alternative payment instrument. As in Chart 4.2, the credit card has been omitted, because of the great difference in cost levels vis-à-vis the other three payment instruments. The transaction-linked variable costs involved in one debit card and one e-purse transaction are, respectively, EUR 0.1903 and EUR 0.0333. Thus, substitution of one e-purse payment for a debit card payment saves EUR 0.1570 in terms of transaction-linked variable costs. In addition, there are cost savings relating to sales-linked variable costs; these depend on the size of the purchase. The sum of both cost-saving items leads to the line marked 'debit card → e-purse' in Chart 4.3. Because of the dominance of the costs related to the execution of the transaction for the both debit card and the e-purse, the slope of the line is almost zero. Steeper lines are found for the other possibilities for substitution. The positions of the lines can be determined in a similar way as for the debit card versus the e-purse. The chart shows that the largest savings can be achieved by replacing cash payments over EUR 11.63 by e-purse payments. The largest savings for transactions below EUR 11.63 are achieved by using the e-purse instead of the debit card, but even for transactions above EUR 11.63, using the e-purse is substantially more economical than the debit card. Chart 4.3 presents in an alternative way our earlier finding that for purchases below EUR 11.63, cash is to be preferred over the debit card, while the reverse holds for payments over EUR 11.63. It is most cost efficient, however, to use the e-purse.

Chart 4.3 Cost savings resulting from payment product substitution



The basic message of the above analysis is that substantial savings can be achieved if the e-purse, and for larger amounts the debit card, is used more often. To give an impression of the size of the savings involved, we considered a scenario where 500 million cash transactions (with, on average, a transaction amount of EUR 3) were to be replaced by e-purse transactions, while the debit card would be used instead of cash for 1,000 million cash transactions (with, on average, a transaction amount of EUR 20)¹⁷. These figures imply that the number of debit card payments would roughly double, while e-purse payments (compared to 2002 figures) would increase fivefold (see Table 4.4). The result would be cost savings EUR 106 million.

The total costs savings of EUR 106 million as a result of the shift from cash to electronic payments are not distributed evenly among the parties in the payment chain. Although the cost survey focussed on social costs and hence on the internal costs of the individual sectors, the disaggregated framework offers the opportunity to calculate the effects for the individual sectors. These effects are summarised in Table 4.5, and show that the banking sector will benefit most from the shift to electronic payments. Their cost savings amount to EUR 82 million, or 77% of

¹⁷ This scenario has been calibrated to reflect the large potential for increases in e-purse use for small amounts (more than 95% cash now), and in debit card use in the transaction range around EUR 20 (still about 50% cash according to information from the payment product organization Currence). The reader can calculate alternative scenarios with the help of the parameters in Table 4.3.

the total savings of EUR 106 million. The cost savings of the retail sector will be EUR 13 million (12%), while savings of EUR 11 million (11%) will result for the Dutch central bank. Of course, these figures represent just the first-order effects on costs.

Table 4.4 POS payments – 2002 and under alternative scenario

	Cash	Debit card	E-purse	Credit card	Total
2002					
Total no. of transactions (millions)	7,066	1,069	87	46	8,268
Total amount of sales (EUR millions)	66,263	47,177	236	5,300	118,976
Average transaction amount (EUR)	9.37	44.13	2.72	115.22	14.39
Alternative scenario					
Total no. of transactions (millions)	5,566	2,069	587	46	8,268
Total amount of sales (EUR millions)	44,763	67,177	1,736	5,300	118,976
Average transaction amount (EUR)	8.04	32.47	2.96	115.22	14.39

Transfer payments between sectors will change as well, but they fall outside the scope of the survey. Moreover, as a result of market dynamics, the size of the savings can accrue over time, and the distribution over the sectors may change.

The above calculation of EUR 106 million in cost savings considered only the effects on costs that are considered as variable within a 3–5-year horizon. Possible savings as a result of more radical changes in payment behaviour could potentially be much larger, especially in the longer term, since fixed cost items would be affected as well. The additional effects include, for instance, the necessary expansion of the fixed electronic payment infrastructures and the concomitant downsizing of fixed infrastructures for the handling of cash streams. Because of the large uncertainties inherent in any quantification of these effects, it was decided to refrain from such an exercise. However, in general terms, it is likely that such a shift from cash to electronic payments will be cost efficient, since scale and network effects are predominant in the case of electronic payments. Hence, an extension of electronic payment capacity will have a relatively large impact. Moreover, downsizing the infrastructure of cash payments implies a reduction in the number of ATMs and in the capacity of the banks' branch networks and cash centres. With these disinvestments large savings can be achieved, which are likely to outweigh the investments necessary to process the additional electronic payments.

Of course, costs are only one of the aspects that determine the preference for a particular payment instrument. User convenience and safety are relevant as well. To illustrate the impact of convenience and safety, one may consider the implication of Chart 4.2 that the e-purse is most attractive, irrespective of the specific transaction amount. But for higher transaction amounts, safety aspects (theft of the e-purse means losing the money, debit card is protected as long as the PIN is not stolen as well) and convenience (necessity to load the e-purse) could outweigh the difference in costs between e-purse and debit card. Therefore, taking account of aspects like safety and user convenience would probably lead to a slight adjustment of the recommendation that the e-purse is to be preferred irrespective of the transaction amount.

Table 4.5 Cost effects of a shift of 1,500 million transactions from cash to electronic payment

EUR millions

	Cash	Debit card	E-purse	Credit card	Total
Total cost savings	-306	193	17	-	-106
Fixed	-	-	-	-	-
Variable – transaction-linked	-168	190	17	-	39
Variable – sales-linked	-148	3	0	-	-145
Cost savings for the retail sector	-167	143	11	-	-13
Fixed	-	-	-	-	-
Variable – transaction-linked	-89	143	11	-	65
Variable – sales-linked	-78	0	0	-	-78
Cost savings for banking sector	-138	50	6	-	-82
Fixed	-	-	-	-	-
Variable – transaction-linked	-74	47	6	-	-21
Variable – sales-linked	-64	3	0	-	-61
Cost savings for central bank	-11	-	-	-	-11
Fixed	-	-	-	-	-
Variable – transaction-linked	-5	-	-	-	-5
Variable – sales-linked	-6	-	-	-	-6

Explanatory note: for both transaction-linked and sales-linked variable costs, total savings are divided *pro rata* among the retail sector, the banks and the central bank, according to the shares of each party's variable costs in total variable cost (see Table 4.1).

Section 5 Further discussion

A cashless society?

If electronic payment instruments are cost efficient, the question arises whether a cashless society would be feasible. Garcia Swartz, Hahn and Layne-Farrar (2004), for instance, argue that a cashless society would yield large benefits. Focussing on costs only, section 3 above argued that a necessary condition for the feasibility of a cashless society is that alternative payment instruments are less costly, irrespective of the transaction amount. For the Netherlands, this necessary condition is fulfilled (see Chart 4.2). Yet this condition, though necessary, is not sufficient for a cashless society to be successful. Other aspects such as user convenience and safety should be taken into account. In certain payment situations, cash is the more convenient, if not the only, alternative. A survey conducted by the Nederlandsche Bank shows that there are certain characteristics of the e-purse that make consumers reluctant to use it, e.g. the uncertainty about the exact balance on the card (DNB, 2005). Attempts to introduce 'payment by e-purse only' in specific situations, e.g. parking on the streets of some towns in the Netherlands, have met with protests and even (in the end unsuccessful) legal steps demanding the possibility to pay in cash. Further improvements in payment card technology, cheaper terminals, et cetera, may help to overcome some of the hurdles that prevent a large-scale substitution of electronic transactions for cash payments. A particularly high hurdle to take in this respect is the fact that, in contrast to the other payment instruments, cash has the property of guaranteeing full anonymity.

It seems therefore reasonable that cash will continue to be used, for instance for money received under the counter.¹⁸ With respect to the feasibility of a cashless society, it should be noted also that in any case it is still a very long way off, since the overwhelming majority of all POS transactions are paid with cash and there still are many POS situations where there is no alternative for cash. A cashless society is therefore far from realistic in the near future, notwithstanding its potential cost savings. A less-cash society will have a greater likelihood of success than a cashless one.

¹⁸ The use of cash in the black economy concerns especially large denomination banknotes. Therefore, a substantial decrease of the use of cash is likely to have a limited impact on the central banks' seigniorage income, as these revenues are proportional to the outstanding value of cash and not to the number of banknotes in circulation. Reduction of the use of cash will notably affect the numbers of lower-denomination notes, but will have a relatively limited impact on the value of cash money in circulation and hence on seigniorage revenues. (Groeneveld and Visser, 1997)

The importance of incentives

As the cost survey focuses on the social costs of the different payment instruments, the results cannot present a comprehensive picture of the incentive structure. Section 3 above illustrated that a ranking on a social cost basis can easily differ from a ranking on the basis of individual parties' internal costs or private net costs (internal plus external cost minus revenues). Since individual decisions on developing and promoting the use of specific payment instruments, on offering the related payment facilities (e.g. terminals) and on using the specific payment instruments are decisive for the actual success of a payment instrument, a range of incentives play a role. In this respect, the social costs concept provides a useful perspective on what is optimal for society as a whole, since it focuses on the resource costs to the economy of enabling and processing all POS transactions.

Given the fact that nowadays a range of alternative payment instruments is available and that these instruments differ with respect to their costs, the legitimate question arises whether the current tariff structure provides sufficient incentives to stimulate the use of efficient payment instruments. This has been the subject of a lively debate in the Netherlands. In section 2 it was mentioned that Dutch consumers do not pay per-transaction fees.¹⁹ Of course, they are confronted with costs in the form of annual fees for e.g. debit and credit cards, value-dating et cetera, while merchants of course will factor their costs into the prices of products and services. Therefore, more efficient use of the available payment instruments would be beneficial to consumers. The problem with the indirect and often intransparent ways the costs are covered is that they are less effective in guiding people's behaviour, because the relation between the actual choice of a payment instrument and a specific transaction is absent. Tariff structures are often intransparent as a result of banks' difficulties in charging appropriate per-transaction fees. In France, for instance, charging consumers for the use of cheques is prohibited by law. As a rule of thumb, an electronic payment costs between one-third and one-half of a paper-based one (see Humphrey et al, 2003). Obviously, the use of cheques is costly for the banks, and they can only seek cost recovery via cross-subsidies and other indirect measures.²⁰ Large-scale cross-subsidisation is

¹⁹ Nowadays, more and more merchants charge consumers small fees for small debit card payments. The absence of per-transaction fees has historical roots. The argument used to be that thresholds for consumers should be as low as possible. Savings for the banks as a result of less cash usage were expected to be so substantial that on balance this would be a profitable policy, particularly after the large investments in the infrastructure had been made.

²⁰ Apart from high tariffs for specific other services, banks may also be more selective with respect to their customers. In France, for instance, banks are very strict on consumers with sight account overdrafts. If such a situation continues for 5 weeks, the sight account is terminated. As a result, many French consumers do not have a bank account, which causes a great deal of inconvenience.

likely to be present in other countries, too (see e.g. Guibourg and Segendorf (2004) for Sweden).

In the absence of per-transaction fees in the Netherlands, the actual choice of a particular payment instrument is primarily based on user convenience and, for larger amounts, on safety considerations. One may doubt whether convenience aspects alone provide sufficiently strong incentives to bring about efficient use, particularly if one considers the rather modest usage of the e-purse. Many consumers also use their debit card for small purchases, whereas an alternative in the form of the e-purse is available on the same card. The debit card has useful features in the form of e.g. the check of the sight account balance, the authorisation by means of the PIN code, and the guaranteed crediting of the merchant's account. This sophistication has its price, however, and as a result of the absence of per-transaction fees for consumers, that price is paid only on an aggregate level. The question is whether these advantages are worth the extra costs, especially for purchases of, say, a few euro. For society as a whole on-line authorisation of small purchases does not seem necessary in terms of safety and efficiency and the available off-line alternative suffices. Consumers could still be allowed to make individual decisions, of course, but then they should be prepared to pay the price. This effect can be achieved most easily with per-transaction fees: pay your money and take your choice!

With respect to the optimal incentive structure, due account should also be taken of the fact that a typical (electronic) payment involves two end users, the merchant and the consumer. The theory of two-sided markets shows that for an adequate assessment both sides of the market have to be considered jointly and that it may be optimal to have tariffs on only one side of the market (see Rochet and Tirole, 2002, Bolt and Tieman, 2003). Obviously, both the consumer and the merchant have an interest in easy, safe and efficient payments. In principle, the incentive structure should therefore address both end users. Targeting the group that actually makes the choice of the payment instrument to be used seems to be most effective in guiding the actors concerned. For those POS situations in which the whole set of payment instruments is available, this would imply that the primary focus should be on the consumers. On the basis of the results of the cost survey, this would mean charging the consumer for the use of cash (e.g. by fees for cash withdrawals), and for the use of the debit card for small amounts. The use of the e-purse should remain free of charge. As far as a lack of acceptance points for the e-purse and debit card is a problem, proper incentives for merchants could be built in their contract with banks for payments services.

The current infrastructure and tariff structures are strongly affected by decisions in the past. Therefore, the one billion euro question is how a regime change towards a system with per-

transaction fees could be brought about. The first bank to introduce per-transaction fees may well be confronted with a strong decline in market share. So no bank is likely to take the first step. Thus the banks face a prisoners' dilemma: it would be optimal if they would act together, but since they pursue their own interests only, a sub-optimal outcome will result (see also Van Hove, 2002). Co-ordination of pricing policies constitutes a solution to this dilemma, but is difficult to envisage without breaking competition rules. The alternative option is to involve not only the banks, but also merchants' and consumers' interest groups in the desired regime change process. In the Netherlands the National Forum on the Payments System offers a platform to enter into agreements among all parties involved. Of course, a regime change may also be brought about by an external shock or an urgent crisis, forcing all major banks to make the move. One may think for instance of low interest rate levels adversely affecting banks' value-dating and float revenues. This may make the banks' payment system-related costs too high, even if allowance is made for cross-subsidising from other banking activities. The single European financial market may also serve as the sledgehammer blow required to bring about the regime change.

Section 6 Main conclusions

The availability of various payment instruments, differing with respect to their costs and other inherent characteristics relating to, for instance, user convenience, raises a number of important questions for policy makers. These questions concern issues such as the size of the cost differences between individual payment instruments and the optimal incentive structure to stimulate efficient payment behaviour. This paper addresses these issues, using the results of a cost survey conducted for the Netherlands as the main vehicle to provide empirical evidence.

In the Netherlands, the commonly used payment instruments in POS situations are cash, the debit card, the e-purse and the credit card. Cheques have been phased out and were taken off the market on January 1st 2002. Hence, paper-based payment instruments are not used, unless one considers bank notes as paper-based instruments. From an international perspective, it is important to note that the absence of cheques affects the picture of payment costs in the Netherlands in a favourable sense, since this paper-based instrument has high processing costs.

The Dutch cost survey is unique in a number of respects, in terms of both its scale and its scope. The survey provides a fairly comprehensive overview of the social costs, because the costs of the banking sector, the merchants' sector and the central bank are all included. The paper presents both the social costs and the costs borne by the individual sectors. The respective cost figures have been collected in a consistent way, using the expertise of the different sectors' specialists. Other advantages of the survey are the fact that it includes the costs of cash and the distinction it makes between fixed and variable costs, divided further into the costs of carrying out the transaction and costs relating to the size of the transaction. This distinction enables one to determine break-even transaction amounts between pairs of payment instruments, i.e. the amounts for which the costs of using one payment instrument or another are equal.

The main findings are:

- Total social costs involved with all POS payments in the Netherlands amount to 0.65% of gdp. Some indicators to place this number in perspective are:
 - the costs per POS transaction average EUR 0.35;
 - costs account for 2.4% of total POS sales;
 - annual costs per household are over EUR 400.
- The costs differ strongly between the individual payment instruments. If one focuses on the variable costs only, the e-purse is most economical, irrespective of the size of the purchase. If one has to choose between cash and the debit card, cash is more economical for purchases

below EUR 11.63 and the debit card for the larger ones. The credit card is the most expensive instrument, irrespective of the transaction amount.

- No evidence is found for the level playing field argument that cash has a competitive advantage because its central bank costs are largely financed out of public funds. The survey shows that the average cash transaction costs EUR 0.30. The costs of the central bank's operational activities constitute only 3% of cash' total costs. Thus, the distorting effect of financing central bank's cash money costs with public funds is very limited.
- Focussing on costs only, a necessary condition for the feasibility of a cashless society is that alternative payment instruments are less costly than cash, irrespective of the size of the purchase. This condition, which is fulfilled for the Netherlands, is, however, not a sufficient condition. Taking due account of aspects such as user convenience and safety, cash may still be preferred in many situations. Also, in contrast to the electronic payment instruments, cash has the unique property that it guarantees full anonymity. A less-cash society is therefore more feasible than a cashless one.
- With the general availability of a range of different payment instruments, it becomes very important to have an incentive structure that stimulates efficient payment behaviour. In the Netherlands, consumers are not confronted with per-transaction fees. Banks use indirect and intransparent ways to cover their costs, like value dating and annual contributions, and merchants discount their costs in the sales prices. These ways to cover the costs are not directly related to carrying out payments and are therefore likely to be less effective in guiding payment behaviour. Of course, consumers do pay their share of the costs of enabling and processing their payments. A preliminary condition for deliberate decisions by economic agents is that they are well-informed about the actual costs. Transparency is crucial in that respect, especially in a situation where many seem to be unaware of the fact that it costs to pay. Economists have noticed already a long time ago that there is not something as a free lunch, and, obviously, nor is there such a thing as a free payment.

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Annex Data

Section 3, taking a general point of view, discussed the cost items relevant for calculating the social costs related to realising payments and receipts. This appendix focusses on the actual data collected and used in the calculations. It illustrates how the conceptual framework of the former section was further made operational.

The cost survey was conducted by the ad-hoc Working Group on the Costs of POS Payment Products, made up of representatives of the central bank, the banking community, and merchants' and consumers' interest organisations. The research plan, assumptions, questionnaires, the progress of the research project, empirical results et cetera were extensively discussed in the Working Group, chaired by the Nederlandsche Bank, which also acted as the secretariat. The chosen set-up, with extensive bilateral and multilateral consultations, opened up the possibility to make optimal use of the parties' expertise. The set-up ensured that both sides of the argument were heard and in this way proved to be instrumental in providing the necessary checks and balances. Another advantage was that the Working Group was not forced to restrict itself to data sources available in the public domain, but had access to confidential information.

The four major banks²¹, with a joint market share of about 90% in the Netherlands, and the Netherlands' central clearing organization Interpay, which plays a pivotal role in processing electronic payments, participated in the project and contributed their payment systems' cost data. With respect to the retail sector, cost figures were compiled for the retail trade, hotels and catering, gas stations and the street trade. Cost figures were also collected for the vending machines industry, including cigarette dispensers, parking meters and ticket machines in public parking garages, railway ticket machines, telephone booths, hot and cold drink dispensers and snack dispensers. The information on the vending machine industry was partly confidential and consisted of an update of information collected within the context of the euro change-over. The Dutch central bank provided the cost figures of its own payment system's activities and reported the data for the Royal Dutch Mint, which produces the coins. The reference period is 2002, while the costs related to one-off phenomena like the introduction of the euro, were ignored in order to obtain an accurate picture of the cost of each payment instrument. With respect to consumers, internal costs were ignored, partly because of the difficulties in obtaining reliable data, e.g. concerning queue times, the travelling time for trips to ATMs and, last but not least, the opportunity cost of time, viz. the appropriate wage rate (see section 4).

As mentioned before, the four major banks in the Netherlands provided their payment systems' cost data. The reporting banks were assumed to be representative. Therefore, to calculate the

²¹ ABN AMRO Bank, ING Bank, Postbank and Rabobank.

costs for the whole banking sector, the reported costs were levelled up on the basis of the reporting banks' market shares, and with respect to the subdivision into fixed and variable costs, the characteristics holding for the reporting banks were used. A similar approach was chosen for the retail sector. Cost figures were collected for the retail trade, hotels and catering, gas stations and street trade and the vending machine industry. For all these sub sectors, data on the numbers of transactions with each payment instrument and on the sales thus effected were also available. The aggregate amounts at POSs were derived from the National Accounts publications of Statistics Netherlands. For the electronic payment instruments, amounts and numbers of transactions are known.²² Hence, the number of electronic transactions and the concomitant amounts for the non-reporting sub-sectors are known. These are a largely heterogeneous group of shops and businesses including entertainment establishments, museums, public transport sales points, small service providers such as hairdressers etc. The total number of transactions for these sectors was estimated to be slightly below 10% of the number of transactions in those sectors that did report their data. As in the case of banking data, we assumed that for the omitted sub-sectors the reporting counterparts were representative, both with respect to the average cost per transaction and the breakdown of costs in the concomitant fixed and variable components. For further details, the reader is referred to the full report of the Working Group on Costs of POS Payment Products (2004). The auxiliary assumptions were only made to obtain estimates for the entire banking community and the entire retail sector. They do not affect measures such as costs per transaction etc., since the procedure followed throughout assumes that the banks and the retail sub-sectors that did report cost figures yield a representative picture for the remaining banks and retail sector.

The cost items in detail

Tables A.1 and A.2 present the questionnaires used for the banking industry and the retail sector, respectively. The shares of the fixed and variable costs (either transaction-linked or sales-linked) are also reported in the tables. First, we discuss the cost items included in the tables. In addition to the global description in section 3, they offer a comprehensive picture of the activities and costs involved. Next, we dwell on the breakdown into fixed and variable cost components.

Table A.1 distinguishes four main cost groups: back office costs, front office costs, overhead costs and cost of armoured car services. Section 3 discussed already the banks' activities in the (re)distribution of cash money and their pivotal role in developing and processing electronic POS payments. This leads to a range of *back office costs*, dealing with cash handling (cash centres

²² Corrected in the case of the debit card, for estimated cash-back withdrawals.

Table A.1 Cost items – banking sector (including the central bank) *

Cost items	Cash	Debit card	E-purse	Credit card
Back-office costs				
- Production costs (broadly defined)	80% F, 10% Vs, 10% Vtr	F	F	F
- production costs ^a				
- transportation costs				
- product development costs				
- Cash centres	20% F, 40% Vs, 40% Vtr	n/a	n/a	n/a
- staff		n/a	n/a	n/a
- buildings		n/a	n/a	n/a
- equipment		n/a	n/a	n/a
- systems		n/a	n/a	n/a
- Other back office costs ^b	50% Vs, 50% Vtr	50% F, 50% Vtr, fraud Vs	80% F, 20% Vtr, fraud Vs	50% F, 50% Vtr, fraud Vs
- control / audit dept.				
- telecommunications				
- subscription				
- tariffs				
- information supply through account statements ^c				
- fraud costs				
Front-office costs				
- branch offices ^d	30% F, 20% Vs, 50% Vtr	F	F	F
- staff				
- buildings				
- equipment				
- systems				
- ATMs & e-purse chargepoints	80% F, 10% Vs, 10% Vtr	n/a	95% F, 5% Vtr	n/a
- depreciation		n/a		n/a
- maintenance/servicing		n/a		n/a
Overhead costs^e	50% F, 25% Vs, 25% Vtr	F	F	F
Armoured car services^f	20% F, 30% Vs, 50% Vtr	n/a	n/a	n/a

* The costs to the central bank concern only cash-related items.

F = fixed costs; Vtr = transaction-lined variable costs; Vs = sales-linked variable costs. Not every bank supplied figures on all sub items. For this reason, estimates are used, based in part on the cost figures of other banks, which did supply the detailed information. For this reason, the Table presents only fixed-variable costs breakdowns on main items.

n/a means non-applicable.

^a Debit card and e-purse production costs are attributed in proportion to the numbers of ATM withdrawals, debit card payments and e-purse payments, to cash, debit card and e-purse, respectively.

^b All costs made within the central organisation and relating directly to the different payment products.

^c Only to the extent of the ATM and POS transactions.

^d Including Post Offices; this item equals total costs minus costs attributable to other bank products (lending, insurance, travel, etc.).

^e Costs of staff departments etc. attributable to the POS payment products.

^f Both for cash and for restocking off-premise ATMs.

etc.), with the production and distribution of cards (both for ATM withdrawals and POS terminal payments), with the maintenance of the interbank computer network, including measures to guarantee that the required security conditions are fulfilled, et cetera. In addition, there are back-office costs at centralised levels to be allocated to the retail payment system, such as the costs of control and management departments related to, for instance, logistics issues, the costs of information supply to customers in the form of account statements and telecommunications costs. Such costs were counted only to the extent that they related to retail payments. The *front office costs* relate to activities involving more direct contacts with the customers, in particular costs related to branch office networks, such as bank office counter services in connection with retail payment products (cash withdrawals and deposits, delivery of debit cards etc.) and cash deposit facilities (night safes, seal bag deposit machines etc.). Again, the branch office costs were included only to the extent that they relate to retail payment products. Front office costs also include costs related to e-purse recharge facilities and ATMs (depreciation of investments, maintenance including physical and IT security upgrades) and the costs of servicing ATMs. Finally, there are the *overhead costs* related to head-office managing departments and to the central organisation as a whole (only partly ascribed to payment system activities) and the costs of *armoured car services*. The latter item relates in particular to the costs of delivering and collecting cash to branch offices and of restocking off-premise ATMs (i.e. those not installed on the premises of branch offices).

For the retail sector, back-office and front-office costs were distinguished, as well. *Back-office costs* relate to the preparation, emptying and balancing cash registers, cash management, preparing the day's receipts to be deposited, the procurement of small change and cash register rolls and all underlying administrative activities. *Front-office costs* are the costs of processing the payments, defined as the length of time between the moment the customer has been informed of the balance due and the moment the sales slip, change etc. has been handed to the customer. This duration is expressed in terms of staffing costs at the average wage rate for shop workers. Thus, the time involved in paying at the counter constitutes a major factor in calculating front-office costs. Cost figures are based on the following durations: cash: 19 seconds; debit card: 26 seconds; e-purse: 14 seconds, and credit card: 28 seconds. Also included were the costs of POS terminals (depreciation, maintenance contracts), of telecommunications including those related to debit card payments, and losses due to theft (including change-giving errors). Finally, the cost of cash transportation (by armoured car, or by staff with the necessary time expressed as money) and insurance costs were taken into account as well.

TableA.2 Cost survey – retail sector*

Cost items	Cash	Debit card	E-purse	Credit card
Back-office costs ^a	F	F	F	F
Front-office costs ^b	Vtr	Vtr	Vtr	Vtr
Telecommunications	n/a			
- Subscription	n/a	F	F	F
- Tariffs	n/a	Vtr	F	Vtr
Cash transp. (in-house/outsourced)	Vs	n/a	n/a	n/a
POS terminal costs	n/a			
- Depreciation ^c	n/a	50%F, 50%Vtr	80%F, 20%Vtr	50%F, 50%Vtr
- Servicing/maintenance	n/a	50%F, 50%Vtr	80%F, 20%Vtr	50%F, 50%Vtr
Cash theft	Vs	n/a	n/a	n/a
Insurance costs	Vs	Vs	Vs	Vs

* F = fixed costs; Vtr = transaction-linked variable costs; Vs = sales-linked variable costs.

^a Costs include cash register handling (preparation for use, regular emptying, balancing receipts, cash management etc.) and administration costs.

^b Labour costs related to the actual processing of payments.

^c For combined terminals: break down according to the numbers of transactions processed with each payment product.

Fixed versus variable costs

Tables A.1 and A.2 also report how the individual cost items are subdivided into fixed costs (F) and variable costs, either of the transaction-linked or of the sales-linked type (Vtr and Vs, respectively). The breakdown assumes a medium-term horizon of 3–5 years. As a result, labour costs are largely variable in character, because staff may be reallocated in case of shifts in payment patterns of consumers and/or merchants. Table A.1 illustrates that for the electronic payment instruments, fixed costs constitute a relatively large share of total costs, owing to the dominant role of the electronic infrastructure, whose costs are relatively fixed. Among the electronic payment instruments, the e-purse has the largest fixed cost component, since, unlike the situation for debit and credit cards, merchants' and banks' costs usually relate to a bundle of e-purse transactions. The variable costs of electronic payment products are predominantly transaction-linked, both for banks and merchants. In the case of cash, by contrast, sales-linked variable costs are relatively more important. With respect to the costs of banks' branch offices, the time horizon of 3–5 years implies that there are reasonably ample opportunities for alternative allocation of labour and capital resources. If consumers and merchants change their payment behaviour, branches may be scaled down or even closed. For overhead costs, the share of fixed costs, compared to branch offices, is somewhat larger, as alternative labour and capital allocation

opportunities are more limited, because senior staff departments or head offices are unlikely to be scrapped. Alternative applications for ATMs are relatively limited, resulting in a relatively large fixed cost component. Not all ATM costs are fixed, however, because in the medium term, ATMs can be put out of operation. Costs of cash transportation are largely variable, although not entirely, because cash transportation trips are usually made with regular frequencies, for instance once a day, irrespective of the exact amounts being transported.