



Danmarks
Nationalbank

Payment Systems
in Denmark

PAYMENT SYSTEMS IN DENMARK

Text may be copied from this publication provided that Danmarks Nationalbank is specifically stated as the source. Changes to or misrepresentation of the content are not permitted.

Payment Systems in Denmark is available at Danmarks Nationalbank's website: www.nationalbanken.dk under Publications.

To order Payment Systems in Denmark, please contact:

Danmarks Nationalbank,
Information Desk,
Havnegade 5,
DK-1093 Copenhagen K

Telephone: +45 33 63 70 00 (direct) or +45 33 63 63 63

Office hours: Monday-Friday 9.00 a.m.-4.00 p.m.

E-mail: info@nationalbanken.dk

www.nationalbanken.dk

This publication is based on information available up to June 2005.

Explanation of symbols:

- Magnitude nil
 - 0 Less than one half of unit employed
 - Category not applicable
 - ... Data not available
- Details may not add due to rounding.

Scanprint A/S

ISBN 87-87251-50-7

ISBN 87-87251-51-5 (Online)

Contents

FORWORD	7
1. THE ROLE OF CENTRAL BANKS IN PAYMENT SYSTEMS	
1.1 Serious events within the payments infrastructure	9
1.2 Central banks as system operators	13
1.3 The role of central banks as settlement banks	14
1.4 The roles of central banks and private banks	15
1.5 The central banks' oversight function	16
2. PAYMENT SYSTEMS IN A HISTORICAL PERSPECTIVE	
2.1 From barter economy to monetary economy	20
2.2 Banks and credit-based payment in the middle ages	23
2.3 Payment systems with clearing and central banks	27
2.4 Payments in Denmark 1700-1850	31
2.5 Bank-based payment systems in 19th century Denmark	35
3. PAYMENT AND SECURITIES SETTLEMENT	
3.1 Settlement outside the payments infrastructure	43
3.2 Real-Time gross settlement systems	44
3.3 Net settlement systems.....	48
3.4 Hybrid systems	50
3.5 Securities settlement systems	52
4. RISK IN PAYMENT AND SECURITIES SETTLEMENT	
4.1 Risks of settlement outside the payments infrastructure	64
4.2 Risk in payment systems	64
4.3 Risk in securities settlement	69
5. DANMARKS NATIONALBANK'S ROLE IN THE DANISH PAYMENTS INFRASTRUCTURE	
5.1 Banknote and coins	74
5.2 Danmarks Nationalbank's role as settlement bank	74
5.3 Danmarks Nationalbank provides krone liquidity	76
5.4 Danmarks Nationalbank offers intraday credit in euro	78
5.5 Pledging of collateral to Danmarks Nationalbank	79
5.6 Settlement procedure at Danmarks Nationalbank	86

6.	PAYMENT AND SETTLEMENT SYSTEMS IN DENMARK	
6.1	Kronos	96
6.2	The Sumclearing	104
6.3	VP settlement	111
6.4	FUTOP settlement	119
7.	RETAIL PAYMENTS IN DENMARK	
7.1	Means of payment and payment instruments	125
7.2	Infrastructure for payment cards	132
7.3	The Dankort	135
7.4	New payment instruments	139
7.5	Use of payment cards in EU member states.....	144
8.	INTERNATIONAL PAYMENT AND SETTLEMENT SYSTEMS	
8.1	Target	149
8.2	Target2	151
8.3	EURO1	153
8.4	STEP1	157
8.5	STEP2	159
8.6	The vision of SEPA – The Single Euro Payment Area	161
8.7	CLS	164
9.	THE LEGAL FRAMEWORK FOR THE PAYMENTS INFRASTRUCTURE	
9.1	Contractual and legal basis of the systems	173
9.2	The settlement finality directive	176
9.3	The financial collateral directive	179
9.4	The Hauge convention on the PRIMA principle	180
9.5	Protection of the payments infrastructure in Danish law.....	181
9.6	Other legislation on payment systems	184
9.7	EU legislation on electronic retail payments	185
10.	OVERSIGHT	
10.1	Central banks as overseers	190
10.2	Oversight by Danmarks Nationalbank	195
10.3	International standards for payment systems	195
10.4	International requirements for securities settlement systems ...	198
10.5	Assessment of Danish payment and settlement systems	202
10.6	Oversight of the risk of major operational disruptions	206
Annex 10.A:	BIS' Core Principles for systemically important payment systems	212
Annex 10.B:	BIS/IOSCO recommendations for securities settlement systems.....	214

Annex 10.C: Memorandum of understanding between Danmarks Nationalbank and the Danish financial supervisory authority concerning payment systems and clearingcentres	217
Appendix A: Definition of gridlock and gridlock resolution in Kronos	221
Appendix B: Liquidity management by the RTGS system participants	227
Appendix C: Effect of queue facilities for Kronos participants	235
Appendix D: Simulation of systemic risk in the sumclearing	245
GLOSSARY	253
INDEX	261

Foreword

One of the objectives of Danmarks Nationalbank is to contribute to the efficiency and stability of payment and settlement systems. These systems are necessary for the efficiency of the Danish financial sector.

Danmarks Nationalbank has several roles in relation to payment systems. It operates a payment system for settlement of large-value time-critical payments between financial institutions and it is furthermore the settlement bank for payment systems and the cash leg of securities transactions in Denmark. In addition, Danmarks Nationalbank conducts the oversight of payment and securities settlement systems in Denmark. These tasks are performed by most central banks worldwide.

Danmarks Nationalbank considers it important that the Danish payments infrastructure is described in full detail and that this description is available to the general public. That is why Danmarks Nationalbank has issued this publication on payment systems.

The publication focuses on the technical infrastructure of payment systems, while the use of banknotes and coins for payments is only touched lightly upon. The systems described are primarily payment systems for settlement of large-value payments between financial institutions, as well as securities and foreign-exchange settlement systems. Finally, retail payment systems used in connection with e.g. settlement of Dankort payments are described.

Whenever possible, it has been sought to write the chapters as stand-alone chapters. Chapter 1 presents the roles of central banks in payment systems. Chapter 2 reviews the historical background to payment systems, including the background to the involvement of central banks. This Chapter is aimed primarily at readers with an interest in history. Chapters 3 and 4 describe the general principles and risks in various types of payment and securities settlement systems. Chapters 5-7 review the Danish payments infrastructure and the role of Danmarks Nationalbank therein. Chapter 8 describes international payment and settlement systems of importance to the Danish financial institutions. Chapter 9 reviews the legal framework for payment systems, while Chapter 10 describes the role of Danmarks Nationalbank in the oversight of payment and settlement systems. Appendices A-D present a mathematical treatment of particular concepts/topics related to payment systems. At the end of the publication there is a glossary of payment system terms and an index.

Danmarks Nationalbank would like to thank colleagues in Denmark and elsewhere for useful contributions and suggestions in connection with the preparation of the publication.

If you have any queries or comments, please contact Danmarks Nationalbank, Payment Systems, at bfk@nationalbanken.dk.

The publication closed for contributions in June 2005.

1. The Role of Central Banks in Payment Systems

Payment settlement is the transfer of money from a remitter to a recipient. An example is payment using banknotes and coins. However, most payments are settled electronically nowadays via payment systems.

Over time, payment settlement has developed from the first primitive forms of means of payments into sophisticated, IT-based systems with a number of facilities to support the settlement procedure. Well-functioning payment systems are essential to the daily flow of payments between financial institutions and the corporate sector and households. The establishment of secure and efficient payment systems is therefore an important prerequisite for financial stability and for economic growth.

Central banks often operate payment systems for settlement of large-value payments between financial institutions, since they provide secure assets, i.e. central-bank money, for settlement of payments. This eliminates a number of risks for participants. In most countries central banks therefore function as settlement banks for payment systems that are important to the payments infrastructure. These systems are known as systemically important payment systems (SIPS). In addition, central banks oversee systemically important payment and settlement systems to ensure that they are as secure and efficient as possible.

This Chapter outlines various episodes illustrating the role of central banks in payment systems, followed by a description of central banks in their capacity as system operators. Then the function of central banks in relation to settlement of payments is explained, and the division of work between central banks and private banks is accounted for. Finally, the Chapter describes the central banks' role as overseer of systemically important payment and settlement systems.

1.1 SERIOUS EVENTS WITHIN THE PAYMENTS INFRASTRUCTURE

Today, the traditional role of a central bank as the lender of last resort¹ is effected via the payments infrastructure, which is therefore critical in relation to solving problems within the financial sector. After the terrorist

¹ "Lender of last resort" refers to the possibility that the central bank can extend credit, e.g. to a solvent bank that experiences a liquidity crisis.

THE TERRORIST ATTACKS ON THE USA ON 11 SEPTEMBER 2001

Box 1.1

The financial sector was severely affected by the terrorist attacks on the USA on 11 September 2001, which, *inter alia*, hit the World Trade Center in New York, where some of the USA's largest financial enterprises had offices.

The attacks had no direct impact on the US payment systems, but the number of payments settled dropped substantially below the normal level owing to participants' problems. In addition, settlement of payments was conditional on systems remaining open for longer than usual. Moreover, the Federal Reserve had to provide considerable extra liquidity during the following days. Between 11 and 14 September, bank deposits with the Fed thus rose from USD 13 billion to USD 121 billion. Not until 21 September had the bank deposits fallen back to the pre-attack level.

Securities trading was also severely hit. In dollar terms, the volume of trading in US government bonds that could not be executed in the daily settlements in the week following 11 September was 25 times the daily level in January-August 2001. A contributing factor was that market participants were reluctant to lend securities since the risk was assessed to be too high in relation to the profit.

There was also a significant impact on settlement of retail payments. Clearing of cheques, which are frequently used as a means of payment in the USA, was affected by the inability of several banks to honour cheques drawn on them. The Fed ensured that this did not have liquidity effects by crediting the paying bank, even though the Fed could not debit the bank issuing the cheque in the days after the terrorist attacks.

Likewise, New York saw a surge in the demand for cash, and consequently many ATMs ran out of cash.

Source: Fleming and Garbade (2002) and McAndrews and Potter (2002).

attacks on the USA on 11 September 2001, the Federal Reserve (Fed) chose to offer virtually unlimited liquidity to the banks, cf. Box 1.1. Moreover, the Fed found it extremely important to ensure that payment systems remained in operation, and it managed to keep the Fedwire payment system open. Combined with the extraordinary injection of liquidity, this contributed to limiting the impact of the terrorist attacks on the financial sector.

There are also examples of central banks helping to solve problems in relation to securities settlement systems. As Box 1.2 illustrates, the Fed had to step in to provide substantial liquidity when a large US custodian bank, Bank of New York, in 1985 experienced securities settlement problems following IT system failure.

The establishment and use of a secure payments infrastructure can reduce, and in many cases eliminate, the risks related to settlement of payments and transactions in securities and foreign exchange. For this reason central banks are often involved in the development of payment and settlement systems. Under the auspices of BIS¹ central banks have e.g. called

¹ The Bank for International Settlements (BIS) is banker to the central banks.

BANK OF NEW YORK'S IT SYSTEM FAILURE ON 21 NOVEMBER 1985

Box 1.2

In the morning of 21 November 1985, Bank of New York experienced an IT system failure which meant that its custody function could not release, but only receive securities. Since Bank of New York is one of the USA's largest custodian and settlement banks, its problems had major consequences for the US securities market.

At the peak of the crisis, the bank had borrowed approximately USD 30 billion from the Fed to pay for securities purchased. Under normal circumstances, such purchases would be covered by the proceeds from the securities sold. Although the US payment and securities settlement systems extended their opening hours, the problems were not solved until the following day. Consequently, the bank had to borrow almost USD 24 billion from the Fed overnight, equivalent to about 23 times the bank's equity capital.

Without this loan, the US payment and securities settlement systems would have crashed on 21 November 1985. This would have had serious consequences, not only to Bank of New York, but also to the other settlement participants.

Source: Corrigan (1986).

for the establishment of a payments infrastructure for settlement of foreign-exchange transactions.

Foreign-exchange transactions have traditionally been settled via correspondent banks, whereby the parties incur a mutual credit risk, known as

THE CASE OF BANKHAUS HERSTATT

Box 1.3

Bankhaus Herstatt, a small bank in Cologne that was active in the foreign-exchange market, became insolvent on 26 June 1974. The German banking supervision authority, Bundesaufsichtsamt für das Kreditwesen, immediately withdrew Herstatt's banking license and Herstatt suspended its payments.

The suspension of payments took effect at 3.30 p.m., after the German interbank payment system had closed. Prior to the suspension of payments, banks selling D-marks against dollar to Herstatt in foreign-exchange contracts that were due for payment had effected irrevocable payments of D-marks to Herstatt via their German correspondent banks. This was done in the expectation that Herstatt, via its US correspondent bank, would pay in dollars to them on the same day. At the time of suspension of payments (10.30 a.m. US Eastern Time) the US banks and payment systems were still open. When Herstatt's correspondent bank received notification of the suspension of payments, it immediately froze Herstatt's funds and cancelled all outgoing payments from its accounts.

For the counterparties, the freezing of Herstatt's accounts meant that they incurred an involuntary credit exposure on Herstatt, equivalent to the principal of the D-mark payments made on 26 June on foreign-exchange contracts falling due. In addition, they suffered losses owing to the liquidity risk they had run since they had to borrow dollars at short notice to cover the dollar payments that would otherwise have been effected using the dollars received from Herstatt.

As a consequence of this episode, the principal risk on settlement of foreign-exchange transactions is often referred to as "Herstatt risk".

¹ Source: BIS (1996).

the Herstatt risk, equivalent to the amount of the transaction. The term Herstatt refers to the insolvency of Bankhaus Herstatt, in which connection Herstatt's counterparties incurred losses owing to the risk on settlement of foreign-exchange transactions, cf. Box 1.3. The Herstatt episode led the banks to introduce restrictions on the counterparties and counterparty exposures they were willing to accept. Such restrictions limit the banks' risks, but do not eliminate them. As the volume of transactions in the foreign-exchange markets grew in the 1990s, the need for a secure and efficient infrastructure for settlement of foreign-exchange transactions became increasingly evident. In dialogue with the central banks, the largest private banks established an infrastructure for settlement of securities transactions, CLS (Continuous Linked Settlement), in 2002, cf. Chapter 8.

As the above examples illustrate, secure and efficient payment and settlement systems are important for the financial sector. Efficient does not only mean that the system yields satisfactory profits from a commercial point of view, but also that the participants find the system useful and that it supports their settlement of payments in a cost-effective manner. However, payment-system participants and central banks do not always agree on the definition of efficient systems, cf. Box 1.4.

SECURITY AND EFFICIENCY OF PAYMENT SYSTEMS	Box 1.4
<p>International standards for payment systems¹ state that a key element of the design of payment systems is the combination of high efficiency and low risk. Efficiency and limitation of risk can to some extent be seen as complementary objectives: more secure systems can only contribute to reducing risk if the systems are actually used to a sufficient degree, which in turn requires that they are efficient.</p> <p>As regards payment systems for large-value payments between financial institutions, the level of security that is desirable to society as a whole is often higher than what individual participants deem to be optimum from a commercial point of view. One reason is that the probability that problems will arise within a payment system is very small, but on the other hand the consequences to society are huge if the systems do not function. The low risk means that it is not commercially attractive for participants to spend large sums on the security of the systems, while the potential consequences entail that society has an interest in making the systems sufficiently secure. Secure payment systems are particularly important during economic recessions when financial institutions do not wish to take on large positions and thus large risks on each other. For these reasons, central banks often develop and operate large-value payment systems.</p> <p>In some cases, commercial use of the payments infrastructure is lower than what is desirable to society. This means that the financial institutions must sometimes be encouraged to use the infrastructure. This can be done by subsidising the use of the systems, cf. section 1.2, or by urging banks to use the infrastructure via "moral suasion", cf. Chapter 10, section 10.1.²</p>	

¹ The international standards are described in Chapter 10.

² Nielsen (2005) is an example of moral suasion.

1.2 CENTRAL BANKS AS SYSTEM OPERATORS

An important task for central banks is to establish and operate payment systems. An early example is the Fed's establishment of the telegraph-based Fedwire payment system in the USA in 1918 with a view to enabling nationwide settlement of payments, cf. Chapter 2, Box 2.6.

Today many central banks operate payment systems for settlement of large-value payments between financial institutions, i.e. Large-Value Payment Systems (LVPS). These systems have the following characteristics:

- *Network externalities*, i.e. the higher the number of participants, the more advantageous the payment system is for all participants.
- *Economies of scale* since the fixed costs of establishing and operating the systems are high.
- *Positive externalities* since the advantages of secure and efficient payment systems are greater to the system/society in general than to the individual participant.

Among other things, network externalities entail that it is difficult to establish a new system since a critical mass of participants is required for the system to be efficient. The combination of network externalities and economies of scale means that, all other things being equal, it is optimum for society to have only one LVPS. In other words, such systems are natural monopolies.

The positive externalities of payment systems arise because minimisation of systemic risks is of greater value to society than to the individual participant. One participant's problems in meeting its financial obligations can quickly spread to other participants via payment systems. Consequently, measures to reduce systemic risks are important. Such measures are costly, and therefore private payment-system providers will weigh the resources needed against the commercial profit from the system. As a result, too few resources may be employed to minimise the risks compared to what is optimum from society's point of view, cf. Box 1.4.

When central banks develop and operate systemically important payment systems, the issue arises of whether costs should be fully covered, i.e. whether participants should pay all costs of developing and operating the system. The argument in favour of full coverage is that the central bank would otherwise subsidise participants. However, it could also be argued that secure and efficient payment systems are to the benefit of everyone in society, so it makes sense to provide public support to

encourage banks to use the payments infrastructure whenever possible. If the payments infrastructure is too expensive to use, payments will be settled outside the payments infrastructure, which would – all other things being equal – increase the settlement risk, cf. Chapter 4.

Another aspect to consider is that the fixed costs of establishing payment systems must be paid irrespective of whether it is a small country with relatively few participants or a large one with many participants in the payments infrastructure.¹

1.3 THE ROLE OF CENTRAL BANKS AS SETTLEMENT BANKS

Settlement of payments is the process from a payment is debited to one account until it is credited to another. On settlement of securities and foreign-exchange transactions, securities or foreign exchange is transferred from one owner to another. In many systemically important payment and settlement systems, payments are exchanged via the participants' central-bank accounts, i.e. the central bank acts as settlement bank for the system.

If a private bank acts as settlement bank, confidence in the settlement may suffer as a result of asymmetrical information: an individual private bank is better informed of its own financial strength than the other banks. The reason is that only the bank itself knows the value and composition of e.g. its lending portfolio.² In the event of uncertainty as to the financial strength of the settlement bank, the asymmetrical information may entail that participants are reluctant to send payments to the settlement bank. If a participant withholds its payments, there is a risk that other participants cannot meet their payment obligations. In extreme cases a domino effect may be seen, so that more and more participants are unable to meet their obligations, resulting in a systemic crisis.

When the central bank acts as settlement bank, the risk of systemic crises is reduced for two reasons. Firstly, payments are settled in "central-bank money", cf. Box 1.5, and thus the participants' credit risk on the settlement bank is eliminated. Secondly, the central bank can provide banks with extra liquidity against appropriate collateral if their liquidity is insufficient to settle their payments.

It is important for the central bank to ensure that adequate liquidity is always available within the financial system to settle payments on time. Consequently, central banks offer intraday liquidity to support settle-

¹ To take an example, Fedwire has more than 8,000 participants, and although the Fed requires that the participants pay all costs, including return on equity, the costs per transaction are low in Fedwire.
² Cf. Kjeldsen (2004).

CENTRAL-BANK MONEY

Box 1.5

The best known example of central-bank money is banknotes and coins, but private banks' deposits in central-bank accounts are also central-bank money in the form of account money, i.e. electronically registered deposits. Private banks also issue account money as customers' (including other banks') deposits in accounts. In a modern, well-functioning economy the general public does not make a distinction between central-bank money and account money from private banks, i.e. commercial bank money. The reason is that commercial bank money can be exchanged directly for central-bank money such as banknotes and coins.

Settlement of payments using central-bank money means that payments are settled via central-bank accounts, where the recipient has a claim on the central bank and the remitter either has a deposit at the central bank or the option to obtain credit from the central bank against collateral.

Central-bank money has five characteristics:

- It is secure since there is no credit risk on the central bank.
- It is available to all participants in e.g. a payment system.
- It is efficient since it is secure and can easily be used as a means of payment.
- It is neutral since central banks do not discriminate participants.
- It is final since central-bank money can be used directly as a means of payment.

By using central-bank money, the credit and liquidity risks in payment and settlement systems are reduced substantially. There is no credit risk on central banks, and central banks are able to create liquidity, i.e. increase the volume of central-bank money, by lending money to participants for settlement of payments. International standards recommend that systemically important payment and securities settlement systems settle via central-bank accounts, i.e. in central-bank money or equally secure funds, cf. Chapter 10.

Source: BIS (2003).

ment of payments. In addition, the central bank may offer liquidity for more than one day, i.e. interday liquidity, as part of its monetary-policy operations.¹

Most central banks require securities as collateral for credit. Pledging collateral is expensive for participants, who therefore seek to minimise the liquidity required to settle payments. In connection with unforeseen events it is often necessary for participants to raise extra liquidity at short notice. This means that the central bank must be able to provide liquidity to participants quickly and flexibly.

1.4 THE ROLES OF CENTRAL BANKS AND PRIVATE BANKS

Central banks and private banks normally share the tasks so that systems aimed at private banks' customers, including retail payment systems, are operated by private banks. These systems are an important part of the

¹ Cf. Danmarks Nationalbank (2003).

private banking business area, where customer-related initiatives are important competitive parameters. Consequently, private banks are often far more focused on customer requirements than central banks would be. Another significant aspect is that central banks do not compete with private banks for customers' business in the field of payment services. Therefore operation and development of retail payment systems is typically handled by private banks, whereas settlement of payments between the participating banks and oversight of the systems are the tasks of the central bank.

As regards settlement of payments, both central-bank and commercial bank money is required in the payments infrastructure of a modern economy, cf. Box 1.5. It is not efficient to use central-bank money in all settlement systems since the use of central-bank money makes great demands on the systems and participants in terms of security and creditworthiness. Systems that do not settle using central-bank money include systems for settlement of Internet payments, i.e. e-payments, cf. Chapter 7.

1.5 THE CENTRAL BANKS' OVERSIGHT FUNCTION

A core task for central banks is to ensure that systemically important payment systems comply with international standards and are thus assessed to be secure and efficient. With the growing significance of these systems to financial stability, it has also become increasingly important for society to ensure that payment and settlement systems are as secure as possible.

Settlement risks can potentially have major systemic impacts if one financial institution's problems in meeting its financial obligations spread to other financial institutions, e.g. via payment systems. While the probability that payment and settlement systems trigger systemic crises is usually regarded as very small, the consequences of a potential crisis can be considerable and may threaten financial stability. It is therefore sought to minimise the various types of risks incurred by financial institutions in relation to payment and settlement systems, cf. Chapter 4, e.g. via the central banks' role as overseer and settlement bank.

Central banks both operate and oversee systemically important payment systems. It is important that these two functions are performed by separate organisational units to ensure adequate and impartial assessment of whether the central bank's own systems comply with the international standards.

Under the Financial Sector Assessment Programs (FSAP), the International Monetary Fund, IMF, and the World Bank have begun to assess

whether systemically important payment systems comply with the international standards. In this way the central banks' oversight functions are controlled. At the end of 2005, the IMF will conduct an FSAP of Denmark. The FSAP is described in more detail in Chapter 10, Box 10.2.

LITERATURE

BIS, 1996. *Settlement risk in foreign exchange transactions*, Report prepared by the Committee on Payment and Settlement Systems, Bank for International Settlements.

BIS, 2003. *The role of central bank money in payment systems*, Report prepared by the Committee on Payment and Settlement Systems, Bank for International Settlements.

Corrigan, E. Gerald, 1986. Statement to Congress, December 12, 1985, circumstances surrounding the problem at Bank of New York on November 21 and suggested steps to prevent recurrence, *Federal Reserve Bulletin*, 1986, February issue.

Danmarks Nationalbank, 2003. *Monetary Policy in Denmark*, 2nd edition.

Fleming, Michael J. and Kenneth D. Garbade, 2002. When the Back Office moved to the Front Burner: Settlement Fails in the Treasury Market after 9/11, *Economic Policy Review*, Federal Reserve Bank of New York, Vol. 8, No. 2.

Kjeldsen, Kristian, 2004. The Role of Capital in Banks, Danmarks Nationalbank, *Monetary Review*, 3rd Quarter.

McAndrews, James J. and Simon M. Potter, 2002. Liquidity Effects of the Events of September 11, 2001, *Economic Policy Review*, Federal Reserve Bank of New York, Vol. 8, No. 2.

Nielsen, Torben, 2005. Risks on Settlement of Large Payments, Danmarks Nationalbank, *Monetary Review*, 1st Quarter.

2. Payment Systems in a Historical Perspective

The methods and requirements for effecting payments have changed significantly over time. Fundamentally, the development in payment systems has comprised three elements:

- Emergence of new means of payment and payment instruments used for effecting transactions.
- Establishment of new institutions through which payments were channelled from remitter to recipient.
- Development of new rules, procedures and systems for effecting and regulating payments.

Changes in one of these areas have typically been driven by a wish to optimise the efficiency and security of payment systems.¹ Often changes have been a natural consequence of e.g. growing trade, new social structures or technological breakthroughs.

This Chapter identifies various milestones in the historical evolution towards the payment systems we know today. The Chapter first describes the transition from a barter economy to a monetary economy and the pivotal role of a stable coinage in payment systems.

Then follows an overview of how banks in the Middle Ages gained a central position with the emergence of a credit-based payments infrastructure. That period also saw the introduction of liquidity-saving procedures for netting of payments before settlement. The significance of, initially, clearing banks and subsequently, from the mid-16th century, central banks in the stability and efficiency of payment systems is also explained.

The last part of the Chapter outlines the development in Denmark from 1700 to 1900, during which period Denmark was generally lagging somewhat behind the development of the leading European countries. The historical overview concludes in the latter half of the 19th century, by which time the Danish banking system, centred around Danmarks Nationalbank, was in place.

¹ Cf. Goodfriend (1989).

2.1 FROM BARTER ECONOMY TO MONETARY ECONOMY

In a modern market economy, barter, in which trade is effected by exchange of goods for other goods, is regarded as a curiosity, used only in developing countries or on the fringes of the economy. However, we only have to go back to the 19th century to find a different situation in which a very large segment of the population in Denmark and other western European countries only to a limited extent purchased and sold goods and services for money.¹ Until then, money was used mainly in towns, in foreign trade and in connection with government revenue and expenditure. This reflected that the rural population's existence was based mainly on goods paid for in kind, where production for own consumption played a large role. Consequently, there was little need for money to effect transactions.

2.1.1 Emergence of money-based trading

The development from a barter economy to a monetary economy coincided with the transition from a predominately self-sufficient economy to an economy in which individuals produced goods and services to be sold for proceeds that could be used for the purchase of goods and services produced by others. The increased dependence on trade – and thus on money – is thus a logical extension of the greater specialisation/division of work in the economy.

The transformation from a barter economy to a monetary economy was effected by "elevating" a commodity to the status of money. In order for a commodity to play the role of money – and thus overcome the problems inherent in bartering – it had to meet the following three conditions²:

- It should be a generally accepted means of payment ("object of barter"), i.e. have a utility value for all parties concerned.
- It should be possible to store it for savings purposes, so that the purchase and sale of goods and services did not have to take place simultaneously.
- It should function as a unit of account on the pricing of goods. In the absence of a common unit of measurement, relative prices had to be established for all combinations of goods traded.³

Throughout history, many different commodities have played the role of money, but ultimately metals, primarily silver and gold, became the

¹ Cf. Kindleberger (1993) and Hansen and Svendsen (1968).

² Cf. Goodhart (1989).

³ In a barter economy with N goods, $\frac{1}{2}N(N-1)$ relative prices have to be determined. This can be reduced to $N-1$ relative prices if one commodity (money) forms part of all trade transactions.

dominant form of money. Before coins were invented, silver and gold by weight were used for transactions between traders.

The value of the metals depended on their utility value. As far as gold and silver were concerned, their utility value lay in their use in the production of jewellery and other ornaments. This did not change significantly when people began to mint coins.

2.1.2 Coins, Gresham's Law and seignorage

The transition to coins made the settlement of a transaction easier, because it was no longer necessary to weigh the metal to be delivered by the buyer. However, the prerequisites to efficient coinage were trust in the coin minter as well as the existence of coins with values that could be used in the transaction in question.

The Greeks were the first Europeans to mint coins as we know them. The earliest coins date back to around 650 BC and were minted in the ancient state of Lydia in what is now western Turkey.¹

The first coins to appear in Denmark were Roman. They are known from archaeological excavations from around AD 100² and the use of foreign coins in Denmark is documented by numerous archaeological finds. In addition to Roman coins, the finds typically comprised German, Anglo-Saxon, Arabic and Byzantine coins. Denmark started minting silver coins around AD 800, but the first well-organised coinage was not established in Denmark until the reign of Canute the Great (1018-35).

The emergence of coins did not change the fact that their trading value remained closely linked to their gold or silver content (metal value).³ This is illustrated by the frequently occurring situation of circulating coins having the same denomination, but different metal values. In these cases, "bad" coins with a low metal value drove "good" coins with a high metal value out of circulation, since people preferred to save up in the coins with the highest value. This effect is known as Gresham's Law, cf. Box 2.1.

Coin minters benefited from seignorage, i.e. the difference between the face value of the coins and the cost of minting them. Therefore, kings and princes typically monopolised the right to mint coins.

Throughout history, there have been numerous examples of dilution of the metal content of coins with a view to increasing seignorage. Such dilution often coincided with a country's need to finance wars or otherwise being short of money. Dilution of the metal content of coins led to

¹ Cf. Davies (2002).

² Cf. Jensen (2004).

³ The linkage of the value of money to a metal was known right up to the 20th century. In the USA, the dollar's convertibility into gold was not abolished until 1971 in connection with the collapse of the Bretton Woods system.

GRESHAM'S LAW

Box 2.1

According to Gresham's Law, a situation in which two different coins have the same denomination will lead to the "bad" coins with a low metal value driving the "good" coins with a high metal value out of circulation, since people prefer to save up the coins with the highest metal value. In extreme cases, Gresham's Law has entailed that coins with a high metal value were forced out of circulation altogether, leading to a shortage of means of payment. The reason was that when some of the coins became inactive for transaction purposes, this was, in practice, tantamount to a reduction of the money supply. If the demand for money remains unchanged, this, all other things being equal, has a deflationary impact and thus hampers trade and economic activity.

Gresham's Law is often used to explain the difficulties of maintaining a stable money supply in a coinage based on both gold and silver. However, Gresham's Law also applied to coinages based on one metal, provided that the relative ratio between the face value of the coins and the metal value differed, cf. the description in section 2.4.1 of the Danish coinage based on different silver coins in the 18th century.

Gresham's Law was founded on attempts by the money-issuing authorities to peg the market value of the coins to a given face value rather than letting the value of the coins be determined by supply and demand, allowing for the metal value of the coins. In a countermove to Gresham's Law, and despite prohibitions, business enterprises and citizens have therefore often allowed coins to have different values, depending on their metal content.

Gresham's Law also had an international dimension, when foreign coins with a high silver content via trade entered a country whose coins had a low silver content. The foreign coins were then often taken out of circulation because they were melted down into domestic coins with a low silver content. As a result, seignorage accrued to the domestic authorities. One example is the melting down of Danish coins into Prussian coins during the Seven Years' War (1756-63), cf. section 2.4.3.

inflation when vendors nonetheless required the metal content of coins used for trade to be unchanged.

At worst, the reduction of the metal content of coins resulted in hyperinflation. This situation caused trust in coins to vanish altogether for a period of time, to the serious detriment of trade. Hyperinflation almost always led to a reform of the coinage in order to restore trust in coins. Subsequently, minting of coins with an acceptable metal content was resumed. In the absence of a coin reform, the king or prince would typically have had to accept that payments were made using other means of payment, e.g. foreign coins.¹

¹ Cf. Kindleberger (1993). The fact that hyperinflation led to bad coins being driven out of circulation by good coins may be seen as a "reverse Gresham's Law".

2.2 BANKS AND CREDIT-BASED PAYMENT IN THE MIDDLE AGES

A new type of institution emerged in the Middle Ages. These institutions contributed to making exchange of payments more flexible by swapping foreign coins for local coins that were more readily acceptable in local trade. In Italy, these exchange bureaux began to issue bills of exchange that corresponded to the gold and silver coins deposited. These bills of exchange turned into payment instruments that could be used in trade.¹

Initially, the bills of exchange issued were always covered in full by the coins deposited, but relatively quickly bills of exchange were no longer issued on a fully covered basis. Consequently, the exchange bureaux evolved from deposit banks into banks in the modern sense, entailing that they also extended loans. That paved the way for payments based on formalised extension of credit. Due to the risks inherent in extension of credit, bills of exchange were subject to legal measures designed to facilitate their negotiability and the collection of debt from a debtor defaulting on payment obligations.

2.2.1 The exchange bureaux of northern Italy – the first European banks

Europe in the Middle Ages comprised numerous independent kingdoms and principalities and the number of coins was extensive, making it difficult to establish the value of the coins. Since the value of an individual coin was also highly dependent on its metal content, valuation was complicated further by quality differences between coins of the same type due to dilution of the metal content, wear and "clipping".² Clipping was the practice of coin holders cutting small pieces of metal off the coins or dividing coins into two if the vendor did not have small change equivalent to the difference between the value of the buyer's coin and the goods sold.

In the 12th century, the large number of different coins and coin qualities led to exchange bureaux in northern Italy that specialised in exchanging coins – operating much like modern bureaux de change. The need to exchange coins arose because foreign coins were not accepted as legal tender. The lack of acceptance was due either to an outright ban on using foreign coins in the local area or to uncertainty as to the metal content (value) of the foreign coins.³

Initially, the exchange bureaux exchanged only foreign coins for local coins, but they subsequently proceeded to exchanging coins for bills of

¹ For a description of the difference between means of payment and payment instruments, see Chapter 7, section 7.1.

² Cf. Cohn (2001).

³ Cf. Wee (1997) and Cohn (2001).

BILLS OF EXCHANGE – THE FIRST EUROPEAN PAYMENT INSTRUMENTS

Box 2.2

The bills of exchange issued by northern Italian exchange bureaus when coins were deposited with them were used for payment of trade transactions and can be seen as the first European payment instruments. They did not have the status of a means of payment in the modern sense, since the ultimate completion of the payment was, in principle, not effected until the vendor presented the bill of exchange to the exchange bureau against receipt of silver coins, cf. the definition of means of payment and payment instruments in Chapter 7. From the point of view of the holders, a bill of exchange was often equivalent to a means of payment (money), however, since it was often used in several trade transactions before it was exchanged for coins at the exchange bureau.

The bills of exchange represented a risk to the holders, as experience showed that the exchange bureaus were not always able to exchange the bills for coins. Therefore, a characteristic feature of bills of exchange was that they were typically traded at a price below par. There are also examples to show, however, that the convenience of using bills of exchange meant that they were traded above par relative to coins. In these situations, the premium on bills of exchange may also have been considered payment for the efficient control of the metal value of the deposited coins by the exchange bureau/the bank and that bills of exchange without cover were not issued.

Source: Kindleberger (1993).

exchange, which assumed the status of payment instruments in the local area, cf. Box 2.2. The use of bills of exchange in trading entailed that the retailers' costs of controlling the coin quality were reduced.

The northern Italian exchange bureaus are often considered to be the first banks. To begin with, they only accepted deposits. Other types of banking, including lending, contributed little or not at all to their earnings partly due to the opposition of the church to interest, which was seen as usury.

2.2.2 Participation of banks in credit-based payment exchange

From the 12th century, trade expanded within Europe. Wholesale trading emerged, centred around large trade fairs in central Europe, to enhance the efficiency of trading between northern and southern Europe, cf. Box 2.3.

To support wholesale trading at the fairs, it was possible to pay in cash or against trade credits, which were often issued by banks. Moreover, new routines were developed for clearing and settlement of payments based on multilateral netting, cf. Chapter 3.

Trade credits were frequently extended against bills of exchange underpinned by various legal measures to facilitate both the negotiability (discounting) of the bills of exchange and the collection of debt from debtors if they defaulted on the bills.

CLEARING AND SETTLEMENT OF PAYMENTS AT MEDIEVAL FAIRS

Box 2.3

In the Middle Ages there was extensive trading between northern Europe and the city states of the present northern Italy. The fairs in Champagne were at the centre of these trading activities, bringing together merchants from north and south. Wool and clothing from north-western Europe and spices, medical herbs, etc., from the Mediterranean area accounted for most of the trade at the fairs.

Trade at the fairs in Champagne and the fairs that succeeded Champagne in the following centuries was conducted within an established framework. In general, trade and the subsequent payment were effected in three steps:

- First, clothing was traded whereby northern European merchants obtained monetary claims on the Italian trading houses.
- Then, spices and medical herbs were traded, giving Italian trading houses claims on the northern European merchants.
- Finally, the monetary claims were settled. Settlement started by netting of counter claims, after which the remaining claims were settled, either in cash using silver coins or via extension of credit by issuing bills of exchange.

Counter claims were netted both bilaterally and multilaterally. In the absence of banks, multilateral netting took place by gathering all participants at one location to net payments before the final settlement. This was e.g. the case at the Spanish fairs in the 16th century. Netting served to reduce the amounts to be settled, and thus the liquidity requirement in connection with settlement of payments, cf. the comparison of net and gross settlement systems in Chapter 3.

The final outcome of the settlement procedure at a fair was that the net buyers at the fairs had their deposits reduced or had to raise loans with the banks, while the bank deposits of the net vendors were increased.

Source: Cohn (2001), Kindleberger (1993) and Wee (1997).

Settlement of transactions against bills of exchange was common practice. Many indications suggest that this type of settlement by far exceeded settlement in coins – in part because it was practical and in part because the circulating volume of silver coins was too small to support the volumes traded at the fairs.

The tenor of the bills of exchange was usually short, meaning that the bills would often mature at the next fair a few weeks or some months after the issuance of the bills. This served to limit the credit risk, since the creditworthiness of the counterparty could be verified regularly, because it was possible to demand that the bills of exchange be converted into coins at maturity. Obviously, the use of bills of exchange could cause traders at the fairs to contract extensive debt over time in the event that they continued to purchase goods based on trade credits.

The involvement of banks in the completion of transactions must be ascribed, in particular, to the fact that an increasing number of credit-based transactions were effected between parties who did not know each other. Settlement of transactions against bills of exchange was thus

possible without the involvement of banks only for as long as trading took place within a relatively small group, allowing everyone to stay informed of the creditworthiness of the other participants. In larger groups, banks specialising in extending credit were needed to keep the credit risk relative to the trading partners at an acceptable level.¹

The banks playing a central role in the exchange of payments at the large trade fairs across Europe were often rooted in the northern Italian trading houses or the exchange bureaux described above.² As opposed to the original exchange bureaux, which only issued bills of exchange corresponding to the deposited coin holdings, the banks now proceeded to lending the coins deposited, so that the issuance of bills of exchange no longer fully corresponded to the coins deposited. The concentration of credit extension in banks was conditional on the participants at the fairs considering the banks to be creditworthy. Otherwise, bills of exchange drawn on banks would not have been generally accepted as payment in connection with trade transactions.³

The presence of banks at several central market places was also used for exchange of payments over long distances without transfer of coins. This was achieved, for instance, by a debtor paying in coins at the branch of a bank at one location against the bank's issuance of a bill of exchange, which was surrendered to the creditor. The creditor could then go to the branch of the bank at a different location to recover the debt against submission of the bill of exchange. During a period in which liquidity was equivalent to gold and silver coins, this entailed a reduction of the operating costs and risks pertaining to the transport of money over long distances, including the risk of robbery.

The emergence of banks and the use of bills of exchange in trading did not extend to all markets in Medieval Europe. While banks became the pivotal point in the exchange of payments at fairs in central Europe, trading between merchants in the Hanseatic League of northern Europe was effected without any use whatsoever of banks and bills of exchange. The prime reason was that the merchants of the Hanseatic League based their trading on balanced exchange of goods (bartering) or, when this was not possible, on payment with coins.⁴

¹ Cohn (2001) states that trading based on informal extension of credit took place locally where the buyer and the vendor knew each other well. In trading outside the local area, this was not possible, however, due to the vendor's lack of knowledge of the buyer and lack of opportunities to collect defaulted payments from the buyer. The latter also increased the buyer's incentive not to pay. The new payment habits arising in the Middle Ages thus centred around development of payments based on formalised extension of credit by banks.

² Until the 14th century, banks were concentrated mainly in northern Italian towns, but subsequently banks also emerged in other European countries.

³ Already then, the significance of banks to the economic cycle was noted and they were usually subject to various kinds of public regulation, cf. Cohn (2001).

⁴ Cf. Abulafia (1997) and Kindleberger (1993).

2.3 PAYMENT SYSTEMS WITH CLEARING AND CENTRAL BANKS

The emergence of clearing banks and central banks from the mid-16th century was an important step in the evolution of European payment systems. The main contribution of clearing banks was that their high creditworthiness helped to reduce the credit risk of payment systems. The central banks also contributed credit facilities, which served to reduce the liquidity risk in payment systems. Moreover, issuance by central banks of generally accepted banknotes reduced the costs and risks of banknote-based payments compared to a situation in which banknotes issued by competing private banks were used.

2.3.1 Clearing banks – *Amsterdamsche Wisselbank*

Amsterdamsche Wisselbank (Bank of Amsterdam) was one of the most significant clearing banks in the 17th century.¹ The bank was set up by the authorities to overcome the problems of an untransparent and chaotic coinage, which had enabled private banks to reap extraordinarily high profits through speculative foreign-exchange and money-market transactions. Since restriction and regulation of the banks' activities failed to produce the desired result, the city council of Amsterdam in 1609 resolved to prohibit private banking in favour of a public deposit and clearing bank.

The overall objective of the establishment of *Amsterdamsche Wisselbank* was to stabilise the monetary and banking system with a view to strengthening the position of Holland as a centre for foreign trade. The bank contributed to stability by minting coins of high quality with a stable purchasing power, so that the relationship between the silver content and the face value was kept at a constant level. Confidence in *Amsterdamsche Wisselbank* and hereby in the bank's payment settlement was also based on its very high creditworthiness and liquidity. This condition was not difficult to meet, since the bank's articles of association prohibited it from engaging in lending.

In addition, a centralised system was established for settlement of payments. To effect a payment, the remitter submitted a bank bill drawn on *Amsterdamsche Wisselbank* to the recipient. Upon the vendor's presentation of the bill to the bank, the vendor either received the purchase sum in coins or as an increase in his deposit with the bank. From the point of view of the vendor, the risk of accepting the bill depended exclusively on the buyer's ability to pay, i.e. whether or not funds were available in the buyer's account to cover the purchase price.

¹ Cf. Wee (1997).

Bank bills drawn on Amsterdamsche Wisselbank could not be issued on the basis of credit extended by the bank, cf. the description above.¹

The clearing and settlement system of Amsterdamsche Wisselbank quickly gained a dominant position in international payment systems. One reason was the dominant position held by Amsterdam in international trading, another a requirement by the city council that all payments exceeding a certain amount were to be settled via accounts with Amsterdamsche Wisselbank. The centralisation of payment systems in one clearing bank enabled multilateral netting of the incoming and outgoing payments of account holders. This reduced the liquidity requirement compared with a situation in which payments were handled by a network of banks, allowing only bilateral netting.

The role of Amsterdamsche Wisselbank gradually diminished after 1650, among other reasons because London took over Amsterdam's position in international trade. Another contributory factor was that the ban on private banks was lifted, after which private banks regained a share of payment handling, e.g. because they were able to offer trade credits, entailing that the dependence of trading houses on positive liquidity to cover their payments decreased. The trade credits offered by private banks also reduced the need for the trading houses to extend credit among themselves as supplier credits, which, in turn, served to reduce the credit risk of the trading houses in payment handling.

2.3.2 The first central banks – Bank of England

The Bank of England was established in 1694 by a group of private businessmen. The main objective of the bank was to contribute to the financing of Britain's participation in the Nine Years War (1688-97) via direct loans to the state and by assisting in the sale of government bonds.²

Parliament conferred the exclusive right to issue "public" banknotes on the Bank of England. Since the bank was privately owned, seignorage accrued not to the state, but to the bank's shareholders. The Bank of England was not the world's first banknote-issuing central bank, however. That position is held by Sveriges Riksbank, which was established in 1668, cf. Box 2.4.

The banknotes of the Bank of England soon became a generally accepted means of payment in London. As a result, goldsmiths – some of whom evolved into actual private banks – increasingly began to deposit

¹ Over time, the prohibition on lending was relaxed, however, since the bank, contrary to the main rule, began to lend money to the Dutch East India Company and the city council of Amsterdam, the owner of the bank. Therefore, the account holders' deposits in the bank were no longer fully covered by the silver deposits.

² Cf. Bowen (1995) and Kindleberger (1993).

SVERIGES RIKSBANK – THE FIRST CENTRAL BANK

Box 2.4

Sveriges Riksbank, established in 1668, was the world's first central bank. As far as payment systems were concerned, Sveriges Riksbank launched an innovation by being the first central bank to print banknotes. Sweden was a pioneer in this field because the Swedish coinage at the time was based on copper coins. This presented problems in connection with payments, since the copper coins had a low value relative to their weight.

Sveriges Riksbank's banknotes replaced the "copper notes" used by copper mines for paying wages to the miners. The copper notes had become so popular that their value exceeded the value of the amount of copper they represented. The popularity of the copper notes must be ascribed to the circumstance that they entailed an efficiency gain relative to coins.

Sveriges Riksbank did not contribute to the payment systems of 17th century Sweden other than via its note-issuing activities. Payments based on trade credits were typically made using bills of exchange drawn on clearing banks in Amsterdam and Hamburg, equivalent to the practice in Denmark, cf. section 2.4.2.

Source: Lindgren (1968) and Kindleberger (1993).

their gold stock with the Bank of England and instead used the bank's banknotes in connection with payments.¹

The bank gradually assumed the role of central clearing bank to the other London banks and, in contrast to Amsterdamsche Wisselbank, benefited from being able to engage in lending activities, e.g. by discounting bills of exchange. From the point of view of private banks, the access to lending from the Bank of England entailed that their liquidity risk was reduced, which, all other things being equal, contributed to enhancing their capacity to effect large payments.

The access of private banks to obtain loans from the Bank of England strengthened the stability of the overall banking sector by contributing to ensuring that one bank's lack of liquidity did not spread to other banks. This laid the foundations for a banking system centred around a central bank as lender of last resort to the other banks.

The concentration of the banks' gold stock at the Bank of England also laid the foundations for a money market that enabled private banks to transfer liquidity among themselves through exchange of "IOUs" (bills of exchange).

2.3.3 Payment systems in the USA

In the USA, the centralisation of payment systems around clearing banks in the first half of the 19th century by and large followed the same principles as in Europe. Generally accepted banknotes were not, however,

¹ Cf. Wee (1997).

PAYMENT SYSTEMS USING PRIVATE MONEY IN 19TH CENTURY BOSTON

Box 2.5

The payment systems around Boston in the first half of the 19th century illustrate the problems involved when payments were to be based on banknotes – issued by small private banks – that were general accepted only within a restricted geographical area.

The use of the banknotes of the small private banks as a means of payment depended, in part, on the costs related to the transport of the banknotes to the issuing bank and, in part, on the financial strength of the issuing bank. Transport costs comprised mainly the time spent and the risk of robbery. The financial strength of the issuing bank was relevant due to the risk of loss in the event that the banknotes could not be exchanged for coins, either because the issuing bank was insolvent before the encashment (credit risk) or temporarily did not have sufficient silver coins (liquidity risk). Both factors entailed that the discount rate of banknotes increased with the geographical distance between the holder and the issuer of a banknote.

"Note brokers" took advantage of this situation to purchase banknotes at a discount and encash them for coins at par in the issuing banks. The earnings of the note brokers were to cover both transport costs and the costs related to monitoring of the banks' risk profiles.

In the 1820s, the role played by the note brokers was assumed by Suffolk Bank, which began to encash banknotes issued by small banks in the Boston area. Suffolk Bank was able to convert the banknotes at par, because the bank handled the task more efficiently than the note brokers – the reason being that the small banks deposited part of their coin holdings with Suffolk Bank, thereby allowing encashment to take place centrally in Boston for all the banks connected to the system. The scheme helped to reduce the credit risk of holding the banknotes, since the exchange for coins could take place more quickly when the banknotes did not have to be transported to the issuing banks. The concentration of banknote encashment in one location also contributed to economies of scale in terms of the monitoring of the risk profiles of the small banks.

Source: Goodfriend (1989) and Calomiris and Kahn (1996).

issued by a central bank or a clearing bank to the same extent as in Europe. Instead, banknotes issued by private banks were used, and these banknotes did not enjoy the same degree of acceptance outside the local area of the banks. As a result, a payments infrastructure emerged based on the fact that the banknotes of private banks were ultimately to be returned to the issuing bank for payment, cf. Box 2.5.

The problem of banknotes issued by private banks was reduced when the US government (the North) started large-scale issue of banknotes during the American Civil War (1861-65). In practice, the banknote-issuing activities of private banks ceased in 1865 when a 10-per-cent tax was levied on banknote issuance. From 1865 until 1913, US banknotes were issued by "National Banks" against collateral in US government bonds or directly by the US government.¹ However, the absence of a

¹ Cf. Flamme (1995).

FEDWIRE's ESTABLISHMENT IN 1918

Box 2.6

In the course of the 19th century, the USA was bound together by a network of telegraph lines, laying the technological foundations for significantly swifter settlement of payments over long distances than settlement by mail or courier. The Federal Reserve took advantage of this situation in 1918 when it established a telegraph-based payment system, Fedwire. With Fedwire, a payment between two banks could be effected quickly, even where the banks did not hold accounts with the same Federal Reserve Bank.

Shorter settlement periods entailed that the credit risk of payment systems across the USA was significantly reduced. The decision to establish Fedwire was driven not only by a wish to enhance US payment systems, but also by a wish to strengthen US monetary policy via the creation of a single money market with uniform interest-rate and liquidity terms.

Source: Goodfriend (1989).

central bank to inject liquidity into the banking system as required represented a potentially destabilising factor in 19th century USA. This period was indeed characterised by relatively frequent crises in the USA during which the liquidity reserves of the banks were depleted.¹

The Federal Reserve – comprising 12 banks that perform central-bank functions in relation to the private banks in their districts – was established in 1913. A few years later, the Fedwire payment system was set up. Fedwire was a telegraph-based system of payment transfers, cf. Box 2.6. The introduction of the new technology resulted in substantial efficiency enhancements and reduction of risks in the US payment systems by shortening the time span for settlement of interstate payments.

2.4 PAYMENTS IN DENMARK 1700-1850

In the early 18th century, Danish payments could be made using three different types of silver coins, which presented certain problems for users. Issuance of Danish banknotes for use in trade transactions started in earnest in 1736 with the establishment of the Kurant Bank. However, banknotes were not accepted across the country on equal terms with coins until the mid-19th century.

Far into the 19th century, Danish payment systems were closely connected with Hamburg, through which most Danish foreign trade was channelled. Danmarks Nationalbank did not play a central role in Danish payment systems until around the 1840s, by when Hamburg's significance to Danish payment systems had begun to decline.

¹ According to Goodfriend (1989), research indicates that the US banking crises of the 19th century were attributable mainly to liquidity problems, rather than solvency problems.

2.4.1 The Danish monetary system 1700-36

In the early 18th century, the Danish coinage comprised three monetary standards: rigsdaler, kroner and kurant.¹ The exchange rate between the three standards was not constant due to variations in their silver content and to supply and demand, which were affected by the fact that certain payments were required to be made in a specific standard.

A coinage based on three standards in which the relationship between the face value of the coins and their silver content was not identical obviously caused problems, cf. the description of Gresham's Law in Box 2.1. Attempts were made to minimise these problems by pricing the different coins relative to each other to ensure that the purchasing power of the coins was equivalent to their silver content. For extended periods of time, however, the authorities imposed restrictions on the pricing of coins.

It did not make the situation any less complicated that the Danish coinage was similar to that used in many parts of Germany, or that Danish coins were circulating in Hamburg, and Hamburg coins were circulating in Denmark. Thus retailers not only had to handle Danish coins – but also to take account of the silver content of German coins.

Moreover, the three standards were not full payment substitutes, so that supply and demand could also affect the exchange rate between the coins. For example, much mortgage debt was tied to the rigsdaler and if debtors did not have stocks of rigsdaler, they either had to exchange into rigsdaler before maturity or pay a premium. The value of the rigsdaler generally strengthened vis-à-vis the other coins, since it was more current abroad. Moreover, the government in certain circumstances preferred payment in rigsdaler.

Towards the end of the 1730s, the kurant became the dominant standard in the Danish monetary system, which went a long way towards reducing the problems of three standards. The reason was that no new coins were minted in the two other standards and that they had probably to a large extent been taken abroad despite a ban against this throughout most of the period. It should also be noted that, during the period before the establishment of the Kurant Bank, the state had already issued the first Danish banknotes to finance the Danish participation in the Great Northern War, cf. Box 2.7.

2.4.2 Hamburg's significance to Danish payment systems 1700-1850

Throughout the 18th century and far into the 19th century, most of Denmark's foreign trade passed via Hamburg, and Denmark and north-

¹ Cf. Hansen and Svendsen (1968).

THE DANISH MONETARY SYSTEM DURING THE GREAT NORTHERN WAR

Box 2.7

The Danish coinage was strongly affected by the Great Northern War (1700-20) during the first decades of the 18th century. The state financed Denmark's participation in the war by issuing the first authorised banknotes in Denmark and by reducing the silver content of the *kurant* coins.

The banknotes were not considered to be equivalent to coins and they were not meant to be of a permanent nature. This was reflected e.g. in a requirement that payments to the state could not be effected exclusively in banknotes; at least 50 per cent of a payment should be made in coins.

This entailed that the purchasing power of banknotes was consistently below that of coins; in the final years of the War approximately 60-80 per cent of coins' purchasing power. After the end of the War, the purchasing power improved, since the banknotes, as originally promised, were gradually taken out of circulation.

Source: Hansen and Svendsen (1968).

ern Germany were closely linked economically. As a result, foreign coins circulated extensively in Denmark and Danish coins circulated in Hamburg, where they were also used as payment for much trade that did not concern Denmark. This was possible because the coin systems in Denmark and Hamburg had many similarities, making it easier to use each other's coins. The close relations between the monetary systems in Denmark and Hamburg were not without problems, however, cf. Box 2.8.

Clearing and settlement of payments in Hamburg were concentrated in Hamburger Bank, which had been set up in 1619 inspired by Amsterdamsche Wisselbank, cf. section 2.3.1. Hamburger Bank functioned as a clearing bank until 1875, at which time it was replaced by the Reichs-

RELATIONS BETWEEN THE DANISH MONETARY SYSTEM AND HAMBURG

Box 2.8

The close economic ties between Hamburg and Denmark, with closely interwoven coinages, meant that problems with the monetary system of one area would inevitably spill over on the monetary system of the other area. One example was the dilution of the silver content of Danish *kurant* coins in the period during and after the Great Northern War (1700-20).

As a result of Gresham's Law, the debasement of the Danish *kurant* entailed that its use as a means of payment in Hamburg rose above the level acceptable to the Hamburg authorities. As a countermeasure, Hamburg decided, in 1725, to float the exchange rate between the two areas' *kurant* coins. In addition, Hamburg's banks stopped accepting payments in Danish *kurant* coins. These two countermeasures prevented Danish coins from forcing Hamburg's own coins out of circulation.

Denmark responded by banning all import of goods via Hamburg, requiring imports to take place directly from the exporting country. The trade-war-like conflict was resolved in 1736 with the signing of a treaty under which Denmark was obliged to mint *kurant* coins with a satisfactory silver content.

Source: Hansen and Svendsen (1968).

bank, the first German central bank. A factor contributing to the success of Hamburger Bank was that, contrary to Amsterdamsche Wisselbank, it was authorised to engage in lending activities, including extension of trade credits.¹

Hamburg's significance in Danish foreign trade – in combination with the requirement by the authorities that all payments exceeding a certain amount had to be settled via Hamburger Bank – meant that all major Danish trading houses involved in imports/exports held accounts with Hamburger Bank. Settlement of payments related to Danish foreign trade in Hamburg was typically effected using bank bills drawn on Hamburger Bank or silver coins, cf. section 2.3.1.

In the absence of banks, credit-based domestic payments in Copenhagen and elsewhere had to be based on the vendor's extension of trade credits directly to the buyer. Credit was typically given via issuance of bills of exchange or as overdraft facilities. The first Danish Bills of Exchange Act was introduced in 1681, but the use of bills of exchange in domestic payments was reduced by a prohibition on certain types of bills of exchange due to fear of usury. Consequently, it was common also for payments attached to domestic trading to be settled using bills of exchange drawn on Hamburger Bank. Domestic trading based on bills of exchange issued outside Hamburg did not start in earnest until after 1824 when a number of legal restrictions on use of bills of exchange were abolished. At the same time, Danmarks Nationalbank began to show an interest in this business area, cf. section 2.5.1.

2.4.3 The Kurant Bank 1736-1813 – the first banknote-issuing bank

The Kurant Bank was set up in 1736 in response to a wish to establish an institution capable of contributing to Danish economic development by channelling savings into investments. Though the bank was privately owned, its operations were strictly regulated by the Danish state. The establishment of the bank was probably also inspired by other countries, where there had been similar banks for many years, e.g. Britain and Sweden, cf. section 2.3.2.

The Kurant Bank was awarded the exclusive right to issue banknotes, which were to be fully convertible for silver coins. The face value of the banknotes was to be at least 10 rigsdaler, which made them unsuited for small payments. Initially, the banknotes were legal tender only in connection with payments to and from the Danish state (which was, admittedly, responsible for a large proportion of money-based payments during the period). Banknotes did not become legal tender in private con-

¹ Cf. North (1997).

tractual relationships until 1757. Issuance of small banknotes with a face value of 1 rigsdaler was not a reality until 1762, after which banknotes became more widely used in town trading. Issuance of banknotes did not exceed the value of coin issuance until the end of the 1770s.

The banknote issuance of the Kurant Bank was not subject to specific rules, but throughout the period until the Napoleonic Wars importance was attached to ensuring that the volume of banknotes did not become excessive relative to the silver stock. Among other things this was because in the 18th century the view persisted that the value of banknotes was attached first and foremost to their convertibility into "real" money, i.e. silver coins.

The convertibility of the Kurant Bank's banknotes for coins was suspended over long periods of time, mainly in periods of war or military armament. The bank's decisions to issue new banknotes and suspend the convertibility of the banknotes were likewise often founded in the export of Danish coins to abroad where they were melted down into other coins with a lower silver content. This was, for instance, the case during the Prussian Seven Years' War (1756-63), which was financed by Frederick the Great via issuance of coins with a low silver content.

The Kurant Bank never became a clearing bank, such as Hamburger Bank and Amsterdamsche Wisselbank. In the Struensee years (1770-72), this was considered, but these plans were never realised.

In 1773, the Kurant Bank was acquired by the Danish state, which was thus able to refrain from paying interest on the loans it had raised from the bank. Thereafter, the issuance of banknotes was equivalent to monetary financing of the national deficit.

While the Kurant Bank was in operation, the value of its banknotes depended on the risk that the convertibility into silver could be suspended. The value of the banknotes was also affected by the fact that they were not accepted as legal tender abroad, primarily in Hamburg, to the same extent as silver coins. There, they were considered as bills of exchange drawn on the Kurant Bank, so they were accepted at a discount. Overall, the banknotes of the Kurant Bank had a relatively stable value, however, except during the last few years prior to the default of the Danish state in 1813.

2.5 BANK-BASED PAYMENT SYSTEMS IN 19TH CENTURY DENMARK

The establishment of a bank-based payment system did not commence in Denmark until the 19th century. The first steps were taken with the establishment of Danmarks Nationalbank after the default of the Danish state in 1813. Initially, Danmarks Nationalbank's primary task was to

stabilise and restore confidence in a banknote-based monetary system. When this objective had been achieved in the late 1830s, Danmarks Nationalbank was able to extend its activities in relation to Danish payment systems, for instance by discounting bills of exchange.

The next steps in the establishment of a bank-based payments infrastructure in Denmark that could undertake the same tasks as Hamburg began in the 1840s with the foundation of the first commercial banks. Subsequent decades saw the establishment of the business enterprises that have been at the core of the Danish payments infrastructure until modern times.

2.5.1 The default of the Danish state in 1813 – the establishment of Danmarks Nationalbank

Denmark's involvement in the Napoleonic Wars after 1807 led to rising war inflation. To resolve this situation, a major reform was implemented in 1813 when the Danish state de facto defaulted on its obligations. A pivotal element of the reform was the establishment of a new monetary system from scratch based on a currency reform and the establishment of the Rigsbank, which assumed the Kurant Bank's issuance of banknotes.

At that time, the remaining stock of silver was far too small to fill the role of a means of payment or to form the basis of issuance of banknotes that could be exchanged for coins. To overcome this problem, the Rigsbank's banknotes were issued against security in a first-priority mortgage on all property in Denmark, equivalent to 6 per cent of the property value. In practice, the mortgage, which carried interest at a rate of 6.5 per cent, was a one-off tax on Danish properties, which was "paid" by raising a loan from the Rigsbank. The loan could only be serviced in silver. Due to the interest terms for the loan, there was a clear incentive to redeem the mortgage; therefore, the Rigsbank gradually began to cover issued banknotes on the basis of silver rather than mortgages.

In 1818, the Rigsbank was restructured as a privately owned bank, "Nationalbanken i Kjøbenhavn". The experience drawn from the Kurant Bank had clearly demonstrated the problems of a banknote issuing bank that was operated with a view to financing the state's expenses rather than ensuring a stable monetary system. The restructuring was designed to ensure trust in the bank and its banknotes.

In the first few years after the conversion, Danmarks Nationalbank acted as a supplier of banknotes and coins, but otherwise participated in the payment systems only to a limited extent.¹ Only a limited number of

¹ It is striking that a review of the principles governing commodity payments in a Danish textbook from the 1820s "to be used in teaching trade sciences" referred only to Hamburger Bank and not to Danmarks Nationalbank.

VELOCITY OF THE BANKNOTE CIRCULATION

Box 2.9

Demand for Danmarks Nationalbank's banknotes, and thus the exchange rate of the banknotes relative to coins, depended not only on the transaction volume (trading), but also on the velocity of the banknote circulation.

The velocity of circulation was not constant. It was affected, among other factors, by speculative expectations of the banknote exchange rate relative to coins. Expectations of a higher banknote exchange rate would, all other things being equal, be reflected in a lower velocity if banknotes were increasingly saved up rather than used for payments. This is exemplified by a situation in 1818, at which time the money supply seemed to be ample under the circumstances. Still, a shortage of money arose, because many banknotes were taken out of circulation in expectation of rising prices. This picture was reversed before long and in the following years Danmarks Nationalbank had to withdraw banknotes from circulation on several occasions in order to maintain the banknote exchange rate.

Similarly, increased use of bills of exchange (credit-based payments) could slow down the circulation of banknotes. If the volume of banknotes in circulation remained unchanged, this would lead to an ample money supply.

Source: Hansen and Svendsen (1968).

transactions were conducted using bills of exchange discounted at Danmarks Nationalbank. This may be ascribed to a combination of Danmarks Nationalbank's business practice and a restrictive bills-of-exchange legislation. Danmarks Nationalbank's resistance to discounting bills was founded in the fear that increased use of bills of exchange could reduce the demand for banknotes and thus negatively affect the value of the banknotes, cf. Box 2.9. In that context, it deserves mention that Danmarks Nationalbank's banknotes were not transacted on a par with coins until 1839.

In the 1820s and 1830s, it was still customary to use bills of exchange drawn on accounts with Hamburger Bank – not only in foreign trade, but also for settlement of domestic trade, cf. section 2.4.2. For foreign payments to and from e.g. London and Paris payment via bank accounts held with Hamburg was also preferred to payment instructions to Danmarks Nationalbank in Copenhagen. The reason was that a bill of exchange drawn on Hamburger Bank could be sold across Europe without any problems, while this was not the case with bills drawn on Danmarks Nationalbank, at least not without the buyer demanding a higher discount rate.

With the stabilisation of the value of Danmarks Nationalbank's banknotes at par in 1839, Danmarks Nationalbank's position was significantly strengthened in terms of taking over some of the Danish trading houses' bills-of-exchange transactions with Hamburg. The rapid growth in domestic discounting of bills during the 1840s was also a result of Danmarks

Nationalbank becoming more accommodating towards the discounting of bills. In addition, the legislation on bills of exchange was relaxed, entailing e.g. that issuance of bills of exchange convertible into banknotes was allowed and the maximum maturity of bills was extended.

In another initiative to take over transactions in bills of exchange from Hamburg, Danmarks Nationalbank in 1837 established its first branch, in Århus. This initiative was founded on a wish to enhance Danmarks Nationalbank's handling of payments related to trade in Jutland on terms equivalent to those offered to Jutlandic business enterprises by Hamburg.

1839 saw the establishment of the first rules of cover for Danmarks Nationalbank's issue of banknotes. Under the rules of cover, Danmarks Nationalbank's silver stock was to account for at least half of the banknote issue. At least half of the silver stock was to be made up of coins, while the rest could be placed in silver bullion and deposits with foreign banks, primarily in Hamburg. In addition, a maximum limit was established for banknote issuance, and was independent of the size of the silver fund.

As the economy boomed, leading to increased trade and transaction requirements, the new rules of cover soon became too restrictive as far as the maximum limit was concerned. Moreover, the rules of cover were introduced at a time when Danmarks Nationalbank's banknotes also gained a firmer foothold in trade in the areas of Jutland where coins had previously been used. Both factors contributed to the extension of the maximum limit in 1847 in order to avoid a shortage of money.

The ultimate proof that Danmarks Nationalbank's stabilisation of the Danish monetary system had been achieved came in 1845, with Danmarks Nationalbank's announcement that its banknotes could again be exchanged for silver coins.

In 1873, the Folketing (Parliament) adopted a new coin act, prescribing that the Danish monetary system was to be based on a new coin, the krone, whose value was established relative to gold. The krone was to replace the rigsdaler, the value of which was based on silver. Many other European countries also resolved to adopt the gold standard, initially because the price of silver was declining rapidly during that period, which, all other things being equal, contributed to higher inflation. In a silver standard that pegged the value of banknotes to a specific amount of silver, declining silver prices were thus tantamount to inflation.¹

Moreover, the convenience of silver coins as a means of payment diminished, since their absolute value relative to other goods and services

¹ Cf. Hansen and Svendsen (1968).

decreased. This brought a corresponding decline in the maximum transaction amount for which payment could conveniently be made in coins.

Another argument for adopting the gold standard was that with a monetary system based on the same metal as in Denmark's leading trading partners, the risk of exchange-rate fluctuations that could negatively affect foreign trade declined. This argument presupposed confidence that the countries would not resort to unilateral devaluations of their currencies by writing down the volume of gold for which banknotes could be exchanged at the central bank.

2.5.2 The establishment of banks

The development of the bank-based payments infrastructure known today took place in the latter half of the 19th century with the establishment of commercial banks and savings banks¹ across Denmark.² Similarly to the development in other countries, banks of different sizes were set up, from very small banks conducting business within a limited geographical area only, to regional banks, and to large nationwide banks, which also conducted transactions abroad.

This structure led to the establishment of a correspondent-banking system whereby small banks linked up with a larger institution, which assisted them in effecting payments, including payments related to securities and foreign-exchange transactions. The correspondent-banking system enabled swift and efficient payment transfers between customers of two different banks that did not hold accounts with each other.

Apart from the smallest banks, most banking institutions held accounts for payment transfers with Danmarks Nationalbank. For a bank with a large number of daily payments to and from other banks, the advantage of centralising payment systems at Danmarks Nationalbank was multilateral netting, cf. Chapter 3. In relation to other banks that also settled payments via accounts with Danmarks Nationalbank, the day-to-day liquidity impact of the bank would solely consist of the difference between the incoming and outgoing payments for a specific day.

Major Danish banks, in particular, entered into a global network of correspondent banks used for international payments, including foreign-exchange transactions, similar to the correspondent-banking system established in Denmark. The global correspondent-banking network was typically centred around banks in international financial centres, e.g. London.

¹ The establishment of savings banks started as early as 1810. Initially, the dominant objective of savings banks was to handle the rural population's savings, cf. Hansen and Svendsen (1968). Therefore, they originally played no significant role in payment transactions.

² During the period before banks were established, it was relatively common to place interest-bearing deposits with major Copenhagen trading houses.

The institutional foundations had thus been laid for developing the payments infrastructure known in Denmark today and described in the following chapters. The next steps in the development of Danish payment systems were taken with the introduction of e.g. cheques. As the use of cheques became widespread, a cheque-clearing agreement was established, which can be seen as an early precursor of the current retail-payment system, the Sumclearing, described in Chapters 6 and 7.

LITERATURE

Abulafia, David, 1997. The impact of Italian Banking in the Late Middle Ages and the Renaissance, in: Teichova, Alice et al. (ed.), *Banking, Trade and Industry*, Cambridge University Press.

Bowen, H.V., 1995. The Bank of England during the Long Eighteenth Century, 1694-1820, in: Roberts et al. (ed.), *The Bank of England – Money, Power & Influence 1694-1994*, Oxford Clarendon Press.

Calomiris, Charles W. and Charles M. Kahn, 1996. The efficiency of Self-Regulated Payments Systems: Learning from the Suffolk System, *Journal of Money, Credit and Banking*, Vol. 28, Number 4, Part 2.

Cohn, Meir, 2001. Payments and the Development of Finance in Pre-Industrial Europe, *Working Paper 01-15*, Department of Economics, Dartmouth College.

Davies, Glyn, 2002. *A History of Money – From Ancient Times to the Present Day*, University of Wales Press.

Flamme, Karen, 1995. A brief History of Our Nation's Paper Money, in: *1995 Annual report*, Federal Reserve Bank of San Francisco.

Goodfriend, Marvin, 1989. Money, Credit, Banking and Payment System Policy, in: *The US Payment System: Efficiency, Risk and the role of the Federal Reserve*, David B. Humphrey (ed.), Federal Reserve Bank of Richmond.

Goodhart, Charles A.E., 1989. *Money, Information and Uncertainty*, 2nd ed., Macmillan.

Lindgren, Torgny, 1968. *Riksbankens sedelhistoria 1668-1968 (The Banknote history of Sveriges Riksbank 1668-1968)* (in Swedish only), Raben & Sjögren.

Kindleberger, Charles P., 1993. *A Financial History of Western Europe*, 2nd edition, Oxford University Press.

Jensen, 2004. *Danmarks oldtid (Danish Antiquity)*, volume 4 (in Danish only), the later Iron Age the Viking period, Gyldendal.

Hansen and Svendsen, 1968. *Dansk Pengehistorie (Danish Monetary History)*, volume 1 (in Danish only), 1700-1914, Danmarks Nationalbank.

North, Michael, 1997. The great German banking houses and international merchants, sixteenth to nineteenth century, in: Teichova, Alice et al. (ed.), *Banking, Trade and Industry*, Cambridge University Press.

Wee, Herman van der, 1997. The influence of banking on the rise of capitalism in North-west Europe, fourteenth to nineteenth century, in: Teichova, Alice et al. (ed.), *Banking, Trade and Industry*, Cambridge University Press.

3. Payment and Securities Settlement

The scale of today's payments and securities transactions between financial institutions makes electronic settlement a requirement. Indeed, it is a fundamental precondition for secure and efficient settlement and thereby for a well-functioning financial sector, which is beneficial to economic growth and prosperity.

Most countries today have built up a payments infrastructure based on electronic payment systems. Not all payments are settled via these systems, however, as some payments are still settled outside the infrastructure, typically via correspondent banks.

This chapter first reviews how payments can be settled outside the payments infrastructure, followed by a description of the two main types of payment system: real-time gross settlement (RTGS) systems and net settlement systems. The chapter continues with a brief section on the hybrid systems that combine RTGS and net settlement systems. Finally, in the last section the key principles of securities settlement systems are described.

3.1 SETTLEMENT OUTSIDE THE PAYMENTS INFRASTRUCTURE

A number of financial institutions settle their payments outside the payments infrastructure. These can e.g. be small institutions that settle only few payments, so that it is not worth their while to participate in payment systems. Some large institutions also settle their payments outside the payments infrastructure, e.g. due to ingrained habits.

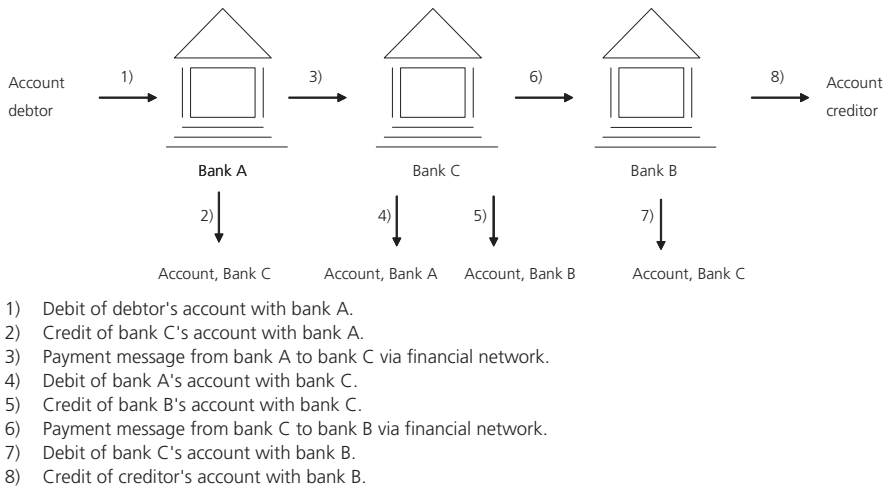
Settlement of payments outside the payments infrastructure normally takes place via one or more correspondent banks. A correspondent bank holds accounts for other financial institutions and makes payments on their behalf, cf. BIS (2003). Correspondent banking is thus based on commercial bank money, cf. Chapter 1, Box 1.5.

Prior to the establishment of payment systems, correspondent banks were of great importance to the settlement of payments, cf. Chapter 2. Moreover, until the establishment of the CLS system for settlement of foreign-exchange transactions correspondent banks played a key role in the settlement of foreign-exchange transactions, cf. Chapter 8.

Chart 3.1 presents an example of the settlement of a correspondent bank payment between bank A and bank B on behalf of two customers. Since banks A and B do not hold accounts with each other, they use

PAYMENT SETTLEMENT VIA A CORRESPONDENT BANK

Chart 3.1



bank C (the correspondent bank), which holds mutual accounts with both bank A and bank B, instead.

There can be certain disadvantages to settling payments via correspondent banks. For example, this settlement method entails a credit risk on the correspondent bank. Usually, settlement of payments via correspondent banks also takes longer than settlement via payment systems.

3.2 REAL-TIME GROSS SETTLEMENT SYSTEMS

In RTGS systems each payment is settled individually and immediately. RTGS systems are typically used by financial institutions for settlement of large-value and/or time-critical payments, e.g. money-market transactions, foreign-exchange transactions and the cash leg of securities transactions. These systems are also used for settlement of net positions from net settlement systems, cf. section 3.3.

RTGS systems did not come into general use until the end of the 1990s. Today virtually all industrialised countries have an RTGS system. When Denmark's Nationalbank's first RTGS system, the DN Inquiry and Transfer System, was introduced in 1981 it was one of the first in the world. Table 3.1 provides an overview of RTGS systems in selected countries.

Usually, the transaction volume in RTGS systems is very high. Annual turnover of more than 50 times a country's GDP (gross domestic product) is not unusual. This high turnover can be attributed especially to the use of RTGS systems to settle large-value payments in the financial markets.

RTGS SYSTEMS

Table 3.1

Country	System	Purpose	Ownership	Average value of payments in million USD, 2003	Annual turn-over/GDP, 2003
Belgium	ELLIPS	L	CB,B	8.7	50.7
Denmark	KRONOS	L	CB	16.0	40.3
France	PNS	L	CB,B	2.8	11.5
Netherlands	TOP	L	CB	5.1	46.4
Italy	BI-REL	L	CB	3.0	19.0
Japan	BOJ-NET	L	CB	32.9	37.7
Switzerland	SIC	L,R	CB,B	0.2	103.1
UK	CHAPS £	L	CB,B	3.1	46.9
Sweden	K-RIX	L	CB	10.7	46.1
Germany	RTGS+	L	CB	4.4	60.4
USA	Fedwire	L	CB	3.5	39.7
Euro area	TARGET	L	CB	7.1	...

Note: L: Large-value payment system, R: Retail payment system, CB: Central bank and B: Bank(s).
Source: BIS (2005) and own calculations.

3.2.1 The principles of RTGS settlement

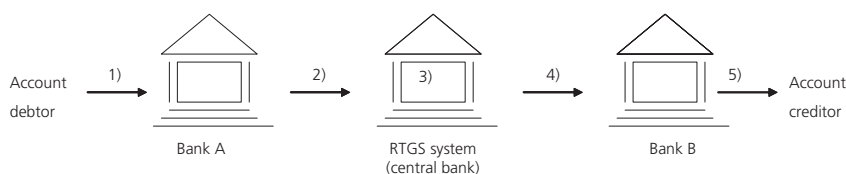
In RTGS systems payments are, as described above, settled individually and immediately after the payment instruction, provided that the remitter has cover for the payment in question. Payments in RTGS systems are typically credit transactions, i.e. payments initiated by the remitter (debtor).

Payments in RTGS systems are settled via the participants' accounts with the settlement bank; normally as simultaneous debiting of the remitter's account and crediting of the recipients's account, after which a payment is considered to be final. In most RTGS systems the settlement bank is the national central bank, which also owns the system, cf. Table 3.1.

Chart 3.2 illustrates the settlement of a customer payment between two participants in an RTGS system with the central bank as settlement bank.

PAYMENT SETTLEMENT VIA AN RTGS SYSTEM

Chart 3.2



- 1) Debit of debtor's account with bank A.
- 2) Transmission of payment instructions to the RTGS system.
- 3) Settlement of payment, i.e. debit of bank A's account and credit of bank B's account with the central bank.
- 4) Transmission of information on the payment to bank B.
- 5) Credit of creditor's account with bank B.

FIFO, prioritisation and cancellation

Most liquidity queues apply a FIFO (First-In-First-Out) principle. This means that the payments are settled in the sequence in which they are entered to the RTGS system, as liquidity becomes available for the payments. In some RTGS systems queued payments are allocated a priority that determines the settlement sequence. Priority can be given automatically on the basis of transaction type or at the initiative of the participant. In some RTGS systems it is also possible to cancel queued payments.

Rescheduling

In some RTGS systems participants can reschedule their payments after they have been placed in the liquidity queue, or change the priority of the payments. This enables the participants to manage their outgoing payments according to their current liquidity situation and to minimise the number and value of queued payments.

Bypass

In some RTGS systems participants can select a bypass function that can be used when the first payment in the liquidity queue cannot be settled due to lack of liquidity. With bypass, the system will attempt to settle one or more of the subsequent payments, provided that there is cover in the participant's account. It will then attempt to settle the first payment at a later time. Using the bypass function prevents a situation where a large-value payment blocks the settlement of small payments.

Optimisation routines

A number of RTGS systems use optimisation routines to minimise the number and value of queued payments. Optimisation routines typically attempt to settle a group of payments simultaneously. A gridlock resolution mechanism is used if a group of queued payments cannot be settled individually, but can be settled simultaneously without an overdraft for any of the participants. Another type of optimisation routine offsets outgoing and ingoing payments of the same size.

Source: BIS (1997).

3.2.2 Liquidity and queuing in RTGS systems

As a consequence of the ongoing individual settlement of payments in RTGS systems, the participants have a large intraday liquidity requirement. Participants can manage their own outgoing payments, but do not usually know with certainty when incoming payments will be received. It is therefore essential to an efficient RTGS system that there is sufficient liquidity in the system.

In order to make the settlement of payments more flexible, central banks normally offer the participants intraday credit. This credit is typically fully collateralised. Participants can also obtain liquidity via monetary-policy loans from the central bank, i.e. loans with a maturity of

minimum one day, or by borrowing from other participants in the money market.

Procuring liquidity normally entails certain costs, e.g. the costs of borrowing in the money market or the indirect costs of pledging securities as collateral for intraday credit rather than more profitable placement.¹ Participants therefore often manage their outgoing payments so as to reduce their need for liquidity as much as possible.

Most RTGS systems offer a queue facility if a participant has insufficient liquidity to settle payments at the required time. The participant thus avoids rejection of a payment by the system, requiring the participant to place the payment in the system again when there is cover for the payment. The queue facility includes a number of features that support the participants' liquidity management, cf. Box 3.1.

3.2.3 Gridlock and deadlock

Queuing in an RTGS system can be a consequence of an inappropriate distribution of liquidity between the participants (gridlock), or a shortage of liquidity in the overall payment system (deadlock). Deadlock can only be resolved by contributing further liquidity to the payment system. Gridlock can also be resolved by redistributing liquidity among the participants, e.g. by applying an optimisation routine, cf. Box 3.1.

Box 3.2 shows an example of gridlock and deadlock in an RTGS system. Appendix A provides a mathematical definition of gridlock and a description of the algorithm, or gridlock resolution mechanism, used in the Danish RTGS system, Kronos.

Gridlock can also occur if some participants minimise their liquidity requirement by not remitting payments until they receive incoming payments. This can lead to a situation where the participants are awaiting each other's payments and where some participants cannot settle their payments due to lack of liquidity. In Appendix B this type of gridlock is illustrated with the help of a game theoretical model.

Some RTGS systems apply mechanisms designed to make participants settle their payments as early in the day as possible. This is to avoid an accumulation of queued payments towards the end of the day. For example, some RTGS systems have rules for the proportion of a participant's total daily payments that must be settled by a certain time. Other RTGS systems apply a pricing policy that makes it more expensive to settle payments in the afternoon than in the morning.

¹ Most central banks do not charge interest on intraday credit. One exception is the Federal Reserve, which on the other hand does not require collateral for this credit.

GRIDLOCK AND DEADLOCK IN RTGS SYSTEMS

Box 3.2

An example can be used to illustrate the significance of gridlock and deadlock in RTGS systems. The first Table shows a situation in an RTGS system with three banks that are each to settle two payments; one to each of the other banks. The distribution of liquidity entails that all payments can be settled individually, i.e. no payments are queued.

No queue	Bank A	Bank B	Bank C
Balance of account before payments	30	40	20
Payments to	B: 12 C: 15	A: 16 C: 20	A: 7 B: 10
Balance of account after individual settlement	+3	+4	+3

In the second Table a gridlock situation is outlined. The payments cannot be settled individually due to the distribution of liquidity among the banks. If there is simultaneous settlement instead, all payments can be settled without an overdraft for any of the banks.

Gridlock	Bank A	Bank B	Bank C
Balance of account before payments	10	15	5
Payments to	B: 12 C: 15	A: 16 C: 20	A: 7 B: 10
Balance of account after simultaneous settlement	+6	+1	+23

The third Table shows a situation with deadlock in the system. The payments cannot be settled due to insufficient liquidity in the system. Even if simultaneous settlement of the payments is attempted, two banks will show an overdraft. The deadlock can only be resolved by contributing more liquidity to the system.

Deadlock	Bank A	Bank B	Bank C
Balance of account before payments	3	10	0
Payments to	B: 12 C: 15	A: 16 C: 20	A: 7 B: 10
Balance of account after simultaneous settlement	-1	-4	+18

3.3 NET SETTLEMENT SYSTEMS

In net settlement systems, payments are cleared and settled on a net basis at fixed hours once or several times during the settlement day. Net settlement systems are typically used to settle retail payments, e.g. payments by cheque and debit card, cf. Chapter 7.

Table 3.2 gives an overview of selected net settlement systems. These are often owned by private banks. Turnover and the average payment

NET SETTLEMENT SYSTEMS

Table 3.2

Country	System	Purpose	Ownership	Average value of payments in USD, 2003	Annual turnover/GDP, 2003
Belgium	CEC	R	CB,B	611	2.1
Canada	LVTs	L	B	5,440,686	25.9
Denmark	Sumclearing	R	B	721	3.1
France	SIT	R	CB,B	467	3.0
Netherlands	Interpay	R	B	677	3.9
Italy	Retail	R	CB	1,412	1.6
Japan	Zengin Sys-	R	B	14,998	4.4
Switzerland	DTA/LSV	R	B	2,527	0.8
UK	BACS	R	B	1,034	2.3
Sweden	Bankgiro	R	B	1,369	1.7
Germany	RPS	R	CB	1,084	1.0
USA	CHIPS	L	B	5,062,961	29.7
Euro area	EURO1	L	B	1,299,830	...

Note: L: Large-value payment system, R: Retail payment system, CB: Central bank and B: Bank(s). In Canada there is no RTGS system, so all large-value payments are settled via LVTs.

Source: BIS (2005) and own calculations.

size are normally considerably lower than in RTGS systems, cf. Table 3.1. In net settlement systems used for large-value payments, however, the turnover is equivalent to the level in RTGS systems.

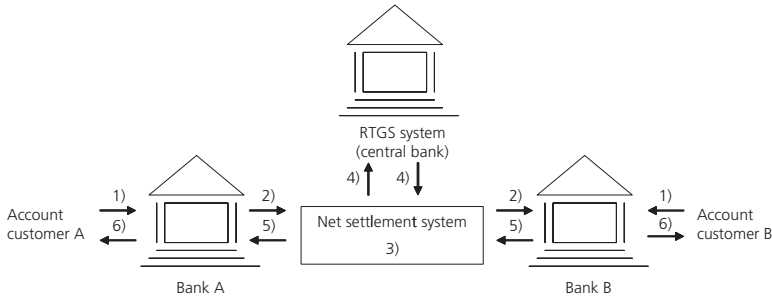
3.3.1 Principles of net settlement

In a net settlement system, payments in the systems are subject to periodic compilation. At fixed times during the settlement day the participants' net positions are calculated and settled by being booked to the participants' accounts with the settlement bank. Payments that are settled via net settlement systems are as a general rule final when booked.

In most cases, participants in net settlement systems do not know their exact net positions before the time of settlement. A participant that does not have cover for its net position is normally fully or partly removed from the settlement. New net positions are then calculated for the remaining participants. In some situations this can lead to other participants also encountering difficulties in meeting their payment obligations.

Net settlement systems have various rules and procedures to minimise the risk that participants' net positions are not covered, including:

- Several net settlements during the day in order to reduce the size of the participants' payment obligations.
- Bilateral and/or multilateral limits to the payment obligations of each participant.
- A maximum limit to the size of the individual payment.
- Notice to the participants of the size of the net positions prior to settlement.



- 1) Customers A and B submit their payment instructions to their respective banks.
- 2) Banks A and B forward the payment instructions to the net settlement system.
- 3) At a fixed time, the net settlement system clears all payment instructions received and calculates the banks' net positions.
- 4) The net settlement system sends the banks' net positions to the central bank, which debits and credits the net positions to the banks' accounts. The central bank then notifies the net settlement system that the positions have been booked.
- 5) The net settlement system notifies the banks that the payments have been settled.
- 6) Banks A and B book the payments (the payment sent is debited, the payment received is credited) to the respective accounts of customers A and B.

Chart 3.3 gives an example of two participants that settle their mutual payments on behalf of customers via a net settlement system in which the central bank is the settlement bank.

3.3.2 Liquidity requirement in net settlement systems

Netting of participants' mutual payments in net settlement systems reduces their liquidity requirement considerably compared to RTGS systems. The effect depends on whether bilateral or multilateral netting is used. In bilateral netting, a participant's net position is stated vis-à-vis each of the other participants in the system. In a multilateral net settlement system, a participant's overall net position in relation to the other participants is calculated. Box 3.3 presents an example of the effect on the liquidity requirement of the two types of netting in a net settlement system.

3.4 HYBRID SYSTEMS

A number of more recent payment systems can neither be classified as pure RTGS systems nor pure net settlement systems. These hybrid systems combine the liquidity-saving elements of net settlement systems with the advantages of RTGS systems.¹ The emergence of hybrid systems

¹ See McAndrews og Trundle (2001) for a description of hybrid systems.

NETTING EFFECT

Box 3.3

The netting effect is a measure of the liquidity that the participants save by settling payments via a net settlement system rather than an RTGS system. The netting effect is calculated as $(TPG - TPN)/TPG$, where TPG and TPN are the total payment obligations for all participants on, respectively, gross and net settlement.

An example can serve to illustrate the calculation of the netting effect. The first Table shows three banks that each have six payments for settlement. Without netting there are 18 payments to be settled, and the participants' total payment obligations are 865 ($=365+230+270$).

Gross settlement	Bank A	Bank B	Bank C
Payments to	B: 30	A: 20	A: 25
	B: 70	A: 50	A: 40
	B: 100	A: 60	A: 70
	C: 20	C: 10	B: 30
	C: 55	C: 30	B: 35
	C: 90	C: 60	B: 70
Total payment obligation	365	230	270

The second Table shows the payments if netting is bilateral. The number of payments falls to three and the participants' total payment obligation is 135 ($=100+35$). The reduction in the participants' liquidity requirement as a consequence of the bilateral netting, i.e. the netting effect, can thus be calculated as $((865-135)/865)*100=84$ per cent.

Bilateral netting	Bank A	Bank B	Bank C
Payments to	B: 70		B: 35
	C: 30		
Total payment obligation	100		35

The third Table shows the participants' payment obligations in the case of multilateral netting. In this case the number of payments falls to two and the total payment obligations can be stated as 105. The liquidity saved on multilateral netting can thus be calculated as $((865-105)/865)*100=88$ per cent.

Multilateral netting	Bank A	Bank B	Bank C
Total payment obligation	100		5

can be attributed to factors such as the development of more sophisticated payment settlement optimisation tools.

In contrast to pure net settlement systems that typically execute a small number of daily settlement cycles, most hybrid systems seek to

effect continuous payment settlement as far as possible. This is based on optimisation routines, e.g. offsetting, cf. Box 3.1, or a large number of daily settlement cycles. If the number of settlement cycles is infinitely large, this in fact corresponds to an RTGS system.

Another characteristic of hybrid systems is that the participants often have access to a number of sophisticated liquidity management tools that extend beyond the queue facilities in Box 3.1. For example, the participants have the opportunity to reserve liquidity for individual settlement of time-critical payments at required times. Other payments, given lower priority, can then be settled in a cycle by applying optimisation routines.

The German RTGS+ and the American CHIPS are often named as examples of hybrid systems. RTGS+ enables participants to reserve liquidity for prioritised payments. The system also seeks to effect ongoing settlement of queued payments by applying optimisation algorithms. In CHIPS a continuous series of settlement cycles is used to settle payments on both a gross and a net basis.

3.5 SECURITIES SETTLEMENT SYSTEMS

In a securities settlement system, securities are exchanged between two parties. In the case of a securities transaction, there is an offsetting transfer of funds. Securities can also be exchanged without an offsetting exchange of funds, e.g. securities lending. Most securities settlement systems also handle periodic payments, i.e. interest, repayments and dividend, from issuers to investors.

3.5.1 Settlement of securities transactions

The cash and securities legs of a securities transaction can be settled on a gross or net basis, or a combination of the two. In gross settlement, trades are executed individually, as in an RTGS system. In net settlement, all trades in a specific period are compiled in one settlement cycle where they are netted bilaterally or multilaterally.

The following is a description of the typical procedure for settlement of a securities transaction. After a securities transaction is concluded, the transaction is reported to a central securities depository that handles clearing and settlement of the transaction. Both the buyer and the seller, or their securities dealers, report the transaction. In many modern trading systems reporting takes place automatically when trades are concluded.

In some settlement systems clearing is handled by a central counterparty that acts as intermediary in the trade. Normally a central counterparty

CENTRAL COUNTERPARTIES

Box 3.4

A central counterparty is an intermediate in securities trading, i.e. acts as seller for all buyers and buyer for all sellers. A central counterparty normally offers netting of securities transactions, which limits the requirements of liquidity and the portfolio of securities. On settlement via a central counterparty the buyer and seller can, if they require, remain anonymous vis-à-vis all other parties than the central counterparty. A central counterparty is often connected to central securities depositories in several countries, which can facilitate the settlement of cross-border transactions. The use of a central counterparty generally entails a concentration of the settlement risks in securities transactions, cf. Chapter 4.

Source: BIS (2004).

offers netting of trades, allowing the buyer and the seller to remain anonymous. Box 3.4 gives a brief description of central counterparties.

As a stage in the clearing, the central securities depository first investigates whether the reports from the buyer and the seller correspond – this is called matching. Among other things, it is checked whether ID code, trading price, nominal quantity and settlement date are identical. With regard to settlement date, the normal market conven-

DELIVERY VERSUS PAYMENT (DVP)

Box 3.5

Simultaneous exchange of securities and funds in the settlement of securities transactions is called Delivery versus Payment (DvP). DvP entails that the buyer of securities only delivers its share of the transaction, i.e. the cash, if the seller simultaneously delivers its share, i.e. the securities, and vice versa.

A distinction is normally drawn between the following DvP models:

- Model 1: Gross settlement of the securities leg and simultaneous gross settlement of the cash leg.
- Model 2: Gross settlement of the securities leg within a settlement cycle and net settlement of the cash leg at the end of the settlement cycle.
- Model 3: Net settlement of the securities leg with simultaneous net settlement of the cash leg.

DvP eliminates the principle risk on settlement of securities transactions, i.e. the exposure of one party to a securities transaction to the other party if cash is delivered before securities are received, or vice versa, cf. Chapter 4.

Source: BIS (1992).

tion is settlement three days after the transaction is concluded, but most securities settlement systems can also handle other settlement dates.

The central securities depository then checks that the buyer and seller have cover for the securities transaction, i.e. that the seller can actually dispose of the securities, and that the buyer can pay. In the case of net settlement, the central securities depository first calculates the net positions of the buyer and the seller in each settlement cycle prior to the check for adequate cover.

If the result of the check for adequate cover is positive, actual settlement of the securities transaction, with exchange of funds and securities, then takes place. On the cash side an amount is transferred from the buyer to the seller, and on the securities side the securities are transferred from the seller's to the buyer's safekeeping account. In most securities settlement systems, a securities transaction is final when settlement is completed.

Most securities settlement systems today settle the two sides of a securities transaction as Delivery versus Payment (DvP). DvP entails that the buyer does not deliver the funds unless the seller simultaneously delivers the securities, and vice versa. DvP eliminates the principal risk on the settlement of securities transactions, cf. Chapter 4. Box 3.5 presents a description of various models for DvP.

The cash leg of the securities transaction normally takes place in central-bank money, cf. Chapter 1, Box 1.5, and the models can vary, e.g. according to whether settlement takes place via central-bank accounts or settlement accounts at the central securities depository. The central securities depository may also have access to book the participants' central-bank accounts or hold its own account with the central bank. Box 3.6 describes different models for settlement in central-bank money.

A securities dealer that does not hold an account with the central bank may participate indirectly in the settlement of the cash leg via an account holder bank. The indirect participant normally holds an account with the direct participant, which then makes liquidity available in the settlement on behalf of the indirect participant. Indirect participants in the settlement of the cash leg are usually non-resident and small resident securities dealers that are not entitled to hold accounts with the central bank or do not wish to defray the costs of holding an account.

Chart 3.4 illustrates the settlement of a securities transaction on a gross basis. The settlement of the cash leg is assumed to take place via accounts at the central bank.

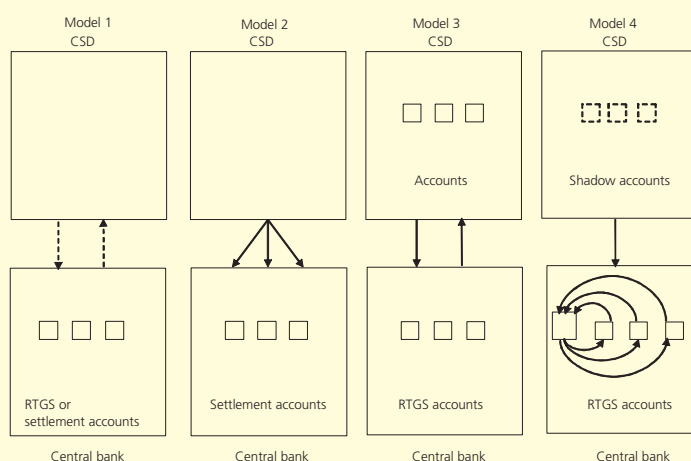
SETTLEMENT OF SECURITIES TRANSACTIONS IN CENTRAL-BANK MONEY¹

Box 3.6

There are various models for settlement of securities transactions in central-bank money. The models vary according to whether (i) settlement is to accounts with the central bank or central securities depository, (ii) the central securities depository has access to transfer funds between the participants' accounts with the central bank, and (iii) the central securities depository itself holds accounts with the central bank. The following presents four examples of such models:

- Model 1: Settlement of the cash leg takes place via the participants' RTGS accounts or special settlement accounts with the central bank and is handled by the participants themselves or the central bank. The central securities depository sends a message on the participants' net cash positions and is notified when funds has been exchanged. This generally corresponds to the model in Denmark, cf. the description of VP settlement in Chapters 5 and 6.
- Model 2: Settlement of funds takes place via the participants' settlement accounts with the central bank. In contrast to model 1 settlement is handled by the central securities depository, which thus has access to transfer the funds between the participants' accounts. The participants will typically themselves have transferred funds from their RTGS accounts to their settlement accounts, while the subsequent emptying of the settlement accounts to RTGS accounts takes place automatically.
- Model 3: Settlement takes place via settlement accounts with the central securities depository on the basis of funds transferred from the participants' RTGS accounts with the central bank. After settlement the new amounts are transferred back to the participants' RTGS accounts.
- Model 4: Settlement takes place via the central securities depository's RTGS account with the central bank. The participants transfer funds to the central securities depository's RTGS account from their own RTGS accounts. The central securities depository settles to its own register of shadow accounts and transfers the new amounts to the participants' RTGS accounts.

MODELS FOR SETTLEMENT OF SECURITIES TRANSACTIONS IN CENTRAL-BANK MONEY

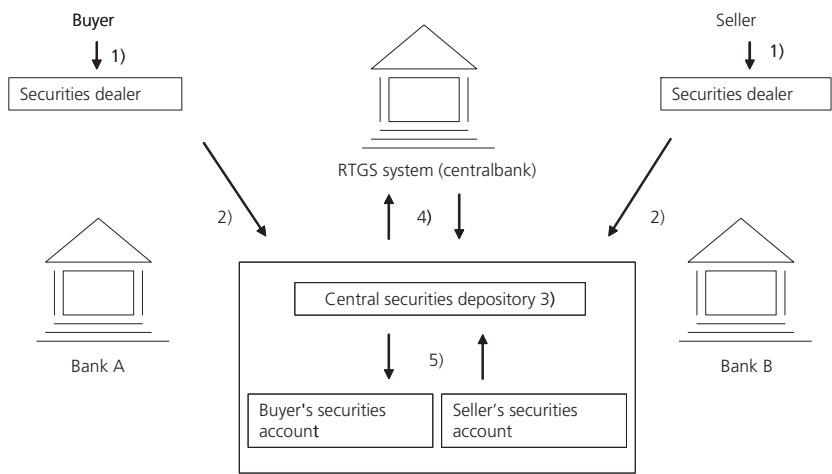


Note: CSD: Central securities depository

¹ This description is based on ECB (2004).

GROSS SETTLEMENT OF SECURITIES TRANSACTIONS

Chart 3.4



- 1) Buyer and seller conclude a securities transaction, possibly via securities dealers.
- 2) Buyer and seller, or securities dealers, report the transaction to the central securities depository.
- 3) The central securities depository undertakes clearing (matching, calculation of net positions and check for adequate cover).
- 4) Settlement of the cash leg (debit/credit of banks A and B's respective accounts via the RTGS system).
- 5) Settlement of the securities side (debit/credit of the securities accounts of, respectively, the seller and the buyer).

Note: It is assumed that the securities transaction is cleared in a central securities depository without using a central counterparty. The Chart does not illustrate the settlement of payments between the buyer and the seller and their respective banks.

3.5.2 Settlement of periodic payments

When interest or dividend is disbursed, funds are transferred from issuers to investors. In most securities settlement systems this transfer of funds as a general rule takes place in the same way as the settlement of the cash leg of a securities transaction. An issuer that does not hold an account at the central bank must make an arrangement with an account holder to provide liquidity for settlement of the payments.

Most central securities depositories register ownership of the securities to omnibus accounts that are administered by custodian banks. When interest or dividend is disbursed, one overall amount is transferred to each custodian bank, which then itself distributes the funds to the investors. Central securities depositories that hold single investor accounts also disburse one overall amount to each custodian bank, but can also provide information on the distribution on recipients. In this way the custodian bank avoids having to calculate this distribution itself.

CENTRAL SECURITIES DEPOSITORIES

Table 3.3

Country	Central securities depository	Ownership	Settlement bank	Types of securities	DvP model	Value date for settlement	No. of transactions in thousands, 2003	Value of transac- tions/GDP, 2003
Belgium	Euroclear Bank	B, A ¹	CB, B	S, O, E, OS	DvP 1	T+3, T+n	22,000	426.2
Denmark	VP	CB, B, A	CB	S, O, E, OS	DvP 3, DvP 1	T+3	6,215	18.9
Canada	CSD	B, X, A	CB	S, O, E, OS	DvP 2	T, T+1, T+3	39,200	33.4
France	Euroclear, FR	B, A ¹	CB	S, O, E, OS	DvP 1	Up to T+100	27,812	33.7
Netherlands	Euroclear, NL	B, A ¹	CB, B	S, O, E	DvP 1	T+3	3,072	1.5
Japan	JASDEC	B, X, A	CB, B	E, OS	DvP 3, DvP 1	T+1, T+2, T+3	37,587	...
Switzerland	SIS	B, X	CB	S, O, E, Ø	DvP 1	T+3	18,800	19.9
UK	Crest, Euroclear	B, A ¹	CB, B	S, O, E, Ø	DvP 1	From T to T+3	63,800	53.0
Sweden	VPC	B, O	CB	S, E, OS	DvP 1	T+2, T+3	10,277	35.8
Germany	Clearstream	X	CB	S, O, E, OS	DvP 1	Up to T+40	45,592	6.7
USA	DTC	B, X, A	CB	O, E, OS	DvP 2	T, T+3	225,200	9.6

Note: CB: Central bank, B: Bank(s), X: Stock exchange, A: Others, S: Government securities, O: Other bonds, E: Equities and OS: Other securities.

The DvP models are described in Box 3.5 (DvP 1 is model 1, etc.).

Source: BIS (2005) and own calculations.

¹ Owned by Euroclear plc, which is owned by banks and others.

3.5.3 Overview of central securities depositories

Table 3.3 gives an overview of central securities depositories in selected countries. The Table confirms that today a number of characteristics of settlement of securities transactions are standard for most central securities depositories, including DvP settlement, settlement in central-bank money and settlement with three days' value.

Within the EU, recent years have seen a number of consolidations of central securities depositories (horizontal consolidation), and of central securities depositories, stock exchanges and central counterparties (vertical consolidation), cf. Box 3.7. The consolidations have been driven primarily by economies of scale and expectations of greater automation of settlement. Consolidation has also been perceived as a necessity in order to reduce the cost of cross-border securities trading within the EU.

CONSOLIDATION OF THE EUROPEAN SECURITIES INFRASTRUCTURE

Box 3.7

Traditionally, each European country has had its own national stock exchange, central securities depository and possibly also its own central counterparty. During the last few years, however, there has been some consolidation of the infrastructure of the European securities markets.

The Chart illustrates the key aspects of the present securities infrastructure for selected European countries. One example of vertical consolidation involved Deutsche Börse, Eurex Clearing and Clearstream. The latter was formed in 2000 as a merger of Deutsche Börse Clearing and the international securities depository, Cedel. An example of horizontal consolidation involved the international securities depository Euroclear and the national securities depositories in France, the Netherlands and Belgium, and most recently in the autumn of 2002 with Crest in the UK.

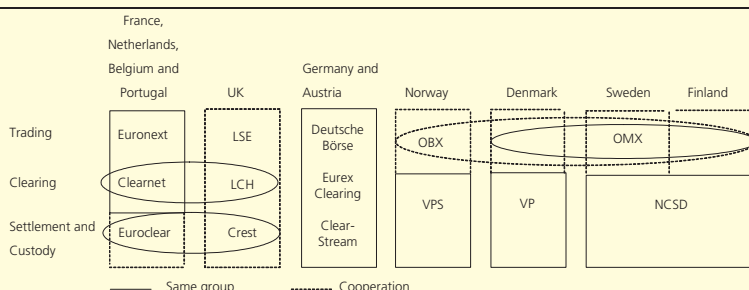
In the Nordic countries, equivalent consolidation of the securities market infrastructure has been seen. The stock exchanges in Denmark, Sweden and Finland have been consolidated in a company owned by OMX AB of Sweden. These stock exchanges also participate in the Norex Alliance that also includes the stock exchanges of Norway and Iceland. On the clearing and settlement side, the central securities depositories in Sweden and Finland have merged under the holding company Nordic Central Securities Depository (NCSD).

The vertical consolidations have been driven especially by expectations of a more automated settlement procedure. This e.g. applies to better opportunities for Straight-Through Processing (STP), whereby a transaction is automatically sent for clearing and settlement. The horizontal consolidations have been motivated primarily by economies of scale since the systems entail high fixed costs and low marginal costs.

Consolidation of the securities infrastructure has also been seen as a necessary step towards reducing the current high costs of cross-border securities trading in Europe, cf. Lannoo and Levin (2001). In two reports from 2001 and 2003 the Giovannini Group points out 15 barriers to such trading and puts forward proposals for the elimination of these barriers. According to the Giovannini group, eliminating these barriers will support the ongoing consolidation process.

The European Commission plans to introduce a framework directive for clearing and settlement that, among other things, will contribute to a more integrated securities infrastructure in the EU.¹ Greater integration can be achieved through ongoing consolidation and via links between central securities depositories. The directive will support both by ensuring mutual recognition of securities settlement systems based on joint supervision rules and will create greater freedom of choice between these systems for cross-border trading.

OUTLINE OF THE EUROPEAN SECURITIES INFRASTRUCTURE



Note: LSE: London Stock Exchange, LCH: London Clearing House, OBX: Oslo Stock Exchange, NCSD: Nordic Central Securities Depository.

¹ See the European Commission (2004).

LITERATURE

Arnt, H. and A. R. Pedersen, 2003. Securities Market Infrastructures, Danmarks Nationalbank, *Monetary Review*, 3rd Quarter.

Bech, M and K. Soramäki, 2001. Gridlock Resolution in Payment Systems, Danmarks Nationalbank, *Monetary Review*, 4th Quarter.

Berg, J. and M. Kruse, 2000. Securities Settlement in an International Perspective, Danmarks Nationalbank, *Monetary Review*, 2nd Quarter.

BIS, 1992. *Delivery versus payment in securities settlement systems*. Report prepared by the Committee on Payment and Settlement Systems, Bank for International Settlements

BIS, 1997. *Real-time gross settlement systems*, Report prepared by the Committee on Payment and Settlement Systems, Bank for International Settlements.

BIS, 2003. *The role of central bank money in payment systems*. Report prepared by the Committee on Payment and Settlement Systems, Bank for International Settlements.

BIS, 2004. *Recommendations for central counterparties*. Report prepared by the Committee on Payment and Settlement Systems, Bank for International Settlements.

BIS, 2005. *Statistics on payment and settlement systems in selected countries – Figures for 2003*. Report prepared by the Committee on Payment and Settlement Systems, Bank for International Settlements.

BIS, 2005. *New developments in large-value payment systems*, Report prepared by the Committee on Payment and Settlement Systems, Bank for International Settlements.

ECB, 2004. The use of central bank money for settling securities transactions, May 2004.

European Commission, 2004. Communication from the Commission to the Council and the European Parliament – Clearing and Settlement in the European Union – The way forward, COM(2004) 312 final, April 2004.

Giovannini Group, 2001. Cross-Border Clearing and Settlement Arrangements in the European Union, November 2001.

Giovannini Group, 2003. Second Report on EU Clearing and Settlement Arrangements, April 2003.

Lannoo, K. and M. Levin, 2001. The securities settlement industry in the EU – structure, costs and the way forward, *CEPS Research Report*, December 2001.

Koponen, R. and K. Soramäki, 1998. Intraday Liquidity Needs in a Modern Interbank Payment System – A Simulation Approach, Bank of Finland, *Studies in Economics and Finance*, Series E, No 14.

Leinonen, H. and K. Soramäki, 1999. Optimizing Liquidity Usage and Settlement Speed in Payment Systems, Bank of Finland, *Discussion Papers*, No 16.

Leinonen, H., 2003. Simulation Interbank Payment and Securities Settlement Mechanisms with the BoF-PSS2 Simulator, Bank of Finland, *Discussion Papers* No 23.

McAndrews, J. and J. Trundle, 2001. New payment system designs: causes and consequences, Bank of England, *Financial Stability Review*, December 2001.

4. Risks in Payment and Securities Settlement

When payment and securities transactions are settled, financial institutions are exposed to various types of risk, cf. Box 4.1. These risks can entail systemic risk if problems within one financial institution spread to others. Payment and securities settlement systems that can generate this domino effect, or cause problems to spread to the domestic or international financial system, are referred to as systemically important systems, cf. Chapter 1.

The probability that payment and settlement systems trigger systemic crises is generally considered to be very small. However, if a crisis does occur the consequences can be considerable and pose a threat to financial stability. When designing payment and securities settlement systems it is therefore sought to minimise the various types of risk.

Payments and securities transactions can be settled outside the payments infrastructure or via payment and settlement systems,

RISKS IN PAYMENT SYSTEMS

Box 4.1

For the financial institutions involved, payment systems entail a number of risks that can lead to financial losses. These risks can be categorised under the following four types of risk:

- *Credit risk* is the risk of financial loss as a consequence of a counterparty's inability to meet its payment obligations, either at the time of settlement or at a later time. The credit risk is dependent on the size of the counterparty's obligations (exposure), which can e.g. be a payment for settlement or an account balance, as well as the counterparty's creditworthiness. Credit risk increases with the maturity of the exposure.¹
- *Liquidity risk* is the risk of incurring a loss because a payment is not received at the expected time. The loss can occur if the liquidity has already been deployed and liquidity therefore has to be obtained at short notice. This often entails extraordinary costs, e.g. a high interest rate.
- *Legal risk* is the risk of suffering a loss as a consequence of unforeseen interpretation of the systems' contractual basis or the legislation on which the contracts between the parties are based, e.g. in connection with a court ruling.
- *Operational risk* is the risk of economic loss resulting from inadequate or failed internal processes, people and systems, or from external events such as natural disasters, terrorism, etc. Operational risks entail loss of tangible (hardware) and intangible (software) assets, or unexpected credit and liquidity exposure.

¹ A variant of the credit risk is the membership risk that can arise in a system where the participants are jointly and severally liable for losses due to problems experienced by one of the other participants.

cf. Chapter 3. Settlement outside the payments infrastructure entails certain risks, which can be reduced by using payment and settlement systems. The risks on settlement in these systems cannot be eliminated entirely, however, and even though the participants are exposed to risk for a relatively short time very large amounts are involved.

Below, first the risks of settlement outside the payments infrastructure are described. Then an account is given of the overall types of risk related to settlement via payment systems, including RTGS and net settlement systems. Finally, the special risks in relation to securities settlement systems are described.

4.1 RISKS OF SETTLEMENT OUTSIDE THE PAYMENTS INFRASTRUCTURE

Some banks settle large-value payments outside the payments infrastructure, e.g. as ongoing settlement of payments to the banks' mutual accounts with each other, so-called correspondent accounts. The banks may also net their mutual payments in the course of the day, so that only their net positions are settled via the payments infrastructure once or several times a day. In both cases, the banks can potentially build up large inter-bank exposures. This is not the case if the payments are settled on an ongoing basis via the payments infrastructure.

Banks that do not settle their payments via the payments infrastructure can achieve a reduction of their liquidity requirement compared to individual settlement of the payments in an RTGS system. However, the banks incur a credit risk on either the correspondent bank or the banks with which netting agreements have been made. This credit risk is avoided by settling the payments in an RTGS system with the central bank as settlement bank.

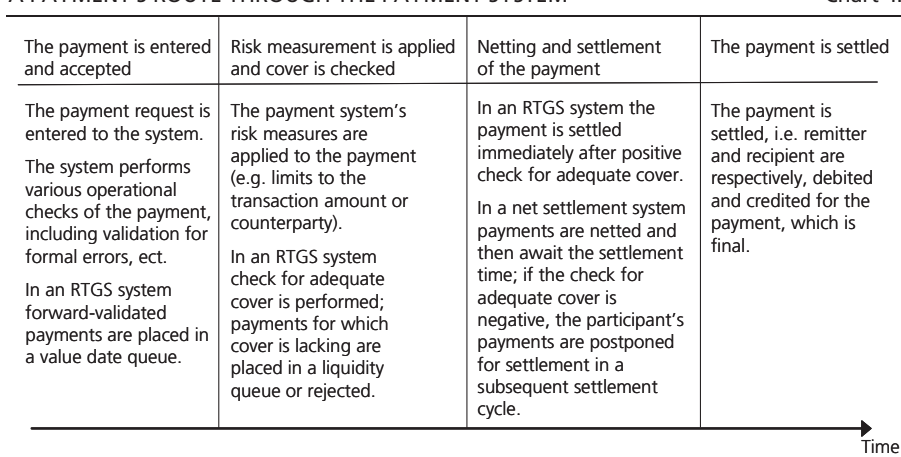
When payments are settled via correspondent bank accounts, central-bank money is not used in the settlement, cf. Chapter 1. The banks thus assume a liquidity risk since the counterparties may have difficulty in honouring the bank's outstanding claims when they fall due. Problems at one bank may spread to others. Settlement of large-value payments outside the payments infrastructure can therefore ultimately jeopardise financial stability.

4.2 RISKS IN PAYMENT SYSTEMS

Chart 4.1 illustrates the phases of a payment transaction in an RTGS or net settlement system, from the participant's entry of the payment instruction until final settlement of the payment.

A PAYMENT'S ROUTE THROUGH THE PAYMENT SYSTEM

Chart 4.1



Source: BIS (2001b).

4.2.1 Credit risk in payment systems

Credit risk in payment systems is the risk of financial loss as a consequence of a counterparty's inability to meet its payment obligations, either at the time of settlement or at a later time. The risk can occur in the period between a system's acceptance of a payment and its final settlement. In modern payment systems this period is often very short, and rarely longer than a few days.¹ The probability of suffering a credit loss on another participant is therefore very small, but the potential loss can be high, in view of the often considerable exposures.

The participants in a payment system can also run a credit risk on the system's settlement bank where payments are exchanged via the participants' accounts in connection with settlement of payments. In most systemically important payment systems the settlement bank is the central bank, cf. Chapter 1, section 1.3. In practice this eliminates the participants' credit risk on the settlement bank.

A third type of credit risk is the membership risk that can arise in a payment system where the participants are jointly and severally liable for losses. This liability could e.g. be based on a loss-sharing agreement between the participants. In this situation the inability to settle by one participant can also result in losses to participants that have no exposure to the insolvent participant.

Finally, a special type of credit risk can occur in connection with payments on behalf of customers if a participant credits the customer for a

¹ In an RTGS system the time of the system's acceptance of a payment and its final settlement in practice coincide. In a net settlement system this period in many cases extends to up to a day or more.

payment that has not yet been received.¹ This can occur if the participant has access to information on incoming customer payments in a liquidity or value date queue. The wish to avoid this risk could be an argument for not letting participants view queued incoming payments. On the other hand, greater transparency in liquidity and value date queues improves the participants' opportunities to manage their liquidity.²

4.2.2 Liquidity risk in payment systems

Liquidity risk in payment systems is the risk of incurring a loss because liquidity is not received at the expected time. A participant that has already disposed of the expected liquidity will have to procure liquidity by other means at short notice. The participant may have to borrow in the money market or sell securities in a real-time transaction. As a rule this will entail losses.³

A participant can eliminate the liquidity risk by establishing credit facilities to draw on at short notice. Another option is to hold liquid deposits with banks or to build up a portfolio of securities that can be collateralised in the money market or sold for immediate liquidity. In addition, any initiative in a payment system designed to ensure the execution of the payments will contribute to reducing the liquidity risk.

Payment systems where the central bank acts as settlement bank generally involve a lower liquidity risk than other systems since the participants can usually raise liquidity quickly and easily from the central bank. In most countries central banks grant unlimited intraday credit against collateral, cf. Chapter 1.

4.2.3 Legal risk in payment systems

A participant in a payment system is exposed to legal risk in the event of uncertainty regarding the system's contractual basis or the underlying legislation. This can lead the participant to make decisions that are less appropriate in terms of the correct interpretation of the contractual basis or the law, thereby incurring a loss.

¹ This type of credit risk can also be seen as an operational risk in the event of breach of internal procedures, cf. section 4.2.4.

² Cf. BIS (1997) for a discussion of the advantages and drawbacks of transparency in liquidity and value date queues.

³ A simple example can serve to illustrate the difference between credit risk and liquidity risk in a payment system. Participant A expects a payment of 100 from participant B on day T. On the same day, participant A requires the amount to settle a securities purchase. However, participant A does not receive the payment from participant B on day T and instead has to borrow the amount in the money market at a cost of e.g. 2. Regardless of whether participant A receives the payment from participant B at a later time, A will suffer a loss, due to the liquidity risk, of 2. If B later goes into insolvent liquidation and does not pay the amount to A, then A will also suffer a loss of 100 as a consequence of the credit risk.

An example of legal risk is uncertainty as to a system's rules concerning payment finality. Consequently, the participant may deploy an incoming payment in the belief that it is final before this is actually the case. In this situation the participant can suffer a loss if insolvency proceedings are opened against another participant and the exchanged payments are reversed (the unwinding principle).

Legal risk in payment systems can be prevented on a centralised basis by adopting new, less ambiguous legislation. For example, the Settlement Finality Directive adopted in 1998 helped to give more clarity to the finality of payments in EU payments systems, cf. Chapter 9. A participant can also seek to protect itself against legal risk by obtaining a legal opinion in order to have a more robust interpretation of the system's contractual basis or the applicable legislation.

4.2.4 Operational risk in payment systems

A participant runs an operational risk if there is a risk of financial loss as a consequence of manual or technical faults, breach of rules or laws, or as a consequence of external events such as natural disasters, terrorism, etc. In modern payment systems operational risk mainly relates to IT systems. Like legal risk, operational risk can lead to unexpected exposure that can amplify credit and liquidity risks.

Measures to limit operational risk include clear procedures and contingency procedures, including chains of command, to ensure that action is taken without delay in the event of system failure, etc. In addition, it is customary to establish two separate operations centres to reduce operational risk in critical systems.

4.2.5 Risks in RTGS and net settlement systems

The two main types of payment system are RTGS and net settlement systems, cf. Chapter 3. The risks on settlement in the two systems vary in a number of respects.¹

Credit risk

In an RTGS system, a payment is usually settled immediately after it has been entered and accepted in the system.² So in principle there is no credit risk on other participants in the system. In a net settlement system, there is normally a certain time lag between the system's accep-

¹ Hybrid systems combine elements of RTGS and net settlement systems, cf. Chapter 3. Settlement risks in hybrid systems are thus a combination of risks in RTGS and net settlement systems. Risks in hybrid systems are typically smaller than in RTGS and net settlement systems.

² An exception is payments that are placed in liquidity or value date queues. A recipient of such a payment in an RTGS system will have a credit risk on the remitter until the final settlement of the payment.

tance and final settlement of a payment. In this period the recipient will have a credit risk on the remitter. The credit risk in net settlement systems can be reduced by increasing the frequency of settlement cycles.

The other types of credit risks in payment systems, cf. section 4.2.1, are in general terms equally relevant for RTGS and net settlement systems.

Liquidity risk

All other things being equal, the individual settlement of payments in RTGS systems entails a larger liquidity requirement and thereby a greater liquidity risk than settlement in net settlement systems. Moreover, in RTGS systems gridlocks and deadlocks can arise which prevent the execution of payments at the agreed time, cf. Chapter 3.

On the other hand, the ongoing settlement of payments in RTGS systems entails greater flexibility in the participants' liquidity management than in net settlement systems, where liquidity has to be available at fixed times.

Operational risk

The underlying operational risk factors are the same in both RTGS and net settlement systems. However, differences in settlement procedures entail that the operational risk differs. In a net settlement system a failure will not delay settlement if the fault is corrected before clearing and settlement are initiated. In an RTGS system, on the other hand, a failure will delay any payments submitted for settlement in the period during which the system is down.

Systemic risk

The risk of a systemic crisis is normally evaluated to be smaller for RTGS systems than for net settlement systems. This is firstly because, as already mentioned, in an RTGS system there is no credit risk on other participants in the system. In a net settlement system, insolvency proceedings against a participant in the period between the system's acceptance and settlement of the participant's payments can lead to credit loss for the other participants. In extreme cases these credit losses can be of such a magnitude that they have systemic consequences.

Secondly, in RTGS systems there is no risk that unexpected payment obligations arise during the settlement process if another participant fails to fulfil its obligations. This is the case in net settlement systems, where a participant that has not reserved sufficient liquidity for settlement is normally removed, after which new positions are calculated for the remaining participants. This can lead to other participants not being

able to fulfil their payment obligations either, so that they have to be removed from the settlement, in a worst-case scenario causing a systemic crisis.

4.3 RISKS IN SECURITIES SETTLEMENT

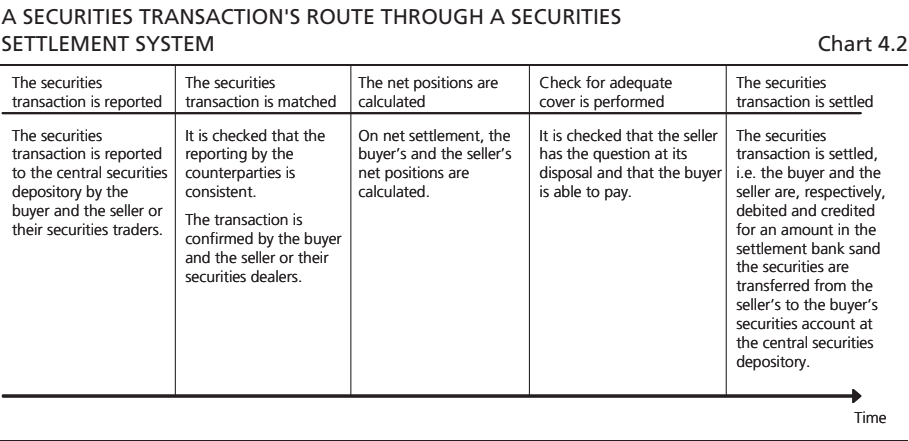
Chart 4.2 shows the phases of a securities transaction from its reporting to a securities settlement system until its final and irrevocable settlement.

4.3.1 Credit risk

The credit risk on settlement of securities transactions can be broken down on principal risk, replacement risk and other credit risk.

Principal risk arises if the buyer and seller in a securities transaction do not deliver money and securities simultaneously. The party that delivers its part of the transaction first has a credit risk on the counterparty equivalent to the agreed value of the principal. The longer the time lag between the two parties' planned delivery, the larger the principal risk becomes. The principal risk can be eliminated by settling the securities transactions as Delivery versus Payment (DvP), cf. Chapter 3, Box 3.5.

The replacement risk is the risk of loss due to insolvency proceedings against the counterparty between the time that a securities transaction is concluded and its settlement, so that the transaction cannot be executed. A securities buyer will lose a potential capital gain if the market price of the asset has risen since the transaction was concluded. In the same way, a seller of an asset will suffer a loss if the market price has fallen. The longer the time lag between conclusion and settlement of the transaction, and the greater the fluctuation in market prices, the



Source: BIS (2001a).

higher the replacement risk. Replacement risk can be avoided by settling the securities transaction in real time, with settlement immediately after the transaction is concluded.

Settlement of securities transactions can also lead to a number of other credit risks. For example, participants in the settlement can have a credit risk on the settlement bank. This is not the case, however, if settlement takes place in central-bank money. Credit risk can also occur between direct and indirect participants in the settlement of cash positions. Moreover, a central securities depository may incur a credit risk on the participants if it grants securities lending or other credit facilities in order to facilitate settlement.

4.3.2 Liquidity risk

The liquidity risk on settlement of securities transactions is the risk of incurring a loss because funds or securities are not received at the expected time. The loss can occur if the funds or securities have already been deployed. In that situation, the seller will have to borrow liquidity or sell securities at short notice, which often entails a loss. In the same way, the buyer can be obliged to borrow equivalent securities in the market in order to honour resale with same-day value.

Any settlement mechanism that contributes to transactions being settled on the agreed day will reduce the liquidity risk. This could e.g. be a credit facility at the settlement bank to ensure that sufficient liquidity is available for the settlement, or a centralised securities lending facility administered by the central securities depository. A well-functioning money market and a decentralised securities lending market also contribute to reducing the liquidity risk since this reduces the costs of having to borrow liquidity or obtain securities at short notice.

4.3.3 Legal and operational risks

Settlement of securities transactions fundamentally entails the same types of legal and operational risk as payment systems, cf. section 4.2. A special type of legal risk in securities settlement systems can arise if there is uncertainty concerning the legislative basis for regulation of the title to the securities. This can lead to uncertainty concerning the title to securities held with a custodian that goes into insolvent liquidation¹. Legal risk arises most frequently in connection with cross-border securities transactions.

¹ This type of risk is also often called custodian risk, cf. BIS (2001).

4.3.4 Central counterparties

In some securities settlement systems, clearing in the settlement procedure is handled by a central counterparty, cf. Chapter 3, Box 3.4. This entails that the securities dealers know the identity of their immediate counterparty (the central counterparty). Securities dealers will normally prefer a risk on a known counterparty rather than an unknown risk on a party with which they happen to trade. This applies especially to cross-border securities transactions where there is often less knowledge of the counterparty than for domestic transactions.

On the other hand, the use of a central counterparty entails a concentration of the settlement risks on the same counterparty. So the central counterparty's inability to fulfil its obligations, or sudden operational problems for the central counterparty, can have significant consequences and potentially trigger a systemic crisis. In recent years the authorities have therefore increasingly focused on the central counterparties' rules and procedures for risk management.¹

¹ In 2004, BIS and the International Organization of Securities Commissions (IOSCO) published a number of recommendations for central counterparties, cf. BIS (2004).

LITERATURE

BIS, 1992. Delivery versus payment in securities settlement systems, September 1992.

BIS, 1996. Settlement risk in Foreign Exchange Transactions, March 1996.

BIS, 1997, Real-Time Gross Settlement Systems, March 1997.

BIS, 2001a, Recommendations for Securities Settlement Systems, *Report on the CPSS-IOSCO Joint Task Force on Securities Settlement System*, CPSS publication No 46, November 2001.

BIS, 2001b, Core principles for systemically important payment systems, January 2001.

BIS, 2003a. The Role of Central Bank Money in Payment Systems, August 2003.

BIS, 2004. Recommendations for Central Counterparties, November 2004.

Danmarks Nationalbank, 2001. Financial Stability, Danmarks Nationalbank, *Monetary Review*, 2nd Quarter.

Danmarks Nationalbank, 2002, *Financial stability*

Danmarks Nationalbank, 2001. Danmarks Nationalbank's Oversight of Payment and Securities Settlement Systems, Danmarks Nationalbank, *Monetary Review*, 2nd Quarter.

Kahn, C., J.J. Andrews and W. Robards, 2003. Settlement Risk under Gross and Net Settlement, *Journal of Money, Credit and Banking* 35, No 4 (August)

Fry, Maxwell J., Isaack Kilato, Sandra Roger, Krzysztof Senderowicz, David Sheppard, Francisco Solis and John Trundle, 1999, Payment Systems in Global Perspective, *Routledge International Studies in Money and Banking*, Bank of England.

Thygesen, Tobias, 2001. International Standards for Payment Systems, Danmarks Nationalbank, *Monetary Review*, 1st Quarter.

5. Danmarks Nationalbank's Role in the Danish Payments infrastructure

Danmarks Nationalbank plays several key roles in the Danish payments infrastructure. From the general public's point of view, its most visible task is to issue Danish banknotes and coins. These are primarily used for small retail payments and are distributed to citizens and companies via banks in Denmark.

In addition, Danmarks Nationalbank acts as settlement bank for a number of financial institutions that hold accounts at Danmarks Nationalbank. Via these accounts and Danmarks Nationalbank's payment system, Kronos, the financial institutions settle their mutual accounts and their accounts with Danmarks Nationalbank. The financial institutions also use their accounts at Danmarks Nationalbank to settle payments in various Danish and international payment and settlement systems.

In relation to payment systems, Danmarks Nationalbank helps to ensure that there is always adequate intraday liquidity within the financial system to settle payments. To that end Danmarks Nationalbank extends intraday credit in kroner to the financial institutions. This credit must be covered by the end of the day. The financial institutions also have access to intraday credit in euro from Danmarks Nationalbank up to a fixed limit.

For all types of credit, Danmarks Nationalbank requires securities meeting certain criteria as collateral. This can be provided via traditional pledging of securities in a safekeeping account with VP Securities Services. In addition, the financial institutions may pledge collateral for intraday credit in kroner via two supplementary arrangements: automatic collateralisation and the Scandinavian Cash Pool.

Another important task for Danmarks Nationalbank is to oversee that the Danish payment and settlement systems are secure and efficient. As described in Chapter 4, problems within a systemically important payment or settlement system may spread to many participants and affect the entire financial system. Danmarks Nationalbank's oversight of such systems is described in further detail in Chapter 10.

Finally, Danmarks Nationalbank itself to a limited extent participates in the Danish payments infrastructure on a par with other financial institutions. This applies to e.g. settlement of retail payments and securities transactions. Danmarks Nationalbank's tasks in this connection do not

differ from those performed by any other bank and will not be discussed further in this chapter.

5.1 BANKNOTES AND COINS

Danmarks Nationalbank has an exclusive right to manufacture and issue Danish banknotes and coins. Banknotes are printed by Danmarks Nationalbank's Banknote Printing Works, while coins are minted by The Royal Mint under Danmarks Nationalbank. These banknotes and coins are also used in Greenland. In addition, Danmarks Nationalbank prints banknotes denominated in Danish kroner for use in the Faroe Islands.

Banknotes and coins are put into circulation via a number of decentralised banknote holdings placed with banks in various parts of Denmark. These holdings are owned and operated by the banks and supply local banks with cash. In connection with the establishment of a decentralised banknote holding, a maximum limit is set for its size. Danmarks Nationalbank grants the bank in question an interest-free loan corresponding to the value of the banknotes held, but for practical reasons and insurance reasons collateral equivalent to the maximum limit must be pledged.

Banknotes and coins are primarily used for small retail payments. Despite the increasing use of electronic payment instruments, e.g. the Dankort (debit card), banknotes and coins remain an important means of payment in Denmark.

5.2 DANMARKS NATIONALBANK'S ROLE AS SETTLEMENT BANK

Danmarks Nationalbank is often referred to as banker to the banks. The reason is that a number of financial institutions hold accounts at Danmarks Nationalbank, from which they settle various payments. Danmarks Nationalbank acts as settlement bank for these institutions because claims on Danmarks Nationalbank are risk-free and liquid and can therefore always be used for settlement of accounts between the financial institutions.

The financial institutions holding accounts at Danmarks Nationalbank are mainly banks and mortgage-credit institutes, investment firms and foreign credit institutions conducting cross-border activities in Denmark.¹ In the following, these institutions are collectively referred to as "account holders".

¹ Others that, in the assessment of Danmarks Nationalbank, play a significant role in relation to settlement of payments at Danmarks Nationalbank may also open accounts.

An account holder's primary account at Danmarks Nationalbank is its current account. Deposits in current accounts can be used for immediate settlement of payments at the initiative of the account holder and are often referred to as liquidity, current-account liquidity or krone liquidity. The current-account deposits of banks and mortgage-credit institutes accrue interest at the current-account rate since these institutions are monetary-policy counterparties, cf. below. Other account holders' current-account deposits do not accrue interest.¹

The current accounts are linked to a number of settlement accounts used for various payment and settlement systems. Account holders hold settlement accounts for the Sumclearing retail payment system, the VP securities settlement system and the CLS foreign-exchange settlement system.² The procedures for settlement of payments in the individual systems are described in more detail in section 5.6.

Danmarks Nationalbank also offers account holders the option to open current accounts and settlement accounts in euro. This allows them to settle payments in euro via the Sumclearing and VP settlement and to participate in Target, the trans-European payment system³. All deposits in current accounts in euro accrue interest at the rate fixed by the European Central Bank (ECB) for its marginal deposit facility.

Settlement of payments via current accounts and transfer of funds between account holders' current accounts and settlement accounts take place via Danmarks Nationalbank's RTGS system, Kronos. All account holders must therefore be connected to Kronos. Account holders with current accounts in euro must also subscribe to Kronos' Target module. Kronos and its facilities are described in Chapter 6.

Potential account holders are free to choose whether they want to participate directly in the Danish payment systems by holding accounts at Danmarks Nationalbank. Alternatively, they may opt to participate indirectly via other account holders. In practice all major Danish banks and mortgage-credit institutes hold accounts at Danmarks Nationalbank.

Finally, the Danish central government also holds an account at Danmarks Nationalbank, which acts as banker to the central government. The government's liquid funds are deposited in this account, which is also used for settlement of large central-government disbursements. Handling the government's retail payments has been outsourced to a commercial bank, which receives a lump sum from Danmarks Nationalbank and then distributes it to the recipients. Typically incoming pay-

¹ In other countries account holders that are not monetary-policy counterparties do not normally have access to interest-bearing current accounts either. Instead they may earn interest on their excess liquidity overnight in the private financial sector.

² The Sumclearing and VP settlement are described in Chapter 6, and CLS in Chapter 8.

³ Target is described on in Chapter 8.

ments to the central government are also received via banks, which then forward them to Danmarks Nationalbank. Deposits in the central government's account accrue interest at the discount rate¹.

5.3 DANMARKS NATIONALBANK PROVIDES KRONE LIQUIDITY

The account holders' total current-account deposits in kroner are affected by a number of transactions relating to items on Danmarks Nationalbank's balance sheet. For instance, purchase and sale of foreign exchange by Danmarks Nationalbank results in immediate changes in the current-account deposits. Another example is payments to and disbursements by the central government, which are also reflected in immediate fluctuations in the account holders' current-account deposits.

An important task for Danmarks Nationalbank is to offer account holders krone liquidity so that adequate liquidity is always available within the financial system to settle payments. This task can be broken down into two closely linked functions:

- A monetary-policy function to ensure that there is sufficient liquidity available when the account holders' balances are settled at the end of the monetary-policy day. The monetary-policy day in kroner runs from 4.00 p.m. to 3.30 p.m. the following banking day. Within the monetary-policy day, all payments in kroner between current accounts at Danmarks Nationalbank have the same value date.
- A payment systems function to ensure that sufficient liquidity is available within the financial system during the monetary-policy day.

5.3.1 The monetary-policy function

At the end of the monetary-policy day, i.e. at 3.30 p.m., account holders may not have negative balances (overdrafts) in their current accounts. Each account holder must seek to cover any negative balance by borrowing in the money market. If this is not possible for all account holders because the aggregate current-account deposits are insufficient, Danmarks Nationalbank provides extra liquidity via monetary-policy operations.

Danmarks Nationalbank's monetary-policy operations are conducted with the monetary-policy counterparties, i.e. banks and mortgage-credit institutes in Denmark. Monetary-policy operations comprise lending against securities as collateral, and purchase and sale of certificates of deposit. If the aggregate current-account deposits are insufficient, Dan-

¹ The discount rate has been equivalent to the current-account rate from April 1992, when the current monetary-policy instruments were essentially introduced, until today (June 2005).

DANMARKS NATIONALBANK'S MONETARY-POLICY INSTRUMENTS

Box 5.1

In practice, Danmarks Nationalbank's monetary policy is conducted via its monetary-policy instruments. This term covers the facilities used by Danmarks Nationalbank to manage and pay interest on accounts with monetary-policy counterparties, i.e. banks and mortgage-credit institutes.

The monetary-policy counterparties have access to two facilities:

- Current-account deposits on a day-to-day basis. When the monetary-policy day ends at 3.30 p.m., the monetary-policy counterparties must not have a negative balance in their current accounts. A limit has been set for the counterparties' total current-account deposits at the end of the monetary-policy day. The total current-account limit is approximately kr. 20 billion, broken down on individual limits for each of the counterparties.
- Weekly market operations in which the monetary-policy counterparties can borrow against securities as collateral, called monetary-policy loans, or place liquidity by purchasing certificates of deposit. Such operations usually have a maturity of 14 days. Certificates of deposit can be traded among the monetary-policy counterparties, but not outside their circle.

The rate of interest on the two types of 14-day transactions is usually the same and is referred to as, respectively, the lending rate and the rate of interest on certificates of deposit. Current-account deposits accrue interest at the current-account rate, which is lower than the lending rate.

Between the weekly market operations, Danmarks Nationalbank can conduct extraordinary market operations to prevent the total current-account deposit from becoming too low, which would impede the functioning of the money market. Extraordinary market operations usually take place in certificates of deposit, which can be purchased or sold with an immediate liquidity impact.

If there are indications towards the end of the monetary-policy day that current-account deposits will exceed the total limit, Danmarks Nationalbank opens for the sale of certificates of deposit. If the total limit is exceeded at the end of the monetary-policy day, the part of the deposit that exceeds the individual current-account limits will be converted into certificates of deposit.

Source: Danmarks Nationalbank (2003).

marks Nationalbank usually provides liquidity by buying back certificates of deposit. Box 5.1. outlines Danmarks Nationalbank's monetary-policy instruments.¹

The key liquidity concept in monetary policy is the monetary-policy counterparties' current-account deposits at the end of the monetary-policy day. Overall, the monetary-policy counterparties do not have access to more liquidity than Danmarks Nationalbank has provided. The

¹ For a more detailed review of Danmarks Nationalbank's monetary-policy instruments, reference is made to Danmarks Nationalbank (2003).

counterparties can trade liquidity among themselves, but they cannot create liquidity.

5.3.2 The payment systems function

To facilitate settlement of payments, Danmarks Nationalbank extends credit to account holders within the monetary-policy day, i.e. intraday credit. This credit comprises overdrafts on their current accounts at Danmarks Nationalbank and is extended against securities or certificates of deposit as collateral. No interest is charged for account holders' intraday credit, which is in step with the practice in other EU member states.

Access to intraday credit makes it relatively easy for account holders to settle outgoing and incoming payments at different times during the day. For instance, an account holder may have to settle a bond purchase in the morning and receive an incoming payment in the afternoon. The account holder can then borrow from Danmarks Nationalbank in the morning and cover the credit in the afternoon.

The key liquidity concept in relation to payment systems is thus the sum of the account holders' current-account deposits and their maximum access to intraday credit. The account holders' maximum intraday credit depends on their portfolios of securities that can be pledged as collateral to Danmarks Nationalbank. In relation to payment systems overall, account holders can therefore increase their liquidity by acquiring a larger portfolio of eligible securities.

5.4 DANMARKS NATIONALBANK OFFERS INTRADAY CREDIT IN EURO

To facilitate settlement of euro payments, Danmarks Nationalbank also offers intraday credit in euro against collateral.¹ Danmarks Nationalbank can extend intraday credit in euro by on a daily basis depositing an amount in euro with a euro-area central bank². This amount constitutes the total limit for account holders' intraday credit in euro from Danmarks Nationalbank. Danmarks Nationalbank does not extend credit in euro overnight, i.e. monetary-policy loans in euro, which is the prerogative of the euro-area central banks.³

The total limit for intraday credit in euro is broken down on individual limits for account holders. These limits cannot be exceeded. Account holders pay a price for the individual limits corresponding to Danmarks

¹ Since the euro is not Denmark's national currency, euro payments in the Danish payment and settlement systems are in principle not settled via central-bank money, cf. Chapter 1, Box 1.5.

² The amount is deposited in the morning and withdrawn at the end of the day. Originally Danmarks Nationalbank deposited 1 billion euro, but due to lower demand for intraday credit in euro, the deposit has been lowered to 585 million euro at present (June 2005).

³ Danish banks can obtain monetary-policy loans in euro via branches or subsidiaries in the euro area.

Nationalbank's costs of procuring euro liquidity. In the 1st quarter of 2005, the price was 0.06 per cent p.a.

Individual limits are usually allocated quarterly on the basis of the account holders' own requests. If the sum of the requested limits does not exceed the overall limit, all account holders' requests are complied with. If the sum of the requested limits is greater than the overall limit, account holders are allocated limits on the basis of their connection fees to the Target module in Kronos, cf. Chapter 6.

Account holders have access to intraday credit in euro between 7.00 a.m. and 5.15 p.m. After 5.00 p.m., an account holder cannot increase its intraday credit in euro. If the current account in euro still shows a debit balance after 5.15 p.m., Danmarks Nationalbank is entitled to enforce the pledged assets. In addition, the account holder must pay interest at a rate that is fixed by Danmarks Nationalbank and that is equivalent to the costs of procuring extra liquidity.¹

5.5 PLEDGING OF COLLATERAL TO DANMARKS NATIONALBANK

Danmarks Nationalbank extends credit as monetary-policy loans, loans for decentralised banknote holdings, and intraday credit in kroner and euro. For all types of credit, Danmarks Nationalbank requires securities as collateral.² The purpose is to avoid losses on the credit extended if the borrower cannot meet its obligations vis-à-vis Danmarks Nationalbank.

Account holders can pledge collateral for credit from Danmarks Nationalbank in the traditional manner, by pledging securities meeting certain criteria. The pledged securities can serve as collateral for all types of credit. In addition, account holders can pledge collateral for intraday credit in kroner and euro via a number of other arrangements.

5.5.1 Traditional pledging of collateral

Traditional pledging of securities may serve as collateral for any type of credit from Danmarks Nationalbank. The securities pledged by the individual account holder are registered in an account, called a safekeeping account, with VP Securities Services (VP). The safekeeping account is pledged to Danmarks Nationalbank. For practical reasons, securities pledged as collateral for intraday credit in euro are registered in a separate account.

Safekeeping accounts are linked to yield accounts with Danmarks Nationalbank in kroner and euro. Incoming interest and repayments per-

¹ If the current account in euro still shows an overdraft after 6.00 p.m., penalty interest is also imposed on the account holder. This penalty increases in the event of recurrence.

² For a review of pledging of collateral in a legal perspective, see Andersen and Gürtler (2003).

taining to the pledged securities are deposited to these accounts. Like the safekeeping accounts, they are pledged to Danmarks Nationalbank and are included in the calculation of the collateral value. Amounts in yield accounts are transferred to current accounts on a daily basis, provided that the individual account holder's credit does not exceed the collateral value of the remaining collateral.

To pledge securities, the account holder transfers them to the safekeeping account via Kronos. Account holders can remove and replace securities in the pledged safekeeping account on an ongoing basis. When pledged securities are removed or replaced, Kronos automatically checks for adequate cover to ensure that the account holder's credit does not exceed the collateral value of the remaining securities in the safekeeping account.

Collateral basis

The collateral basis for pledging to Danmarks Nationalbank comprises the following securities denominated in kroner or euro, registered at VP and listed on the Copenhagen Stock Exchange (CSE):

- Danish government securities, including bonds issued by the Fisheries Bank and the Mortgage Bank of the Kingdom of Denmark.
- Bonds guaranteed by the Kingdom of Denmark.
- Bonds issued by KommuneKredit and Danish Ship Finance.
- Mortgage-credit bonds issued by institutions subject to the Financial Business Act.

Danmarks Nationalbank may reject certain securities within these categories as eligible collateral, e.g. share-indexed bonds. On the other hand, Danmarks Nationalbank may also include other assets in the collateral basis for credit in Danish kroner, subject to specific assessment.¹

Collateral value

The collateral value of the pledged securities is calculated as their official price (all trades) on CSE on the preceding day, less securities-specific valuation haircuts². The haircut is intended to reduce the risk that the total value of the pledged securities falls below the value of the outstanding credit if market prices fall.

The valuation haircut depends on the remaining maturity and liquidity of the asset. The haircuts applied vary from 0.5 per cent to 9 per cent and are determined on the basis of the same principles as applied by the

¹ A full list of eligible securities can be found at www.nationalbanken.dk.

² For securities that have not been traded on CSE within the last five banking days, a theoretical price fixed by Danmarks Nationalbank is applied.

HAIRCUTS ON CALCULATION OF COLLATERAL VALUE

Box 5.2

Danmarks Nationalbank has adopted the same valuation haircuts on calculation of the collateral value of securities as the ECB. The valuation haircut depends on the asset's liquidity and remaining maturity, which is used as an indicator of interest-rate sensitivity.

When fixing Danmarks Nationalbank's valuation haircuts, eligible securities are broken down on the following three liquidity tiers¹:

- Tier 1: Central-government securities, including bonds issued by the Mortgage Bank of the Kingdom of Denmark and the Fisheries Bank.
- Tier 2: Mortgage-credit bonds with an outstanding volume of more than 500 million euro or the equivalent in Danish kroner. The bonds must also be comprised by the Danish Securities Dealers Association's "Price on request" scheme.
- Tier 3: Other mortgage-credit bonds, bonds issued by government-guaranteed entities and bonds issued by Danish Ship Finance.

For securities with fixed coupon rates, valuation haircuts are fixed in accordance with the following Table:

VALUATION HAIRCUTS FOR SECURITIES WITH FIXED COUPON RATES, PER CENT

Remaining maturity	Tier 1	Tier 2	Tier 3
0-1 year	0.5	1.0	1.5
1-3 years	1.5	2.5	3.0
3-5 years	2.5	3.5	4.5
5-7 years	3.0	4.5	5.5
7-10 years	4.0	5.5	6.5
> 10 years	5.5	7.5	9.0

For eligible securities with no coupon rates or with variable coupon rates, Danmarks Nationalbank's valuation haircuts can be found in ECB (2005a). The same applies to eligible securities issued by KommuneKredit.

¹ The ECB also operates with a fourth liquidity tier, asset-backed bonds. However, Danmarks Nationalbank does not extend credit against securities in this tier, however.

ECB.¹ Box 5.2 provides an overview of Danmarks Nationalbank's valuation haircuts on calculation of the collateral value.

If euro-denominated securities are pledged as collateral for credit in Danish kroner, a currency haircut is also deducted. The same applies if krone-denominated securities are pledged as collateral for credit in euro.

5.5.2 Other collateral for intraday credit in kroner

For intraday credit in kroner, account holders have a number of alternative options to traditional pledging of securities.

¹ The rules for the ECB's calculation of the collateral value of securities for monetary-policy loans and intraday credit in the Eurosystem are described in ECB (2005a). Danmarks Nationalbank must apply these rules to intraday credit in euro and has chosen to apply the same rules for credit in kroner.

AUTOMATIC COLLATERALISATION

Box 5.3

Automatic collateralisation relates to collateral for intraday credit in Danish kroner. Under the automatic collateralisation arrangement, account holders pledge collateral in the form of securities in one or more appointed safekeeping accounts at VP, typically their trading accounts. Automatic collateralisation can be used for settlement of payments in the Sumclearing, VP settlement for securities transactions and periodic payments, and CLS.¹

In many ways, automatic collateralisation is a more flexible credit arrangement than traditional pledging of collateral. Firstly, unlike traditional pledging of collateral, automatic collateralisation does not bind specific assets in the safekeeping account. Under the automatic collateralisation arrangement, part of the value of the account holder's securities – corresponding to the credit extended – is pledged to Danmarks Nationalbank. The account holder is free to dispose of the securities in the safekeeping account, provided that the total value of the account exceeds the total credit under the automatic collateralisation arrangement.

Another feature of automatic collateralisation is that securities purchased can be used as collateral for intraday credit in the settlement cycle in which they are received. Traditionally, securities cannot be used as collateral for intraday credit until later settlement cycles. Owing to this facility, automatic collateralisation binds fewer securities on settlement of securities transactions than traditional pledging of collateral.

An account holder wishing to make use of automatic collateralisation must conclude an automatic collateralisation agreement with Danmarks Nationalbank and open an automatic collateralisation account in Danish kroner. Credit extended under the automatic collateralisation arrangement is debited to the automatic collateralisation account, while reductions are credited to the account. The balance of the automatic collateralisation account thus reflects Danmarks Nationalbank's collateral in the account holder's assets.

VP administers the collateral in the safekeeping accounts on behalf of Danmarks Nationalbank. Danmarks Nationalbank notifies VP of the securities that can be pledged under the automatic collateralisation arrangement. In principle, the same securities are accepted as for traditional pledging of collateral.

Credit under the automatic collateralisation arrangement must now be repaid by 1.30 p.m. on the same monetary-policy day. Any outstanding loan at 1.30 p.m. will automatically be sought to be covered by transferring an amount from the account holder's current account to the automatic collateralisation account. If there are insufficient funds in the current account, Danmarks Nationalbank requests VP to transfer securities with a total collateral value matching the value of the outstanding credit from the account holder's automatic collateralisation account to an account held by Danmarks Nationalbank.

The credit procedures for automatic collateralisation vary with its use. In connection with settlement of securities transactions in VP, the proceeds of the loan are used directly in the settlement process. On settlement of payments in the Sumclearing, VP settlement for periodic payments and CLS, the proceeds are first credited to the borrowers' settlement accounts at Danmarks Nationalbank and then used as required. The different procedures in connection with the various uses are elaborated on in section 5.6.

¹ The option to use automatic collateralisation on settlement of securities transactions in VP was introduced in July 1998. After a statutory amendment, which enables the use of automatic collateralisation in designated payment systems and payment systems operated by Danmarks Nationalbank, the scope was extended in November 2002 to include the Sumclearing and VP settlement of periodic payments. Since September 2003, when the Danish krone joined CLS, automatic collateralisation has also been used for settlement of payments in CLS.

Certificates of deposit

Account holders' certificates of deposit are automatically included in the calculation of the total collateral value for intraday credit in kroner. Since certificates of deposit can only be traded among monetary-policy counterparties, only banks and mortgage-credit institutes can in practice own certificates of deposit, cf. Box 5.1.

Automatic collateralisation

Under the automatic collateralisation arrangement, account holders may pledge collateral for intraday credit in kroner for settlement of payments in the Sumclearing, VP settlement for securities transactions and periodic payments (interest, repayments and dividend) and CLS. In many ways, automatic collateralisation is a more flexible credit arrangement than traditional pledging of collateral, and in practice it is widely used by account holders. Box 5.3 outlines the automatic collateralisation arrangement.

Scandinavian Cash Pool

Account holders can also pledge collateral for intraday credit in kroner via the Scandinavian Cash Pool (SCP). SCP is an automated system for pledging of cross-border collateral between Denmark, Norway and Sweden. The main principle of SCP is that liquidity raised in the central bank of one country can be pledged as collateral for credit from the central bank of another country. SCP is elaborated on in Box 5.4.

Maximum for intraday credit and disposable amount

The traditional krone-denominated collateral pledged by account holders is primarily used to cover any monetary-policy loans and loans for decentralised banknote holdings. The remaining collateral value is included in the calculation of the account holders' potential intraday credits.

An account holder's maximum intraday credit in kroner can thus be calculated residually as:

- Collateral value of traditionally pledged securities
- + yield-account deposits
- = total collateral value of the collateral pledged
- monetary-policy loans
- loans for decentralised banknote holdings
- = Excess collateral
- + collateral value of certificates of deposit
- = Maximum intraday credit in Danish kroner.

Scandinavian Cash Pool (SCP) is an automated system for pledging of cross-border collateral for intraday credit in Danish and Norwegian kroner and Swedish kronor.¹ The system was established in the spring of 2003 and is available to credit institutions in Denmark, Norway and Sweden with activities in several Scandinavian countries. The core principle of SCP is that liquidity raised from the central bank of one country can be pledged as collateral for intraday credit from the central bank of another country.

Via SCP, a credit institution (the principal enterprise) can pledge collateral by transferring an amount deposited at its national central bank to an account pledged to the central bank of the other country. For instance, a credit institution in Sweden may pledge collateral for credit from Danmarks Nationalbank by transferring an amount deposited at Sveriges Riksbank to an account pledged to Danmarks Nationalbank. Sveriges Riksbank then automatically notifies Danmarks Nationalbank of the amount pledged, and on this basis Danmarks Nationalbank extends credit to the Swedish credit institution's subsidiary or branch in Denmark.

A subsidiary or branch may also pledge cross-border collateral for credit to the principal enterprise. For instance, the Swedish credit institution's branch or subsidiary in Denmark may transfer an amount from its current account at Danmarks Nationalbank to an account pledged to Sveriges Riksbank. Danmarks Nationalbank automatically notifies Sveriges Riksbank of the amount pledged, and Sveriges Riksbank extends credit to the principal enterprise in Sweden.

Under SCP, the Scandinavian central banks extend credit in other currencies than the currency of the collateral. To avoid losses on the credit extended as a result of exchange-rate fluctuations, the central banks deduct an exchange-rate haircut when calculating the collateral value. Danmarks Nationalbank currently operates with a 5-per-cent haircut in relation to both Swedish kronor and Norwegian kroner.

An account holder wishing to obtain intraday credit in Danish kroner from Danmarks Nationalbank via SCP, must open an SCP loan account at Danmarks Nationalbank. The account holder's credit under SCP is registered in this account. At the same time, an amount equivalent to the registered credit is transferred to the account holder's current account. If the account holder wishes to obtain intraday credit from Norges Bank or Sveriges Riksbank on the basis of liquidity raised from Danmarks Nationalbank, the account holder must also open an SCP pledged collateral account at Danmarks Nationalbank.

Credit under SCP must be repaid by 2.00 p.m. on the same monetary-policy day. Any outstanding loan at 2.00 p.m. will automatically be sought to be covered by transferring an amount from the account holder's current account to the SCP loan account. If the balance of the SCP loan account remains negative at 3.30 p.m., Danmarks Nationalbank will seek to enforce the assets pledged at Sveriges Riksbank or Norges Bank.

An important motif for the establishment of SCP was to facilitate Scandinavian CLS participants' access to intraday liquidity in the Scandinavian currencies. The introduction of CLS has led to increasing requirements for participants to be able to raise liquidity at short notice, cf. Chapter 8. SCP has also made it possible for credit institutions operating in several Scandinavian countries to centralise liquidity management and pledging of collateral in one of the countries. SCP is primarily used by Danish banks pledging collateral at Danmarks Nationalbank for loans to subsidiaries or branches in Norway and Sweden.

¹ In addition to SCP, agreements also exist concerning a manual arrangement, whereby Danish branches of Norwegian and Swedish credit institutions can obtain credit in Danish kroner from Danmarks Nationalbank on the basis of Swedish and Norwegian government securities pledged to Danmarks Nationalbank. This arrangement, which is mutual, is only used to a very limited extent, however.

The account holder's disposable amount in Danish kroner, i.e. the amount the account holder can withdraw from the current account in Danish kroner, can then be calculated as:

Maximum intraday credit in Danish kroner

+ current-account balance in Danish kroner

= disposable amount in Danish kroner.

THE CORRESPONDENT CENTRAL BANKING MODEL

Box 5.5

Like Danmarks Nationalbank, the Eurosystem, i.e. the ECB and the euro area central banks, only extends credit against collateral. To facilitate pledging of collateral, the Eurosystem has developed the correspondent central banking model, CCBM, for cross-border pledging of collateral.

Under CCBM, an account holder in the euro area can obtain credit in euro from its central bank against securities placed in an account with the central bank of another euro area member state as collateral. The central bank of the other member state acts as the correspondent bank. The Chart below illustrates the CCBM flow.

CCBM is also available for account holders at central banks in non-euro-area member states. Consequently, Danmarks Nationalbank's account holders can pledge collateral for intraday credit in euro in the form of securities held in an account in the euro area. In practice, CCBM is only used to a very limited extent in Denmark.¹

Another option for pledging cross-border collateral in the Eurosystem is to transfer the eligible securities via links between the central securities depositories. This requires that the links comply with a number of standards laid down by the Eurosystem (see EMI (1998)). At the end of 2004, the Eurosystem had approved 59 links.

In January 2005, the ECB decided that securities pledged as collateral for credit in the Eurosystem can also be transferred between two central securities depositories via a third central securities depository, i.e. relayed links. Like the direct links, such links must comply with a number of standards and be approved by the Eurosystem.

The decision to allow relayed links has improved the prospects of Danish euro-denominated bonds becoming eligible in the Eurosystem. The ECB already recognises these bonds as eligible, but it is a requirement that they are immediately accessible to all account holders in the Eurosystem. This requirement will be met if central securities depositories in all euro area member states establish links to the international central securities depository, Euroclear (relayed link), which already has a link to VP Securities Services.

CCBM FLOW

The diagram illustrates the CCBM flow between Country A and Country B. In Country A, there is a 'Central bank A' and an 'Account holder A'. In Country B, there is a 'Central bank B', a 'Central securities depository B', and a 'Custodian bank B'. The flow is as follows: 1. 'Request for credit' from Account holder A to Central bank A. 2. 'Instructions to transfer of collateral' from Account holder A to Custodian bank B. 3. 'Notification of transfer of collateral' from Central securities depository B to Central bank B. 4. 'Confirmation of receipt of collateral' from Central bank B to Central bank A. 5. 'Extension of credit' from Central bank A to Account holder A. Additionally, there is a '2. Preadvice of receipt of collateral' arrow from Central bank A to Central bank B.

¹ Via CCBM it was previously possible to pledge certain Danish bonds as collateral for intraday credit in euro from five euro area central banks (out-collateral). This arrangement ceased on 1 July 2003.

5.5.3 Collateral for intraday credit in euro

As stated above, account holders can pledge collateral for intraday credit in euro from Danmarks Nationalbank as traditionally pledged securities in a special account. The accounts are linked to separate yield accounts at Danmarks Nationalbank in kroner and euro, respectively.

In addition, collateral for intraday credit in euro from Danmarks Nationalbank may in theory be pledged via the Eurosystem's correspondent central banking model (CCBM). This model is used to obtain credit in euro against securities localised in the euro area as collateral, cf. Box 5.5. In practice this model is only used to a limited extent in Denmark.

An account holder's potential intraday credit in euro can thus be calculated as:

Collateral value of traditionally pledged securities
+ collateral value of CCBM assets
+ yield-account deposits
= Calculated maximum intraday credit in euro

However, an account holder's intraday credit in euro cannot exceed the allocated individual limit, cf. section 5.4.

The account holder's disposable amount in euro can thereafter be calculated as:

Maximum intraday credit in euro (the lower amount of calculated maximum intraday credit in euro and the limit for intraday credit)
+ current-account balances in euro
= Disposable amount in euro.

5.6 SETTLEMENT PROCEDURE AT DANMARKS NATIONALBANK

Danmarks Nationalbank acts as settlement bank for the Sumclearing, VP settlement and CLS¹. This means that settlement of the cash leg of transactions in these system takes place via accounts at Danmarks Nationalbank. This section describes payment settlement in each of the three systems, while the systems as such are described in more detail in Chapter 6 (Sumclearing and VP settlement) and Chapter 8 (CLS).

5.6.1 The Sumclearing and VP settlement

The Sumclearing and VP settlement are net settlement systems. Settlement of payments in the two systems takes place in a number of fixed

¹ Danmarks Nationalbank is also settlement bank for the Danish FUTOP Clearing Centre. Settlement of FUTOP payments takes place directly via the account holders' current accounts at Danmarks Nationalbank. FUTOP is described in Chapter 6.

SETTLEMENT CYCLES IN THE SUMCLEARING AND VP SETTLEMENT

Box 5.6

The Table provides a full overview of the settlement cycles in the Sumclearing and VP settlement, stating the settlement time and deadline for transfers to settlement accounts. Between 4.00 and 4.30 p.m. account holders can transfer liquidity to settlement accounts for settlement cycles VP10 and SUM1. It is not possible subsequently to transfer funds to settlement accounts for VP20, VP30, SUM2 and SUM3, which are placed outside Kronos' opening hours. Consequently, the settlement-account balances prior to these cycles are equivalent to the balances before VP10 and SUM1 adjusted for the account holders' booked net positions in those two cycles.¹

SETTLEMENT OVERVIEW

Settlement cycle	Currency	Transfer to settlement accounts	Time of settlement
VP05, periodic payments	DKK	16.15	16.45
VP10, securities transactions	DKK	16.30	18.00
VP20, securities transactions	DKK	Not applicable	23.45
SUM1, 1st normal settlement	DKK	16.30	01.30
SUM2, 2nd normal settlement	DKK	Not applicable	03.00
VP30, securities transactions	DKK	Not applicable	06.00
SUM3, 1st extra settlement	DKK	Not applicable	06.00
SUM4, 2nd extra settlement	DKK	08.45	08.55
VP35, periodic payments	DKK	08.45	09.15
VP33, Payment versus Payment	DKK/EUR	08.50	09.20
SUM-EUR1, 1st normal settlement	EUR	09.35	10.00
VP40, securities transactions	DKK	09.45	10.15
SUM-EUR2, 1st extra settlement	EUR	11.50	12.00
VP60, securities transactions	DKK	11.35	12.00
VP45, periodic payments	EUR	11.35	12.05
VP65, periodic payments	ISK	12.30	12.45
VP50, securities transactions	EUR	13.05	13.35
VP55, periodic payments	SEK	13.35	14.15
SUM-EUR3, 2nd extra settlement	EUR	14.05	14.30

¹ Before SUM1, the settlement-account balance for the Sumclearing also includes any assets reserved under the automatic collateralisation arrangement, cf. the description of the settlement procedure in section 5.6.1.

settlement cycles within each 24-hour period. Settlement cycles are run for both kroner and euro, and in VP settlement for both securities transactions and periodic payments¹. Box 5.6 provides an overview of all settlement cycles in the two systems.

Account holders hold separate settlement accounts for the various settlement types. In these accounts, amounts can be reserved for each settlement cycle. This means that within a given period of time, lasting until after the settlement cycle has been run, the account holders cannot dispose of the funds in the accounts in question. In this way Danmarks Nationalbank can guarantee the amounts reserved for settlement without incurring any risk.

¹ VP settlement also settles periodic payments in Icelandic kronur and Swedish kronor.

Settlement of payments in Danish kroner

Most of the krone-denominated payments in the two systems are settled in the overnight settlement cycles, which take place between 6.00 p.m. and 6.00 a.m., cf. Box 5.6. These settlement cycles are the primary reason that the monetary-policy day in kroner runs from 4.00 p.m. to 3.30 p.m. the following banking day, since this allows account holders to base overnight settlement on intraday credit in kroner, which can then be covered on the following day.

Account holders can provide liquidity for the settlement cycles in kroner in two ways. Firstly, account holders can transfer funds from their current accounts to their settlement accounts via Kronos. Transfer of liquidity for overnight settlement can take place between 4.00 and 4.30 p.m. Account holders cannot transfer more than amounts equivalent to their disposable amounts in kroner.

Secondly, account holders may provide liquidity for the settlement cycles in kroner via automatic collateralisation, cf. Box 5.3. In the Sumclearing, this is done by reserving a specific amount under the automatic collateralisation arrangement prior to a settlement cycle. The amount is credited to the account holder's settlement account for the Sumclearing and debited to the account holder's automatic collateralisation account at Danmarks Nationalbank.¹

The procedure for automatic collateralisation in connection with VP settlement of securities transactions differs from the Sumclearing procedure. For securities settlement, the account holder's entire automatic collateralisation account is included, i.e. no specific amount is reserved. If liquidity is needed for settlement, the automatic collateralisation arrangement is first utilised to its full extent, and if this proves insufficient any settlement-account deposit is used.

Prior to each settlement cycle, Danmarks Nationalbank notifies the Sumclearing or VP of each individual account holder's settlement-account balance. In the Sumclearing, the settlement-account balance is equivalent to the account holder's line in the settlement cycle. In VP securities settlement the account holder's line also depends on the amount available under the automatic collateralisation arrangement.

The Sumclearing and VP then check that each individual account holder's net payment in the settlement cycle does not exceed its line. If this criterion is met, the Sumclearing and VP inform Danmarks Nationalbank of the account holders' net positions in that cycle. Danmarks Na-

¹ For settlement of periodic payments in the VP settlement, automatic collateralisation is used in the same way as in the Sumclearing.

tionalbank then books the positions to the account holders' settlement accounts and automatic collateralisation accounts, and settlement has been concluded.

When settlement has taken place, the settlement accounts are emptied and the funds transferred to the current accounts. Any unused amounts reserved under the automatic collateralisation arrangement are, however, first used to reduce the credit under this arrangement. Any excess amount in a Sumclearing settlement account is deposited to the account holder's current account.

Box 5.7 illustrates payment settlement in the Sumclearing and VP settlement in kroner using an example, while Charts 5.1 and 5.2 illustrate the settlement procedures in the two systems.

EXAMPLES OF PAYMENT SETTLEMENT IN THE SUMCLEARING AND VP SETTLEMENT	Box 5.7
<p>Payment settlement in the Sumclearing and VP settlement for securities transactions can be illustrated via an example. At the beginning of the monetary-policy day, two banks, A and B, both have current-account deposits of kr. 100 million. Both banks make liquidity available for settlement under the automatic collateralisation arrangement. It is assumed that only one settlement cycle is run in the Sumclearing and VP settlement, respectively.</p> <p>Prior to settlement the two banks make the following dispositions:</p> <ol style="list-style-type: none">1) A reserves kr. 300 million under the automatic collateralisation arrangement for the Sumclearing.2) B reserves kr. 200 million under the automatic collateralisation arrangement for the Sumclearing. <p>The banks' net positions are then calculated in both settlements. It is assumed that A pays kr. 100 million net to the Sumclearing and kr. 400 million to the VP settlement, while B receives the same amounts net. The check for adequate cover is met in the Sumclearing and is also assumed to be met in the VP settlement. Subsequently, both settlements are run with the following entries:</p> <ol style="list-style-type: none">3) A's and B's Sumclearing settlement accounts are, respectively, debited and credited with kr. 100 million.4) In connection with VP settlement, A obtains credit of kr. 400 million under the automatic collateralisation arrangement. An equivalent amount is transferred to B's settlement account for securities transactions. <p>After settlement, A and B's settlement accounts are emptied, resulting in the following entries:</p> <ol style="list-style-type: none">5) A's unused reserved amount under the automatic collateralisation arrangement, kr. 200 million (kr. 300 million less kr. 100 million), is used to reduce the credit under the automatic collateralisation arrangement.	
Continues	

EXAMPLES OF PAYMENT SETTLEMENT IN THE SUMCLEARING AND VP
SETTLEMENT – CONTINUED

Box 5.7

- 6) B's unused reserved amount under the automatic collateralisation arrangement, kr. 200 million (kr. 200 million less kr. 0), is used to reduce the credit under the automatic collateralisation arrangement.
- 7) B's remaining balance on its Sumclearing settlement account, kr. 100 million, is transferred to its current account.
- 8) B's balance on its VP settlement account, kr. 400 million, is transferred to its current account.

When the settlement accounts have been emptied, A's automatic collateralisation account shows an overdraft of kr. 500 million. This overdraft must be covered by 1.30 p.m., which can be achieved as follows:

- 9) A transfers kr. 500 million from its current account to its automatic collateralisation account.

A's current-account balance is then negative by kr. 400 million, which must be found by 3.30 p.m. In the example this can be done by borrowing from B.

ILLUSTRATION OF BOOK ENTRIES

Bank A				Bank B			
Current account		VP settlement account		Current account		VP settlement account	
9) 500	100				100	8) 400	400 4)
					100 7)		
					400 8)		
Sumclearing account		Automatic collateralisation account		Sumclearing account		Automatic collateralisation account	
3) 100	300 1)	1) 300	200 5)	6) 200	200 2)	2) 200	200 6)
5) 200		4) 400	500 9)	7) 100	100 3)		

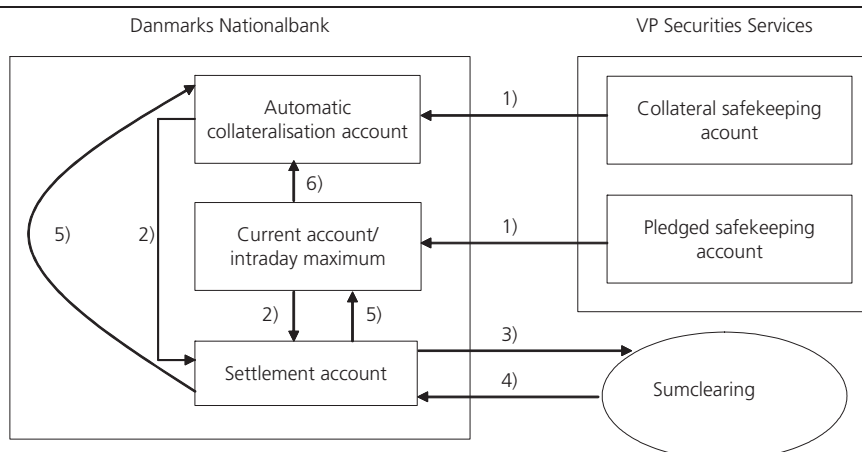
Settlement of payments in euro

Settlement of payments in euro in the Sumclearing and VP settlement takes place in daytime settlement cycles. This is done to facilitate the process, since Danmarks Nationalbank only extends credit in euro during the daytime, cf. section 5.4.

Securities transactions in euro are, however, to a large extent settled in the overnight VP settlement cycles. This is achieved by translating the value of the securities into kroner and settling them as krone-denominated securities. In the morning, when account holders again have access to euro credit, the parties then exchange kroner and euro in a Payment-versus-Payment (PvP) settlement cycle so that the net result is settlement in euro.

SETTLEMENT OF PAYMENTS IN THE SUMCLEARING

Chart 5.1

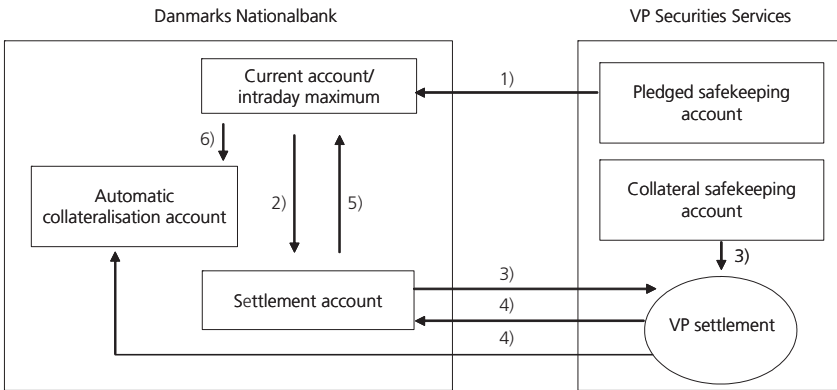


- 1) VP sends information about the safekeeping accounts to Danmarks Nationalbank.
- 2) Each account holder reserves an amount under the automatic collateralisation arrangement, which is debited to the automatic collateralisation account and credited to the Sumclearing settlement account. Each account holder also transfers an amount from its current account to its Sumclearing settlement account.
- 3) Danmarks Nationalbank notifies the Sumclearing of the settlement-account balance of each account holder.
- 4) The Sumclearing checks for adequate cover and sends the net positions to Danmarks Nationalbank. Subsequently the positions are booked to the account holders' Sumclearing settlement accounts.
- 5) After book entry, Danmarks Nationalbank covers any unused reserved amount under the automatic collateralisation arrangement using funds from the account holder's Sumclearing settlement account. Any residual amount is transferred to the current account.
- 6) The account holder covers any outstanding credit under the automatic collateralisation arrangement by transferring an amount from its current account.

For the euro settlement cycles, account holders cannot provide liquidity via the automatic collateralisation arrangement, but only by transferring funds from their current accounts in euro to their settlement accounts in euro. Apart from this difference, the settlement cycles in euro are in principle executed in the same way as the settlement cycles in kroner.

5.6.2 CLS settlement

Unlike the Sumclearing and VP settlement, CLS is a gross settlement system, i.e. transactions are settled on an ongoing basis via accounts with CLS. Netted payments for CLS settlement are transferred to CLS via the participating currencies' RTGS systems. For CLS payments in Danish kroner, participants transfer amounts from their own current accounts or CLS settlement accounts to CLS' current account at Danmarks Nationalbank. If the account holder has a CLS settlement account, payments from CLS' current account must always be made to this account.



- 1) VP sends information about the safekeeping accounts to Danmarks Nationalbank.
- 2) Each account holder transfers an amount from its current account to its VP settlement account.
- 3) For each account holder Danmarks Nationalbank sends information to VP about the balance in the VP settlement account, which, combined with the potential credit under the automatic collateralisation arrangement, constitutes the line in the settlement cycle.
- 4) VP checks for adequate cover and sends the net positions to Danmarks Nationalbank. Subsequently the positions are booked to the account holders' automatic collateralisation accounts, and if there is insufficient cover, to the VP settlement account.
- 5) After book entry, Danmarks Nationalbank transfers any remaining deposit in the VP settlement account to the current account.
- 6) The account holder covers any outstanding credit under the automatic collateralisation arrangement by transferring the funds from its current account.

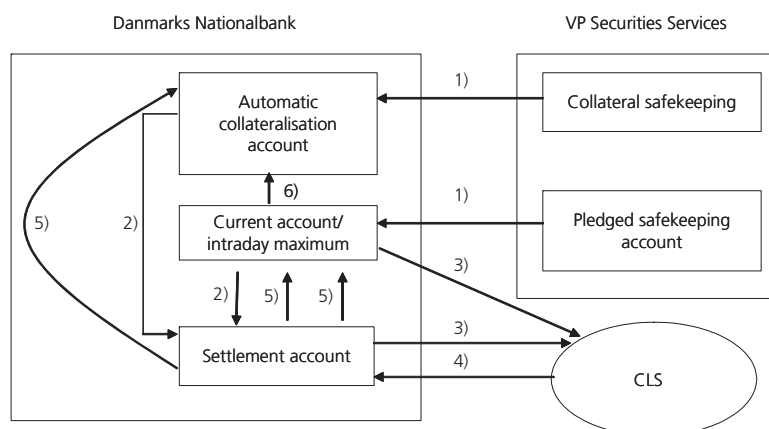
An account holder must have a CLS settlement account in order to obtain credit for CLS settlement under the automatic collateralisation arrangement. As is the case for the Sumclearing, the account holder reserves a specific amount, which is then credited to its CLS settlement account and debited to the automatic collateralisation account.

Any deposit in the CLS settlement account at 1.30 p.m. is used to reduce the credit under the automatic collateralisation arrangement for CLS settlement. Any residual amount after cover of credit under the automatic collateralisation arrangement is transferred to the account holder's current account.

Payment settlement in relation to CLS is illustrated in Chart 5.3.

PAYMENTS TO AND FROM CLS

Chart 5.3



- 1) VP sends information about the safekeeping accounts to Danmarks Nationalbank.
- 2) Each account holder reserves an amount under the automatic collateralisation arrangement. The amount is debited to the automatic collateralisation account and credited to the CLS settlement account. The account holder may also transfer funds from its current account to its CLS settlement account.
- 3) At fixed times, the account holder sends payments to CLS from its CLS settlement account or its current account.
- 4) On an ongoing basis, CLS credits the account holder with payments that are booked to the account holder's CLS settlement account.
- 5) Any positive balance in the account holder's CLS settlement account at 1.30 p.m. is used, in full or in part, to reduce credit under the automatic collateralisation arrangement for CLS. Any remaining deposit in the CLS settlement account is transferred to the current account.
- 6) The account holder covers any outstanding credit under the automatic collateralisation arrangement by transferring funds from its current account.

LITERATURE

Andersen, Niels C. and Kirsten Gürtler, 2003. The Provision of Collateral to Danmarks Nationalbank in a Legal Perspective, Danmarks Nationalbank, *Monetary Review*, 3rd Quarter 2003.

Danmarks Nationalbank, 2001. Financial Institutions' Accounts at and Pledging of Collateral to Danmarks Nationalbank, Danmarks Nationalbank, *Monetary Review*, 4th Quarter 2001.

Danmarks Nationalbank, 2003. *Monetary Policy in Denmark*.

Danmarks Nationalbank, 2003. SCP – Scandinavian Cash Pool, Danmarks Nationalbank, *Monetary Review*, 4th Quarter 2003.

Danmarks Nationalbank, *Documentation Basis for Monetary-Policy Instruments and Settlement of Payments in DKK, EUR, SEK and ISK* (in Danish only).

ECB, 2005a, *The implementation of monetary policy in the euro area – General documentation on Eurosystem monetary policy instruments and procedures*, February 2005.

ECB, 2005b, *Correspondent Central Banking Model (CCBM) – Procedures for Eurosystem counterparties*, May 2005.

EMI, 1998, *Standards for the use of EU Securities Settlement Systems in ESCB credit operations*, January 1998.

6. Payment and Settlement Systems in Denmark

The Danish payments infrastructure comprises a total of five payment and settlement systems that settle different types of transactions:

Kronos, which is owned by Danmarks Nationalbank, is a real-time gross settlement (RTGS) system that is used for real-time settlement of individual, primarily large and time-critical, payments in Danish kroner and euro.

The Sumclearing, which is owned by the Danish Bankers Association, is a multilateral net settlement system that clears and settles retail payments in Danish kroner and euro.

The VP settlement system, which is owned by VP Securities Services, is a multilateral net settlement system that clears and settles securities transactions, etc. in Danish kroner and euro.

FUTOP is owned by the Copenhagen Stock Exchange and is a multilateral net settlement system for settlement of transactions in futures and options that are listed on the Copenhagen Stock Exchange.

CLS, which is owned by large international banks, is an international multilateral clearing and settlement system for foreign-exchange transactions in 15 currencies at present, including Danish kroner.

Table 6.1 presents an overview of the volume of transactions in Danish kroner in the individual systems. The number of payments in the Sum-

KRONE PAYMENTS	Table 6.1	
	2003	2004
<i>Kronos</i>		
Number of transactions, '000	641	647
Value of transactions, kr. billion	56,665	58,418
Average transaction value, kr. million	88.4	90.3
<i>Sumclearing</i>		
Number of transactions, '000	986,537	1,088,813
Value of transactions, kr. billion	4,242	4,421
Average transaction value, kr. '000	4.3	4.1
<i>VP settlement</i>		
Number of trading transactions, '000	6,215	7,348
Value of trading transactions, kr. billion	26,327	27,951
Average trading transaction value, kr. million	4.2	3.8
<i>FUTOP settlement</i>		
Number of contracts, '000	769	704

Source: Danish Bankers Association, VP Securities Services, Copenhagen Stock Exchange and own calculations.

EURO PAYMENTS		Table 6.2
	2003	2004
<i>Kronos</i>		
Number of transactions, '000	103	84
Value of transactions, billion euro	3,208	3,250
Average transaction value, million euro	31.3	38.8
<i>Sumclearing</i>		
Number of transactions, '000	92	148
Value of transactions, billion euro	1.4	2.0
Average transaction value, '000 euro	15.2	13.5
<i>VP settlement</i>		
Number of trading transactions, '000	3.6	10.7
Value of trading transactions, billion euro	16.5	19.9
Average trading transaction value, million euro	4.6	1.9

Source: ECB, Danish Bankers Association, VP Securities Services and own calculations.

clearing is significantly higher than in Kronos, but the total transaction value is considerably lower.

Table 6.2 provides an equivalent overview of the volume of transactions in euro in the relevant systems. The number of euro payments in the Sumclearing is increasing rapidly, but did not exceed the number of euro payments in Kronos until 2004. As is the case for Danish kroner, the total value of the euro payments is, however, substantially lower in the Sumclearing than in Kronos.

For all systems, the volume of euro transactions is considerably below the level for Danish kroner. On the other hand, the average transaction value is substantially higher.

This chapter presents a detailed review of the aforementioned payment and settlement systems,¹ while CLS is described in Chapter 8.

6.1 KRONOS

Kronos is Danmarks Nationalbank's RTGS system for Danish kroner and euro and is thus a core element of Danish payment systems. Kronos was commissioned on 19 November 2001². It is primarily used for large, time-critical payments between Danmarks Nationalbank's account holders, either as customer or interbank payments.³ The system includes a number of facilities for participants to manage their own use of the system,

¹ Chapter 10 describes the compliance by Kronos, the Sumclearing and VP settlement with international standards for systemically important payment and settlement systems.

² Prior to that krone payments were settled via another RTGS system: the DN Inquiry and Transfer System. Euro payments were settled via DEBES, which was implemented on 1 January 1999, when the central banks of the EU member states, including Danmarks Nationalbank, introduced the Target payment system, cf. Angelius et al. (1998). Target is described in Chapter 8.

³ Kronos does not operate with upper or lower limits for the size of an individual transaction.

cf. below. In principle, the functionality of Kronos is identical for krone and euro payments.

Kronos is open for krone payments on all Danish banking days between 7.00 a.m. and 3.30 p.m. In addition, it is open between 4.00 and 4.30 p.m. for transfers from current accounts to settlement accounts for the overnight Sumclearing and VP settlements, cf. sections 6.2 and 6.3. For euro payments, Kronos observes the opening days for euro laid down by the ECB, on which days the system is open between 7.00 a.m. and 6.00 p.m.

6.1.1 Kronos participants

All holders of current accounts at Danmarks Nationalbank must participate in Kronos. The types of financial institutions that can hold a current account are described in Chapter 5. Account holders with current accounts in euro must also subscribe to the Target module in Kronos, cf. below.

Kronos participants must be connected to a data processing centre, cf. Box 6.1. If they wish to use the Target module, they must also be connected to the international financial network, SWIFT, cf. Box 6.2. SWIFT is not a requirement for participants wishing to remit and receive payments in Danish kroner in Kronos.

Kronos allows a participant that does not itself wish to use the system on a daily basis to authorise another participant to execute payments, etc. in Kronos. This option is typically preferred by small participants with very few payments.

At the end of 2004, Kronos had 124 participants in Danish kroner, of which 30 also participate in euro. Kronos' 124 participants comprise 106 banks, 4 mortgage-credit institutes, 4 investment firms and 10 other participants¹.

6.1.2 The structure of Kronos

Kronos offers participants a choice of two different networks for remitting payments. They can remit manually via the Kronos terminal, which uses its own closed network², or via the SWIFT network.

By offering two options for remitting payments, Kronos meets the requirements of different types of participants. The Kronos terminal is typically used by small participants, while the large participants prefer SWIFT.

¹ Other participants can be e.g. settlement systems or branches of foreign banks.

² An Internet Protocol (IP) based network.

THE BANKS' DATA PROCESSING CENTRES

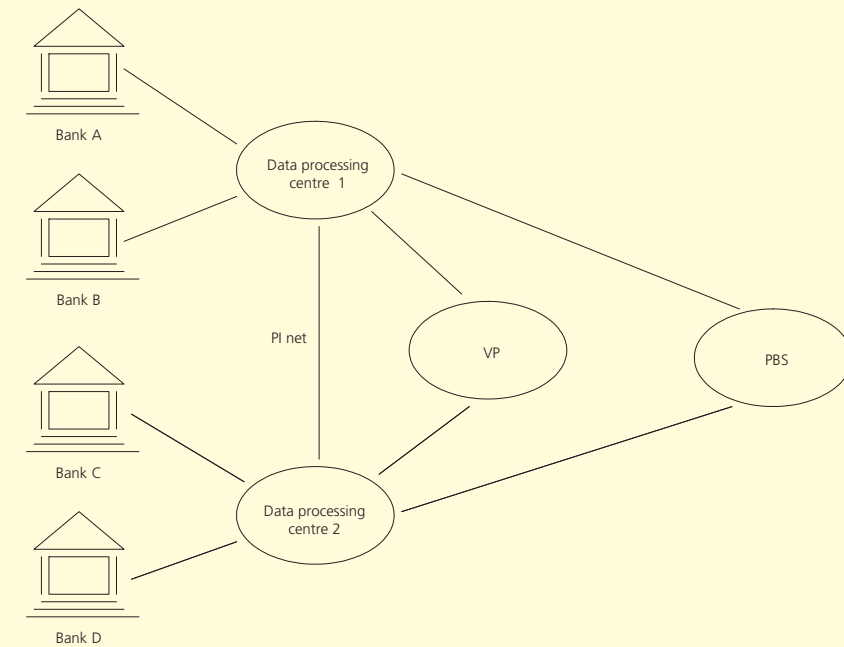
Box 6.1

The data processing centres are responsible for the IT aspects of operating the banks' business and bookkeeping systems. For instance, the individual banks' web bank systems are operated by data processing centres, which also credit and debit customer accounts.

Only the largest Danish banks have their own data processing centres. Most medium-sized and small banks share data processing centres with other banks, cf. the Chart. Consequently, there is a customer relationship between the individual bank and its data processing centre.

The data processing centres handle the technical side of connection to the banks and their branches. Communication between data processing centres takes place via the banks' data network, the PI net, which is, *inter alia*, used for exchange of retail payment data. The data processing centres also have data connections to VP Securities Services and PBS.

THE TECHNICAL INFRASTRUCTURE



Kronos comprises several modules that can be selected as required. All participants must have a basic module that gives access to remit payments in kroner. Participants using SWIFT can also opt for the Poseidon module, which supports fully automated payment processing, cf. below. Finally, participants using SWIFT can select the Target module, which enables them to remit and receive domestic and cross-border euro payments in Target, cf. Chapter 8. Chart 6.1 illustrates the modular structure of Kronos and the interaction between the various networks.

SWIFT	Box 6.2
<p>The Society for Worldwide Interbank Financial Telecommunication, SWIFT, is an international financial network that is used by financial institutions, payment and settlement systems, stock exchanges, etc. worldwide for remitting and receiving a wide range of financial message types, including payment instructions.</p> <p>SWIFT offers a standardised messaging format that supports a high degree of automation in the processing of payments. SWIFT thereby enables fully automated processing of payments, known as Straight-Through Processing (STP). In addition, SWIFT is characterised by speedy processing of messages and a high degree of operational security.</p> <p>SWIFT is owned by its members. There are almost 7,700 users in 202 countries. The daily volume of traffic via SWIFT exceeds 9 million messages.</p> <p>Kronos offers the option to remit payments via SWIFT. This is done via a special SWIFT service, called FIN Copy, which copies payment messages and forwards certain data to Kronos. After validation, check for adequate cover and booking of the payment, Kronos sends confirmation to FIN Copy, which forwards the complete payment message to the recipient.</p> <p>Kronos supports the following SWIFT payment and service messages: MT103 (Single Customer Credit Transfer), MT202 (General Financial Institution Transfer), MT205 (Financial Institution Transfer Execution), MT900 (Confirmation of Debit), MT910 (Confirmation of Credit), MT920 (Request for Message Types MT941 and MT942), MT941 (Balance Report), MT942 (Interim Transaction Report), MT950 (Statement Message), MT298sub251 (Open/Close Message), MT298sub999 (Positive/Negative Status Message) and MT019 (Abort Notification).</p>	

Source: SWIFT and Danmarks Nationalbank (2001).

The Kronos terminal offers participants a wide range of functions, including the option to transfer liquidity to settlement accounts (manually or as standing orders), view entries, follow settlement cycles and monitor and manage large queued payments. In addition, participants may use the Kronos terminal to receive news, view historical entries and administer the use of collateral, including automatic collateralisation and the Scandinavian Cash Pool, cf. Chapter 5.

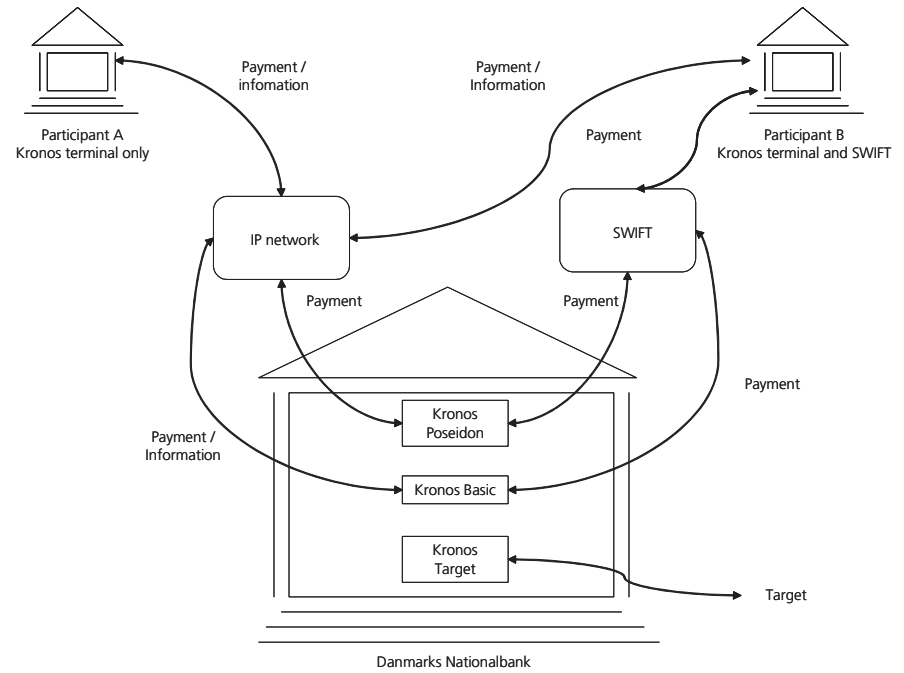
Fully automated payment processing

Participants using SWIFT typically have their own automated systems for remitting and receiving payments to and from other participants via SWIFT. The systems are designed to facilitate Straight-Through Processing (STP), i.e. processing of payments without manual intervention, whenever possible.

Participants with SWIFT typically use SWIFT for as many payments as possible, while participants without SWIFT remit all their payments via the Kronos terminal. To ensure that participants with and without SWIFT can remit payments to each other, Kronos includes the Poseidon mod-

STRUCTURE OF KRONOS

Chart 6.1



Note: Participant A does not have SWIFT and only subscribes to the basic Kronos module. Participant B has SWIFT and subscribes to all Kronos modules.

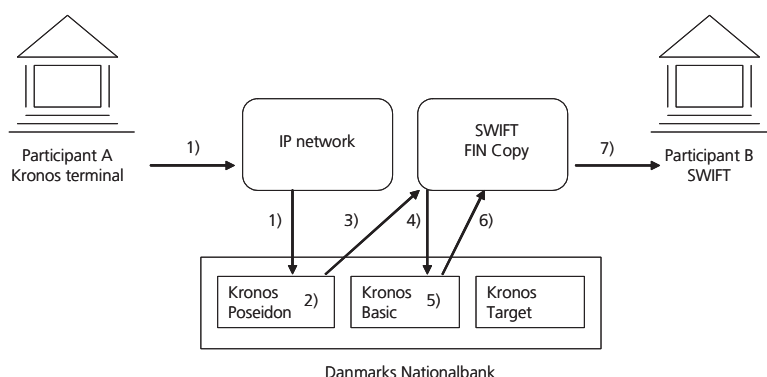
ule, which "translates" payment messages between the Kronos terminal and SWIFT. This allows participants with SWIFT to remit and receive all payments via SWIFT, irrespective of whether the other party uses SWIFT or the Kronos terminal only.

Poseidon can be used for payments in kroner only. Of the 124 Kronos participants, 26 currently use the Poseidon module. Chart 6.2 shows an example of payment settlement via the Kronos terminal, where the payment is translated into a SWIFT transaction before being forwarded to the recipient.

6.1.3 Liquidity management in Kronos

As described in Chapter 5, account holders at Danmarks Nationalbank may not exceed their overdraft access at Danmarks Nationalbank when settling payments. Consequently, Kronos offers participants two key queuing facilities, a liquidity queue and a value date queue, to support their liquidity management.

Appendix C shows the results of a number of simulations of the impact of the Kronos queuing facilities on the participants' liquidity requirements.



- 1) Participant A sends a payment message to Kronos (Poseidon) from the Kronos terminal via the IP network.
- 2) Kronos (Poseidon) validates the payment message.
- 3) Kronos (Poseidon) translates the payment message into a SWIFT message, which is sent to FIN Copy.
- 4) FIN Copy copies parts of the payment message, which are sent to Kronos.
- 5) Kronos validates the SWIFT message, checks for adequate cover and books the payment.
- 6) Kronos sends confirmation that the payment has been booked to FIN Copy.
- 7) FIN Copy sends a SWIFT message to participant B.

Liquidity queue

Each participant has a liquidity queue where payments are placed until adequate funds are available in the current account. Kronos seeks to settle payments in the order in which they are received, i.e. the FIFO principle, cf. Chapter 3, Box 3.1. If there is insufficient cover for the first payment, the subsequent payments in the queue will not be settled either. However, participants may opt for a bypass function, whereby it is nevertheless sought to settle the subsequent payments. Moreover, participants may use the Kronos terminal to change the order of payments in the liquidity queue or to cancel queued payments.

Payments in the liquidity queue are released for settlement if the disposable amount changes so that the individual payments are covered. In addition, a change in the order for or a cancellation of payments may enable settlement of queued payments.

Kronos has an optimisation procedure for ongoing check of liquidity queues for gridlocks, i.e. situations where several participants' payments are mutually awaiting each other's settlement, cf. Chapter 3, Box 3.2. This procedure dissolves gridlocks by settling a group of payments simultaneously, provided that no participants' accounts are then overdrawn.

The mathematical formula for the optimisation procedure in Kronos is shown in Appendix A.

Value date queue

Kronos allows participants with SWIFT to remit payments for settlement on a future value date up to 14 banking days before the value date. Forward-validated payments are placed in the individual participant's value date queue, where a participant can view its own outgoing payments. In addition, participants may cancel payments in the value date queue.

Other liquidity management facilities

Kronos enables participants to place standing orders so that a fixed amount is transferred automatically from the participant's current account to a given settlement account. Transfers take place at fixed times immediately prior to the settlement cycles in the Sumclearing and VP. In addition, participants have online access to information on the status of payment settlement and the individual settlement cycles.

6.1.4 Risk management in Kronos

Chapter 4 describes the various risks in an RTGS system. The following is a review of the elements in Kronos that are designed to minimise these risks.

Credit risk

As a main rule, payments in Kronos are settled immediately after they have been sent to and accepted by the system. This means that Kronos participants do not incur any credit risk on other participants during settlement of a payment transaction.¹ Since settlement takes place via accounts at Danmarks Nationalbank, participants do not incur any credit risk on the settlement bank either.

Kronos does not allow participants to view incoming payments in the liquidity and value date queues. Therefore a participant cannot credit an incoming payment to a customer before it has been finally settled. Consequently, the participant does not incur a credit risk on the participant remitting the payment.

Liquidity risk

Individual settlement of payments in RTGS systems such as Kronos involves a high liquidity requirement and thus a certain liquidity risk. Ac-

¹ An exception applies to payments in the value date queue, where the recipient incurs a credit risk on the remitter until payment has been settled.

cess to intraday credit at Danmarks Nationalbank helps to reduce this risk. The same applies to Kronos' queuing functions, which reduce the risk that payments are not effected on the agreed settlement date.

Operational risk

Technical day-to-day operation of Kronos is handled by an external data processing centre, Bankernes EDB Central (BEC). Danmarks Nationalbank and BEC have jointly drawn up an IT security policy for Kronos, to ensure that Kronos has a high level of security and meets the ESCB's requirements for RTGS systems participating in Target. An important requirement for such systems is that they have two-centre operation. Kronos' two operating centres are placed several kilometres apart.

6.1.5 Kronos pricing structure

Kronos is user-financed in accordance with international practice¹. The pricing structure comprises three components:

- A connection fee to cover development costs.
- A monthly fee to cover fixed operating costs, broken down on the Basic, Poseidon and Target modules.
- A variable monthly consumption charge to cover the individual participants' actual use of the system.

The connection fee and the fixed monthly fee are distributed among the participants in the individual modules in accordance with a distribution key based on working capital² as an expression of the system's expected utility to participants. A similar distribution key is used by PBS for distribution of infrastructure costs.

For mortgage-credit institutes, branches of foreign banks and others that do not calculate their working capital, an estimated value is applied, based on the participants' use of their current accounts. In practice, participants with no working capital are assigned a value corresponding to a participating bank with an equivalent volume of transactions.

To promote the use of Kronos, quantity discounts are given for domestic payments. The maximum charge for a payment transaction is kr. 1.00, while the minimum charge is kr. 0.10. Quantity discounts are also given for cross-border payments in euro, where the prices are fixed by the ECB. This means that the prices for cross-border payments are identical for all Target participants.

¹ Current prices for use of Kronos are available at www.nationalbanken.dk.

² Working capital comprises deposits, issued bonds, subordinated capital contributions and equity capital. Working capital is calculated by the Danish Financial Supervisory Authority.

6.2 THE SUMCLEARING

The Sumclearing is the Danish system for clearing and settlement of retail payments. Originally the Sumclearing was a system for manual cheque clearing, but today virtually all retail payments, e.g. Dankort (debit card) transactions and Betalingsservice (direct debit) transfers, are cleared in this system. Since the early 1980s, the Sumclearing has been fully automated. In May 1999, the Sumclearing was expanded to include a separate clearing and settlement procedure in euro.

The Sumclearing is owned by the Danish Bankers Association, an industry association for banks in Denmark. Members include banks, savings banks, cooperative banks and Danish branches of foreign banks. The tasks of the Danish Bankers Association in relation to payment systems include coordinating the banks' positions in the work to further develop the existing payments infrastructure and the set of agreements on which the payments infrastructure is based, including the Sumclearing.

PBS (Payment Business Services) operates the Sumclearing on behalf of the Danish Bankers Association. PBS is owned by Danish banks and Danmarks Nationalbank¹. The objective of PBS is, *inter alia*, to operate payment systems and to support the development and use of the banks' payments infrastructure.

6.2.1 Sumclearing participants

The Sumclearing has a dual participant structure with both direct and indirect participation. Direct participation among other things requires a current account and a settlement account at Danmarks Nationalbank in kroner and possibly also in euro. Indirect participants settle their payments via settlement accounts held by direct participants. At end-February 2005 the Sumclearing in kroner had 63 direct and 107 indirect participants.

The basis of agreement for the Sumclearing consists of agreements between the Danish Bankers Association and Danmarks Nationalbank concerning the latter's settlement facilities, as well as bilateral connection agreements between the direct participants and the Danish Bankers Association, cf. Chapter 9. In addition, the Danish Bankers Association (system owner) has concluded an agreement with PBS (system operator) on delivery of IT services and other services.

¹ In connection with the merger of Danske Bank and RealDanmark in 2001 Danske Bank gave a number of undertakings to the Danish Competition Authority, among them that Danske Bank would reduce its shareholding in PBS. Against that background, Danmarks Nationalbank acquired 17.7 per cent of the shares in PBS Holding A/S from Danske Bank as of 30 June 2003.

RETAIL PAYMENTS IN THE SUMCLEARING

Box 6.3

The Sumclearing is based on the results of two underlying clearings: electronic clearing and truncation and PBS clearing. Each of these subclearings comprises different types of retail payments, of which the most important are:

Electronic clearing and truncation

- Cheques
- Credit transfers
- Giro inpayment forms
- Joint inpayment forms
- Dankort cash withdrawals
- Dankort transactions via paper slips

PBS clearing

- Transactions via Betalingsservice (direct debit), Leverandørservice (supplier service) and Overførselsservice (transfer service), etc.
- EFTPOS Dankort transactions
- Visa/Dankort transactions abroad
- Payments by international debit cards (Visa Electron and Maestro)
- Dankort transactions in connection with Internet purchases

6.2.2 Clearing and settlement procedure in the Sumclearing

The Sumclearing is a multilateral net settlement system, cf. Chapter 3, which calculates the participants' net positions at fixed times during a 24-hour period. Positions are calculated on the basis of two subclearings: electronic clearing and truncation, and PBS clearing. Box 6.3 outlines the most significant types of retail payments included in each of these clearing cycles.¹

Electronic clearing and truncation

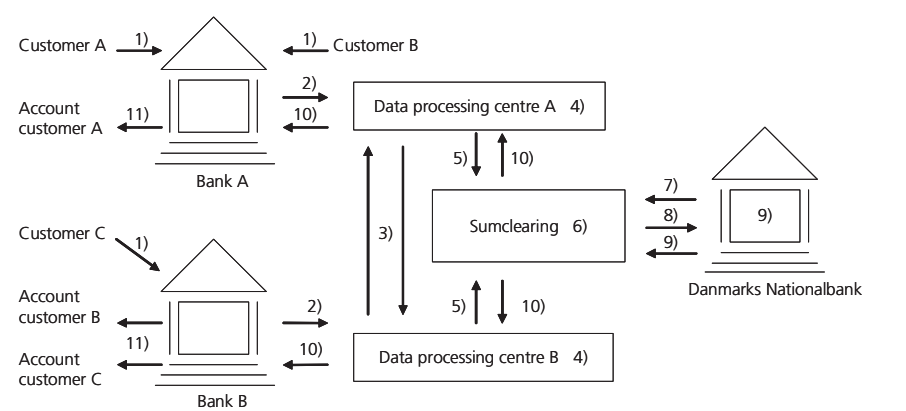
In electronic clearing and truncation, participants calculate payments made by their own customers, e.g. payment via a giro inpayment form, and transactions made in the bank by other banks' customers, e.g. ATM cash withdrawals. Such retail transactions are sent to the individual banks' data processing centres on an ongoing basis. Each data processing centre uses the information to create an overview of retail transactions for each of the banks connected to that centre.

Every evening, total overviews of retail transactions are exchanged bilaterally between the data processing centres. Subsequently the data processing centres prepare a credit and a debit balance, respectively, for each of the banks connected to that data processing centre vis-à-vis all

¹ Retail payments are described in more detail in Chapter 7.

CLEARING AND SETTLEMENT PROCEDURE, ELECTRONIC CLEARING AND TRUNCATION

Chart 6.3



- 1) Customer A pays a giro inpayment form to customer C in bank A. Customer B withdraws cash using a Dankort in bank A. Customer C cashes a cheque from customer A in bank B.
- 2) Banks A and B (currently) send information about debit and credit items to data processing centres A and B, respectively.
- 3) Data processing centres A and B exchange information about debit and credit items (retail transactions).
- 4) Data processing centres A and B calculate the respective debit and credit balances of banks A and B.
- 5) Data processing centres A and B send the debit and credit balances to the Sumclearing.
- 6) On the basis of the information received from electronic clearing and truncation (and PBS clearing), the Sumclearing calculates the net positions of banks A and B.
- 7) The Sumclearing is notified of settlement-account balances (lines) by Danmarks Nationalbank.
- 8) The Sumclearing checks for adequate cover and sends book entries to Danmarks Nationalbank.
- 9) Danmarks Nationalbank debits and credits the net positions to the banks' settlement accounts and sends acceptance of the book entries to the Sumclearing.
- 10) The Sumclearing sends messages to the data processing centres informing them of the retail transactions accepted.
- 11) Bank A debits customer A (cheque). Bank B debits customer B (cash withdrawal) and credits customer C (giro inpayment form).

Note: The chart assumes that the banks are direct clearing participants.
Source: Danish Bankers Association (2001).

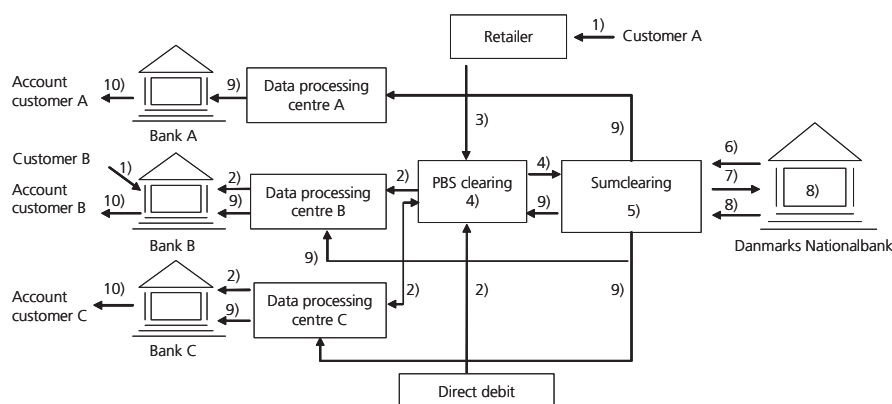
the other banks involved in electronic clearing and truncation. These balances are then sent to the Sumclearing. The clearing and settlement cycle for electronic clearing and truncation and the relations with the Sumclearing are illustrated in Chart 6.3.

PBS clearing

The PBS clearing cycle differs from electronic clearing and truncation in that PBS calculates the banks' outstanding accounts centrally without input from the data processing centres. This is possible because the relevant retail payments are based on PBS' own products. Furthermore, PBS receives direct information from e.g. retailers about EFTPOS (Electronic Funds Transfer at Point Of Sale) payments, cf. Chapter 7.

CLEARING AND SETTLEMENT PROCEDURE, PBS CLEARING

Chart 6.4



- 1) Customer A pays by Dankort via a terminal (EFTPOS) at a retailer banking with bank C. Customer B pays a bill via Betalingsservice (direct debit) in bank B to a private company banking with bank C.
- 2) PBS forwards information about customer B's direct debit transaction to data processing centres B and C.
- 3) PBS receives online information about customer A's payment from the retailer.
- 4) PBS calculates the banks' debit and credit balances, which are sent to the Sumclearing.
- 5) On the basis of the information received from PBS clearing (and electronic clearing and truncation), the Sumclearing calculates the net positions of banks A, B and C.
- 6) The Sumclearing is notified of settlement-account balances (lines) by Danmarks Nationalbank.
- 7) The Sumclearing checks for adequate cover and sends book entries to Danmarks Nationalbank.
- 8) Danmarks Nationalbank debits and credits the net positions to the banks' settlement accounts and sends acceptance of the book entries to the Sumclearing.
- 9) The Sumclearing sends messages to the data processing centres informing them of the retail transactions accepted.
- 10) Bank A debits customer A (Dankort transaction), bank B debits customer B (direct debit) and bank C credits the retailer (Dankort transaction) and the private company (direct debit).

Note: The Chart assumes that the banks are direct participants.

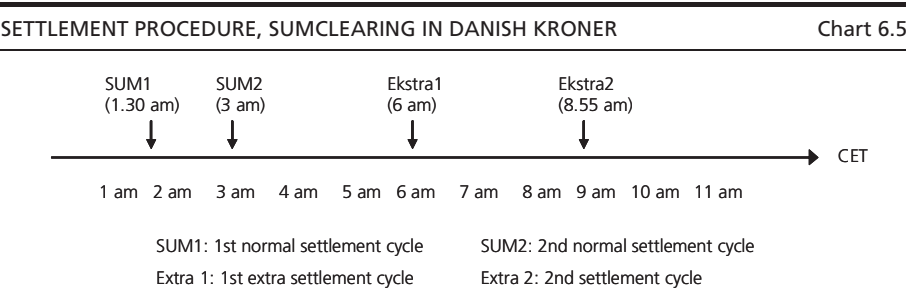
Source: Danish Bankers Association (2001).

PBS calculates each bank's credit and debit balances vis-à-vis each of the other PBS clearing banks and forwards the balances to the Sumclearing for final clearing and settlement. The PBS clearing and settlement cycle and the relations with the Sumclearing are illustrated in Chart 6.4.

PBS forwards information about retail transactions to which PBS has prior access via e.g. Betalingsservice (direct debit) to the banks' data processing centres the day before settlement takes place. Information about retail transactions, e.g. Dankort transactions, that is received by PBS on an ongoing basis is sent to the data processing centres immediately prior to clearing and settlement.

Settlement procedure in the Sumclearing

On the basis of figures reported from electronic clearing and truncation and PBS clearing, the Sumclearing calculates the participants' net positions. Settlement of the net positions takes place via the participants' settlement accounts at Danmarks Nationalbank, cf. Chapter 5.



Settlement of net positions in the Sumclearing in Danish kroner primarily takes place the night before the date of book entry, cf. Chart 6.5. Overnight settlement means that the exchange of funds between the banks can take place via settlement accounts at Danmarks Nationalbank before the payments are booked to the customers' accounts with the banks, and that customers can nonetheless still have access to the funds in the morning. Another advantage of overnight settlement is that the banks' vacant IT capacity is utilised at night. Finally, the Sumclearing settlement procedure is coordinated with the VP settlement procedure with a view to reducing the banks' liquidity requirements. Incoming mortgage payments to the mortgage-credit institutes via the Sumclearing are thus received before the mortgage-credit institutes disburse interest and repayments via VP settlement, cf. section 6.3.3.

It is sought to settle most of the transactions in Danish kroner in the 1st normal settlement cycle at 1.30 a.m., cf. Chart 6.5. The subsequent settlement cycles, i.e. the 2nd normal settlement cycle and two extra settlements cycles, are used to settle delayed or postponed transactions.

Postponed transactions occur if a clearing participant has not reserved adequate liquidity to cover its net position. In that case all the participant's transactions are removed from the settlement cycle and sought to be settled in the next cycle instead. Postponement of a clearing participant entails calculation of new net positions for the other participants. Consequently, it may also be necessary to postpone other clearing participants since their liquidity reserved for the Sumclearing may not be sufficient to cover their new positions. This process continues until the net positions of all remaining participants are covered.

The 2nd extra settlement cycle takes place after Kronos has opened. This allows clearing participants to transfer supplementary liquidity from their current accounts to their settlement accounts between 7.00

and 8.45 a.m. with a view to completing the Sumclearing settlement. If necessary, extraordinary settlement cycles may take place by agreement between the Danish Bankers Association and Danmarks Nationalbank.

When Danmarks Nationalbank has confirmed that the net positions have been booked to the account holders' settlement accounts, PBS advises the data processing centres, which can then book the retail transactions to the relevant customer accounts.

6.2.3 Risk management in the Sumclearing

Payment settlement in net settlement systems involves various risks, cf. Chapter 4. In the Sumclearing and the two underlying subclearings, a number of rules and procedures apply that are aimed at reducing these risks.

Credit risk

The Sumclearing settlement structure entails that in practice retail transactions are not booked to customer accounts until net positions have been booked to the clearing participants' settlement accounts at Danmarks Nationalbank. In principle the credit risk on settlement is thus eliminated. However, as described, the data processing centres receive information about some of the retail transactions from PBS clearing one day before settlement takes place. Participants that credit customer accounts on the basis of this information incur a credit risk until final settlement has taken place during the following night.

Since the Sumclearing, like VP settlement and Kronos, uses central-bank money for settlement, the direct clearing participants incur no credit risk on the settlement bank. Indirect participants use a direct clearing participant as settlement bank. This involves a potential credit risk pertaining to the outstanding accounts between the direct and indirect participants.

Liquidity risk

Participants in the Sumclearing incur a certain liquidity risk since they do not know the size of their net positions prior to the overnight settlement. However, the flexible access to intraday credit at Danmarks Nationalbank, including the credit option under the automatic collateralisation arrangement, enables reservation of sufficient liquidity for settlement, so that postponement of clearing participants can to a large extent be avoided.

In practice Sumclearing participants systematically transfer considerably more liquidity to their settlement accounts and reserve more credit

under the automatic collateralisation arrangement than required to achieve settlement via the Sumclearing.¹

The liquidity risk is further limited by the opportunity to set limits to the size of individual transactions. In electronic clearing and truncation, each clearing participant may determine an upper limit of up to kr. 100 million for the individual transactions that can be debited to that participant in the Sumclearing. PBS clearing operates with an upper limit of kr. 1 million for each Dankort transaction. The purpose of setting upper limits for individual transactions is, *inter alia*, to limit the risk of unexpectedly large withdrawals owing to errors caused by another clearing participant. Payments exceeding the maximum limits must be settled via Kronos.

In addition, clearing participants can set limits to the size of individual transactions that they debit to themselves, e.g. credit transfers on behalf of customers. Such limits may also be set at employee level.

In order to minimise the number of postponements, the Danish Bankers Association can impose fines on clearing participants that are postponed because their reserved liquidity is inadequate to cover their net positions in the Sumclearing. Clearing participants are also subject to an obligation to provide the staffing required to ensure transfer of further liquidity to their settlement accounts when Kronos opens if it proves necessary to conduct the 2nd extra settlement cycle in order to complete the Sumclearing settlement.

6.2.4 The Sumclearing in euro

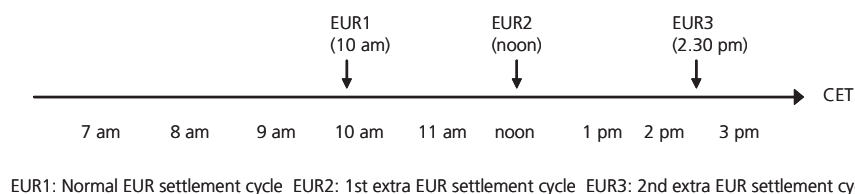
The clearing and settlement procedure for the Sumclearing in euro follows the same procedure as for Danish kroner. At present, however, only credit transfers are settled, and the Sumclearing in euro therefore only receives reports from the electronic clearing and truncation. Settlement in euro takes place before noon, cf. Chart 6.6, since Danmarks Nationalbank cannot provide overnight credit in euro, cf. Chapter 5. At end-February 2005, the Sumclearing in euro had 26 direct clearing participants and 144 indirect participants.

The Sumclearing in euro comprises a normal settlement cycle and two extra settlement cycles. The Sumclearing seeks to settle all euro payments in the EUR1 settlement cycle at 10.00 a.m., with the option to run two fixed extra settlement cycles, EUR2 and EUR3, if payments are delayed or postponed. As with the Sumclearing in kroner, further settlement cycles may take place as agreed between the Danish Bankers Association and Danmarks Nationalbank.

¹ Appendix D and Danmarks Nationalbank (2002a) present analyses of the excess liquidity in the Sumclearing.

SETTLEMENT PROCEDURE, SUMCLEARING IN EURO

Chart 6.6



6.3 VP SETTLEMENT

The VP settlement system is the Danish system for settlement of securities transactions and periodic payments (interest, repayments and dividend). The system is managed by VP Securities Services (VP), which is the central securities depository for all Danish listed securities and certain other securities. In addition to settling transactions and periodic payments, VP handles issuance, custodian services and administration of securities. Box 6.4 provides a brief description of VP and its various tasks.

The VP settlement system is a multilateral net settlement system that calculates the participants' net positions in securities and cash at fixed times during the day.¹ The securities leg is settled via accounts at VP, while cash is exchanged via accounts at Danmarks Nationalbank. Settlement of the cash leg of a VP transaction basically adheres to the same principles as in the Sumclearing, as described in Chapter 5.

A core element of the VP settlement system is the simultaneous exchange of securities and cash, known as Delivery versus Payment (DvP). The DvP principle ensures that a party to a securities transaction does not deliver its part of the transaction without receiving the other part, cf. Chapter 3, Box 3.5. In the VP settlement system, the DvP principle thus contributes to removing the principal risk on settlement of securities transactions.

6.3.1 VP settlement system participants

Participants in VP clearing and settlement are called clearing participants. Participation is open to securities dealers, including banks and mortgage-credit institutes and investment firms, and to Danmarks Nationalbank, clearing houses and the Danish Agency for Governmental Management.

¹ The VP settlement system also gives access to gross settlement. This applies to securities transactions in kroner that are settled in real time, cf. below.

VP SECURITIES SERVICES

Box 6.4

VP Securities Services (VP) is the central securities depository for all Danish listed securities and a limited number of unlisted and foreign securities. VP was set up in 1980 as a private, independent institution. In 1983, VP was the first central securities depository in the world to introduce electronic registration (dematerialisation) of bonds, and in 1988 shares were also dematerialised. On 1 January 2000, VP was converted into a limited liability company owned by the players in the Danish securities market.

VP's core tasks are:

- *Issuance and registration.* Securities are issued by VP. As the national numbering agency, VP is responsible for assignment of ISIN codes¹. After issuance, securities are entered to VP's register, which is the basis for registration of ownership, rights, etc.
- *Clearing and settlement.* VP handles clearing and settlement of transactions in securities registered with VP. In the clearing phase, transactions are prepared for settlement, and checks for adequate cover are performed. In the settlement phase, securities in accounts at VP are exchanged for cash in accounts at Danmarks Nationalbank.
- *Custody service.* VP manages ownership of securities registered with VP by managing securities accounts for investors. Securities accounts at VP are normally opened at individual investor level and managed on a decentralised basis by the account controllers.²
- *Corporate actions.* VP handles a number of tasks related to securities, called corporate actions. Examples include calculation and distribution of periodic payments – i.e. interest, repayments and dividend – and share issues.

VP offers to settle cross-border securities transactions via links to the international securities market. VP has a direct link to Euroclear Bank, cf. Box 6.5, as well as a link to Clearstream Banking. Furthermore, VP has bilateral Free of Payment (FoP) links to the Swedish and Icelandic central securities depositories, whereby securities can be transferred in both directions without offsetting payments.

¹ ISIN (International Securities Identification Number) is an international code for unique identification of a security. Each country has a numbering agency that assigns ISIN codes for securities from that country.

² Ownership of the securities can also be registered with the account controller, which then keeps omnibus accounts at VP. This is customary in most foreign central securities depositories, cf. Chapter 3.

Clearing participants may be connected to the VP system on various terms. A participant that is only connected as a clearing participant is entitled to report its own securities transactions to VP. If the clearing participant is also connected to the VP system as an account controller it may also report transactions on behalf of others. Account controllers handle the administration of securities accounts at VP, cf. Box 6.4.

A clearing participant may also be connected to the VP system as a direct cash settlement participant, called a primary cash provider. A direct cash settlement participant makes liquidity available for settlement of securities transactions. The primary cash provider must hold an account at Danmarks Nationalbank, a current account, and a settlement account

for VP settlement, cf. Chapter 5. A clearing participant that is not a primary cash provider must have an agreement with one.

The clearing participant may also be connected to the VP system as a cash account manager. All securities accounts at VP must have a cash account manager that is responsible for payments relating to the individual account, e.g. in connection with purchase and sale of securities and payment of interest and dividend. A cash account manager must participate directly in VP cash settlement or have concluded an agreement with a primary cash provider.

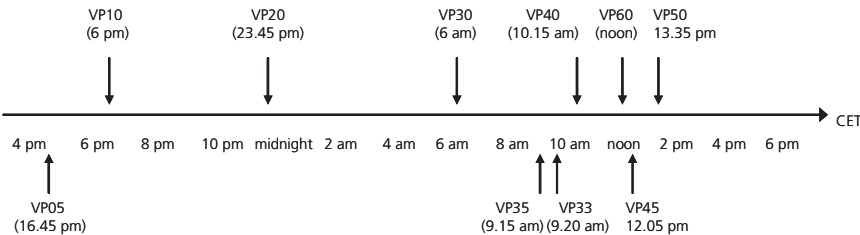
Finally, a clearing participant in VP settlement can be a "major client". A major client can only report its own transactions to VP and cannot be an account controller. This option is aimed especially at institutional investors such as pension funds and insurance companies, as well as foreign securities dealers.

At the end of 2004 the number of VP clearing participants was 197, of which 159 were account controllers, 90 primary cash providers and 11 major clients.

6.3.2 VP settlement procedure

VP's settlement day begins at 6.00 p.m. and ends just before 6 p.m. on the following banking day. VP settlement can be broken down into two separate settlement procedures for, respectively, securities transactions and periodic payments, each comprising a number of settlement cycles, cf. Chart 6.7. In addition, securities transactions can be settled as gross transactions in real time.

VP SETTLEMENT PROCEDURE Chart 6.7



VP10, VP20, VP30, VP40 and VP60: Settlement of securities transactions in Danish kroner.
 VP05 and VP35: Settlement of periodic payments in Danish kroner.
 VP50: Settlement of securities transactions in euro.
 VP45: Settlement of periodic payments in euro.
 VP33: Exchange of euro liquidity for krone liquidity (payment versus Payment, PVP).

Note: In VP10, VP20 and VP30, securities denominated in euro can also be settled, cf. section 6.3.5.

TRADE IN SECURITIES REGISTERED WITH VP	Box 6.5
<p>Today, VP-registered shares listed on the Copenhagen Stock Exchange (CSE) are primarily traded via the Norex Alliance's joint trading platform, Saxess. In addition to CSE, the Norex Alliance comprises the stock exchanges in Stockholm, Oslo, Reykjavik, Helsinki, Riga and Tallinn. Transactions concluded on Saxess can be transferred automatically for clearing and settlement in VP via VP's NOREX STP system. This facility is, however, primarily used by clearing participants that are not account controllers since it can only be used for reporting concerning a single securities account.</p> <p>Since November 2003, trade in Danish government securities in the wholesale market, i.e. the interdealer market, has taken place via the electronic trading platform for European government securities, MTS (Mercato dei Titoli di Stato, "market for government bonds")¹. Trade in Danish government securities takes place in a special segment, MTS Denmark (MTSDk), with the Belgian MTS company, MTS Associated Markets (MTSAM). When a securities transaction is concluded on MTSDk, the system automatically sends a message to the connected central securities depository where the participants wish to clear and settle the transaction.²</p> <p>The remaining trade in bonds registered with VP, including mortgage-credit bonds, mainly takes place by telephone, i.e. Over-The-Counter (OTC). For most clearing participants, reporting to VP takes place automatically, i.e. as Straight-Through Processing (STP), from the moment the individual securities dealer has entered the transaction to the clearing participant's securities system.</p>	

¹ For a description of the introduction of trade in Danish government securities on MTS, see Danmarks Nationalbank (2004).
² Securities transactions concluded on MTSDk can currently be cleared and settled in VP and Euroclear Bank.

Settlement of securities transactions in net settlement cycles

Securities registered with VP are traded on various trading platforms. Shares are primarily traded via Saxess, the joint trading system of the Nordic-Baltic stock-exchange alliance, the Norex Alliance. Some of the trade in government bonds between banks takes place on the electronic trading platform for European government securities, MTS. Bond trading otherwise mainly takes place Over-The-Counter (OTC), i.e. by telephone. Box 6.5 describes the various systems for trading securities registered with VP.

When a securities transaction has been concluded, both parties' clearing participants report the transaction to VP, i.e. provide "preadvice". VP is open for reporting from 5.00 a.m. to 1.45 a.m. the following day. Reporting to VP can take place in various ways, e.g. via the clearing participants' securities systems, via VP's own system, or via messages sent by the trading system, as applies to trading on MTS. In most systems, reporting to VP is an integral part of the conclusion and booking of the transaction. This is known as Straight-Through Processing (STP).

The preadvice to VP must state the date on which the securities transaction is to be settled. In the Danish securities market it is customary to

settle a transaction three days after its conclusion (i.e. T+3), but the parties may opt for any other settlement date up to a year after the transaction is concluded. It is also possible to state a given settlement cycle in which the transaction is required to be settled.

When the two preadvice notices have been received, VP immediately checks whether the information on the transaction is consistent. In case of inconsistencies, the clearing participants must report the transaction once again. Before a securities transaction can be settled, the clearing participants must also have submitted confirmation of the transaction, which can be done at the same time as the preadvice.

Before executing each settlement cycle, VP checks for adequate cover in terms of both securities and cash. In relation to securities, VP checks that each vendor has net cover for each ID code for the securities transactions confirmed. In relation to cash, VP checks that the line for each individual cash account manager covers its net payment, cf. Chapter 5.

If a buyer or vendor cannot cover its net position in a settlement cycle, VP is entitled to remove securities transactions until there is adequate cover for the remaining transactions. Transactions are removed in accordance with fixed criteria, known as elimination rules, designed to optimise the remaining settlement. It is sought to settle securities transactions that are removed from a settlement cycle in the next cycle. Deferred transactions can be scheduled for settlement for up to five settlement days.

VP conducts five daily settlement cycles for securities transactions in Danish kroner. The cycles are settled at 6.00 p.m. (VP10), 11.45 p.m. (VP20), 6.00 a.m. (VP30), 10.15 a.m. (VP40) and noon (VP60). Actual settlement takes place via simultaneous registration to securities accounts at VP and booking to settlement accounts and automatic collateralisation accounts at Danmarks Nationalbank, cf. Chapter 5. A securities transaction has been finally settled when the settlement cycle has been completed.

The primary cash providers are not able to provide further liquidity for the two overnight settlement cycles, VP20 and VP30, which are placed outside Kronos' opening hours. This means that the line in VP20 is equivalent to the line before VP10 adjusted for the booked net position in VP10, and so forth for VP30. However, primary cash providers can transfer liquidity for VP40 and VP60, which are not settled until after Kronos has opened.

The timing of the overnight VP settlement cycles has been coordinated with the Euroclear Bank settlement cycle. This takes account of the securities link between VP and Euroclear, cf. Box 6.5. The timing of the settlement cycles in VP and Euroclear thus enables VP and Euroclear's inves-

SECURITIES LINK BETWEEN VP AND EUROCLEAR BANK

Box 6.6

VP and Euroclear Bank have a link allowing electronic transfer of securities between the two central securities depositories. It is a one-way link since Euroclear holds an omnibus account at VP, while VP does not hold a securities account at Euroclear. This means that securities dealers can buy VP-registered securities and transfer them to a securities account at Euroclear, while they cannot buy securities registered with Euroclear and transfer them to a securities account at VP. Euroclear also holds an account at Danmarks Nationalbank and participates in cash settlement in VP.

VP's settlement procedure is carefully coordinated with Euroclear's. Thus VP's first three settlement cycles (VP10, VP20 and VP30) are placed around Euroclear's two overnight cycles, which are settled at 9.30 p.m. (EOC1) and 1.00 a.m. (EOC2), cf. the Chart. This allows securities dealers connected to VP and Euroclear to trade and settle the same securities several times during the same settlement day without loss of value days. This is known as back-to-back trading.

In a back-to-back transaction, Euroclear may – on behalf of a foreign securities dealer – buy a VP-registered asset for settlement in VP10. In EOC1, Euroclear books the purchase to the securities dealer's securities account and cash account, after which the asset can be sold back to a Danish securities dealer for settlement in VP20. An equivalent back-to-back transaction can take place in settlement cycles VP20, EOC2 and VP30.

After VP30, VP-registered securities deposited with Euroclear can be traded in Euroclear's real-time gross settlement. This also applies to securities transferred to Euroclear deposit accounts in VP40 and VP60. Real-time gross settlement in Euroclear is possible between 4.00 a.m. and 6.00 p.m.

SETTLEMENT PROCEDURES IN VP AND EUROCLEAR

The chart illustrates the settlement procedures in VP and Euroclear. The horizontal axis represents time in CET, from 4 pm to 6 pm. The chart shows settlement cycles VP10, VP20, VP30, VP40, and VP60, and Euroclear cycles EOC1 and EOC2. Arrows indicate the flow of securities between VP and Euroclear. VP10 (18.00) and VP20 (23.45) are settled in VP. EOC1 (21.30) and EOC2 (01.00) are settled in Euroclear. VP30 (6.00) is settled in VP. VP40 (10.30) and VP60 (12.00) are settled in VP. Euroclear real-time settlement is possible from 4.00 am to 6.00 pm.

VP10, VP20, VP30, VP40 and VP60: Settlement of securities transactions in VP.
EOC1 and EOC 2: Settlement of securities transactions in Euroclear.

tors, via the link, to trade and settle the same securities several times in the course of the day. VP's link to Euroclear is described in Box 6.6.

Settlement of periodic payments

Settlement of periodic payments comprises transfer of interest, repayments and dividend from issuers to investors. VP runs two daily settle-

ment cycles for periodic payments in Danish kroner at 4.45 p.m. (VP05) and 9.15 a.m. (VP35), cf. Chart 6.7. VP05 only settles repayments on Danish government bonds, while other repayments, interest and dividend are settled in VP35.

As stated in section 6.2.2., the settlement of periodic payments in VP is coordinated with the Sumclearing settlement cycle with a view to limiting the liquidity requirements of the banks. Mortgage payments to the mortgage-credit institutes via the Sumclearing thus take place at night, i.e. before settlement of interest payments to investors in VP35. Investors can then use the liquidity received via interest payments to settle securities transactions in VP40.

In the settlement cycles for periodic payments, only liquidity is exchanged. Before executing a settlement cycle, VP checks that the lines of the primary cash providers on behalf of the issuers covers their net payments in the settlement cycle. Subsequently, settlement takes place via accounts at Danmarks Nationalbank, as described in Chapter 5.

Real-time settlement

In VP settlement, securities transactions can also be executed in real time outside the fixed settlement cycles. Real-time settlement can take place when one party to a securities transaction needs liquidity or securities immediately.

Real-time settlement can be reported on all banking days between 8.00 a.m. and 3.00 p.m. Settlement of the cash leg of a real-time transaction takes place directly via the primary cash providers' current accounts. Only clearing participants that are primary cash providers can execute real-time transactions and only on their own behalf.

Reporting and matching of real-time settlement take place in the same way as for net settlement. When checking for adequate cover, VP first checks whether the seller has cover in its securities account and reserves the securities. Then VP checks whether the buyer has adequate funds in its current account. If both parties have adequate cover, immediate and simultaneous exchange of cash and securities takes place, and the transaction has been finally settled.

6.3.4 Risk management in VP settlement

Settlement of securities transactions involves a number of risks, cf. Chapter 4. Various elements of the VP settlement system are designed to reduce these risks.¹

¹ Danmarks Nationalbank (2005) includes an assessment of settlement risks in VP.

Credit risk

The potentially most significant risk on settlement of securities transactions is the principal risk, i.e. the risk of supplying cash without receiving securities, or vice versa. In VP settlement this risk has been eliminated via simultaneous exchange of securities and cash (DvP). Multilateral net settlement is based on BIS model 3, while real-time settlement takes place in accordance with BIS model 1, cf. Chapter 3, Box 3.5.

Another type of credit risk is replacement risk, i.e. the risk of suffering a capital loss because the transaction must be cancelled due to the insolvency of the counterparty. In VP settlement this risk can be eliminated by settling the transaction in real time. On multilateral net settlement participants incur a replacement risk.

Other potential credit risks on settlement of securities transactions are of limited relevance to VP. Since VP settlement, like the Sumclearing, settles via central-bank money, the primary cash providers incur no credit risk on the settlement bank. Nor does VP itself incur any credit risk since it does not engage in securities lending or otherwise extend credit to participants. The settlement bank, i.e. Danmarks Nationalbank, extends intraday credit to participants in cash settlement, but only against collateral, which limits the risk.

Cash account managers that are not primary cash providers must participate indirectly in cash settlement via a primary cash provider. Outstanding accounts, and thus potential credit risks, therefore exist between the primary cash provider and the cash account manager. In connection with settlement, the primary cash provider may determine the line for the indirect participant, thereby limiting the credit risk.

Liquidity risk

Liquidity risk is the risk of incurring a loss because liquidity or securities are not received at the expected time.

In VP settlement, the participants' liquidity risk is reduced by various rules and procedures aimed at ensuring that transactions are settled on the agreed date. For instance, the last two settlement cycles, VP40 and VP60, are placed within Kronos' opening hours. This enables participants to obtain extra liquidity for transactions not settled during the night. Furthermore, any unsettled transactions remaining after VP40 or VP60 can be settled as real-time transactions.

Another example is the agreed code of conduct for settlement in VP, encouraging participants to conclude the transactions as early as possible in the settlement cycle, preferably in VP10. Among other things, the code of conduct requires that participants operate with an excess margin when calculating their liquidity requirements. A participant that does

not adhere to this requirement and fails to cover its net positions in cash will be fined.

A third example is VP's procedure for handling transactions that fail the check for adequate cover. VP's elimination rules are designed, as stated, to optimise remaining settlement. If VP removed all transactions for a participant that failed the check for adequate cover, this could have a significant impact on the remaining settlement. Instead, VP removes only the transactions required to ensure that there is adequate cover.

Finally, automatic collateralisation also helps to limit the liquidity risk in VP settlement. For instance, automatic collateralisation allows the use of purchased securities as collateral for intraday credit in the settlement cycle in which the securities are received, cf. Chapter 5, Box 5.3. This means that very few securities transactions fail the check for adequate cash cover.

6.3.5 VP settlement in euro

A number of bonds, primarily government and mortgage-credit bonds, registered with VP are denominated in euro. Part of the VP settlement therefore takes place in euro.

Settlement cycles VP10, VP20 and VP30 allow settlement of securities denominated in euro in addition to those denominated in kroner. However, since account holders at Danmarks Nationalbank do not have access to euro liquidity overnight, cash settlement of euro-denominated securities in these settlement cycles in practice takes place in kroner, cf. Chapter 5. At 9.20 a.m. a special Payment-versus-Payment (PvP) settlement cycle, VP33, is executed, in which the parties exchange kroner and euro so that the net result is settlement in euro.

In addition to this settlement, a settlement cycle for trade in euro-denominated securities takes place at 1.35 p.m. (VP50) and a settlement cycle for periodic payments in euro at 12.05 p.m. (VP45), cf. Chart 6.7. Settlement of these cycles generally takes place in the same way as settlement of the equivalent cycles in Danish kroner.

In VP settlement it is not possible to conduct real-time transactions for euro-denominated securities.

6.4 FUTOP SETTLEMENT

The FUTOP Clearing Centre (FUTOP) clears and settles transactions in futures and options (derivatives) listed and traded on the Copenhagen Stock Exchange. FUTOP is owned by the Copenhagen Stock Exchange.

When a transaction is concluded, it is reported to FUTOP, which steps in as a central counterparty to the transaction and guarantees the con-

tracts. Depending on the nature of the contracts, settlement takes place on an ongoing basis and/or at the expiry of the contract in the form of difference settlement or delivery of the underlying asset.

Daily clearing of futures and options contracts takes place in the Swedish derivatives clearing system, SECUR. By 8.00 a.m. at the latest, SECUR advises FUTOP and FUTOP members of the net positions for current settlement.

Settlement of net positions takes place "manually" via current accounts at Danmarks Nationalbank: members with net debit positions for current settlement of their contracts credit FUTOP's current account by 11.00 a.m. By 11.30 a.m. FUTOP then credits members with net credit positions for current settlement of their contracts. Delivery of the underlying asset at the expiry of the contract is settled via VP.

6.4.1 Risk management

FUTOP's guarantee scheme ensures that a party's derivatives contract is honoured, even if the original counterparty is unable to meet its obligations.

Members pay a margin to FUTOP on the basis of the contracts reported and the price level of the underlying assets. The margin is returned when the contract expires. In addition, the guarantee scheme is based on FUTOP's own funds and variable subordinated capital (VSC) from the members connected.

Each member has a VSC account and a margin account at Danmarks Nationalbank, which are opened as subaccounts to FUTOP's current account. Margin requirements are calculated on a daily basis and members are notified at 8.00 a.m. The margin must be paid into the margin account by 11.00 a.m. Deposits in margin accounts are transferred to current accounts if the excess margin is higher than kr. 5 million.

The VSC requirement is adjusted on a quarterly basis. Members whose VSC requirement is increased transfer the amount to their VSC accounts. For members whose VSC requirement is lowered, FUTOP transfers the amount from their VSC accounts to their current accounts. Deposits in margin and VSC accounts accrue interest from Danmarks Nationalbank at the rate fixed for current-account deposits. The interest is entered to the clearing participants' current accounts.

6.4.2 Future derivatives settlement

In early 2005, the Copenhagen Stock Exchange became part of the OMX Group AB. In that connection trade in and clearing/settlement of Danish derivatives will migrate to the Stockholm Stock Exchange. Migration will take place gradually as derivatives contracts listed on the Copenhagen

Stock Exchange expire. New contracts will be listed on the Stockholm Stock Exchange, which will then be the central counterparty and handle daily settlement via accounts at Danmarks Nationalbank. Settlement is expected to be organised along the same principles as described above. However, participants are not expected to have to provide variable subordinated capital as collateral any longer.

LITERATURE

Andersen, Niels C., 2004. Clearing and settlement in a legal perspective (in Danish only), Danmarks Nationalbank, *Working papers*, 20/2004.

Angelius, Thomas, Søren Lundsby Hansen and Jesper Mærsk, 1998. DEBES – the Danish part of TARGET, Danmarks Nationalbank, *Monetary Review*, 2nd Quarter.

Angelius, Thomas and Astrid Henneberg Petersen, 2002. Danmarks Nationalbank's New Payment System, Kronos, Danmarks Nationalbank, *Monetary Review*, 1st Quarter.

Bech, Morten Linnemann, Bo Madsen and Lone Natorp, 2002. Systemic Risk in the Danish Interbank Netting System, Danmarks Nationalbank, *Working papers*, 8/2002.

Danmarks Nationalbank, 2001. *KRONOS System Specifications*.

Danmarks Nationalbank, 2002a. *Financial Stability*.

Danmarks Nationalbank, 2002b. *Second Assessment of KRONOS in relation to the Core Principles for Systemically Important Payment Systems*, www.nationalbanken.dk.

Danmarks Nationalbank, 2002c. *Review of the Sumclearing in relation to Core Principles for Systemically Important Payment Systems*, www.nationalbanken.dk.

Danmarks Nationalbank, 2004. *Danish Government Borrowing and Debt 2003*.

Danmarks Nationalbank, 2002. *Financial Stability*.

Danmarks Nationalbank, 2005. *Financial Stability*.

Danish Bankers Association, 2001. The Banks' Open Infrastructure (in Danish only), *Finansanalyse* no. 13, September 2001.

Danish Bankers Association, *Payment Systems Handbook* (in Danish only).

Danish Financial Supervisory Authority and Danmarks Nationalbank, 2004. *Review of VP Securities Services in relation to Recommendations for Securities Settlement Systems.*

www.cse.dk

www.swift.com

www.vp.dk

7. Retail Payments in Denmark

When consumers make their daily purchases of goods and services, money is transferred from the buyer to the seller. If the payment is made in banknotes and coins, there is a direct transfer between the two parties involved. If, on the other hand, the consumer pays for goods and services using a payment instrument, e.g. a Dankort (debit card), the transfer is made via the payments infrastructure, cf. Chapter 6.

Many changes have been seen in the area of new payment instruments since the Danish postal services' introduction of the money order in 1851¹. Today, an ever increasing number of payments are made using electronic payment instruments, e.g. payment cards and electronic transfers. This development is supported by the expansion of trading via the Internet and by mobile phone. Electronic payment instruments are cleared and settled daily via the payments infrastructure; therefore, secure and efficient payment systems are of vital importance.

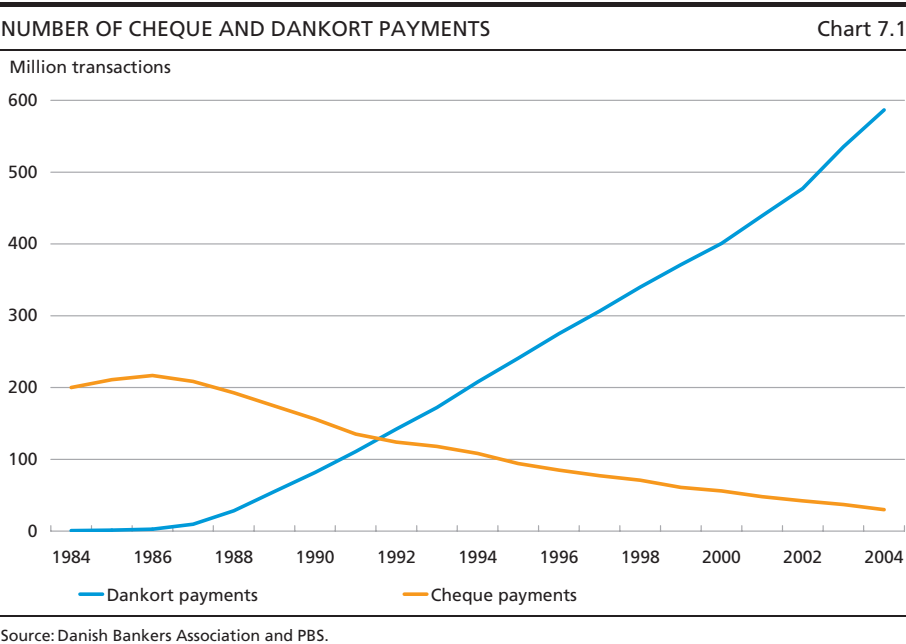
This chapter provides an overall description of retail payments in Denmark, with special focus on the evolution of payment instruments. The infrastructure behind payment cards is described and the chapter is rounded off with a presentation of new payment instruments and a comparison of the use of payment instruments in the EU member states.

7.1 MEANS OF PAYMENT AND PAYMENT INSTRUMENTS

In the area of retail payments, it is important to distinguish between means of payment and payment instruments, since only payment instruments are cleared and settled via the payments infrastructure. A means of payment, e.g. banknotes and coins, can be transferred between two parties without the use of an infrastructure. A payment instrument, on the other hand, is linked directly to an account and has no value in itself. Thus, a payment instrument can be seen as the account holder's access key to the account. In order for the account holder to gain access to the means of payment, a payments infrastructure is required.

The introduction of salary accounts in the early 1960s created the need for secure and easy access to account balances. Therefore, cheques were

¹ The money order as a payment instrument is described in Box 7.1.



in widespread use in Denmark until the mid-1980s. In terms of number of payments, cheques were overtaken by Dankort (debit card) transactions in 1992, cf. Chart 7.1. Since 1987, the number of Dankort transactions has grown significantly, while cheque payments have declined. Despite the rapidly increasing use of the Dankort, the circulation of banknotes and coins has risen over the past two decades.

Below, the means of payment and payment instruments used daily in Denmark are described.

7.1.1 Means of payment

Banknotes, coins and prepaid cards are all means of payment. The most frequently used means of payment are, however, bank deposits, called commercial bank money, cf. Chapter 1, Box 1.5. The consumer can only use these deposits via a payment instrument.

Historically, trust has been the key factor behind the success of a means of payment, cf. Chapter 2. Banknotes and coins issued by Danmarks Nationalbank are the most widely used means of payment. Banknotes and coins represent claims on Danmarks Nationalbank; therefore, people have confidence in the value of money and it is accepted by everyone as a means of payment. Moreover, the use of banknotes and coins is not conditional on the identity of the holder, since they may be used by the bearer.

In principle, prepaid cards share the same characteristics as banknotes and coins. A prepaid card may be bought either as a disposable card with a specific value or as a card to which the owner of the card can transfer money on an ongoing basis. In Denmark, issuers of prepaid cards are subject to the Danish Act on Certain Means of Payment, cf. Chapter 9.

Prepaid cards can extensively replace the use of banknotes and coins where small payments are involved. The most widely used prepaid cards are telephone cards for mobile phone calls, international calls or for use in payphones. Apart from telephone cards, Denmark does not have many prepaid cards. The only other general Danish prepaid card is the Danmønt card, which was introduced in 1991 by Danmønt A/S¹. The Danmønt card was never a success, however, and is to be phased out in the course of 2005.

7.1.2 Payment instruments

Payment instruments are currently used for most private payments in Denmark. This section describes the most widely used retail-payment instruments, which are all cleared and settled in the retail-payment system called Sumclearing, cf. Chapter 6.

Cheques

A cheque is a written order via which the issuer of the cheque by his signature instructs his bank to authorise another person to withdraw the face value of the cheque from his account. This means that cheques can be used as payment instruments for purchases of goods.²

The use of cheques gained momentum in the mid-1890s when the number of banks began to increase, establishing the conditions for payments by cheque in Denmark. The increasing use of cheques led to the adoption of a new cheque act in 1897³, which laid down the framework for use and acceptance of cheques. The use of cheques as a payment instrument increased further in the early 1960s with the introduction of salary accounts. The growing use of cheques entailed that physical clearing and settlement became very cost-intensive for the banks. In 1979, this led to the introduction of electronic cheque truncation, which is still used. Electronic cheque truncation means that the paying bank keeps the cheque, while the information on the cheque is transferred electronically to the account-holding bank.⁴

¹ Danmønt A/S was set up as a limited liability company, its shareholders being PBS and Tele Danmark.

² Apart from ordinary cheques, there are travellers' cheques for foreign travel.

³ Cf. Hansen and Svendsen (1968).

⁴ Cf. Danish Bankers Association (2001).

POSTAL GIRO SYSTEM	Box 7.1
<p>The postal services traditionally played an important role in handling letters and parcels containing money. Sending money by letter involves certain risks, which led the Danish postal services to introduce money orders in 1851.</p> <p>With money orders, payments were effected by the payer paying in a cash amount at a post office. The recipient was then able to cash the amount at another post office against presentation of the money order received by mail. A disadvantage to payment by money order was that the full amount was exchanged twice: when the payer paid in and when the recipient cashed the amount.</p> <p>The Danish postal services solved this problem in 1920 by setting up the postal giro office to manage payments made using the postal giro system. The Danish postal services thus established an alternative to bank-based cheque payments. The postal giro system generated economies of scale for the Danish postal services, which had branched out with offices across the country. Many Danes opened a postal giro account to pay their bills.</p> <p>The increasing prevalence of giro payments was strengthened as Danish central and local governments transferred incoming and outgoing payments via postal giro accounts. To prevent excessive distortion of competition to the disadvantage of the banks, the Danish postal services were not authorised to grant loans. That meant that the customers' postal giro accounts could not be overdrawn in connection with withdrawals.</p> <p>The green light for postal giro lending was not given until 1991 when the system was separated from the Danish postal services and Girobank A/S was established (now a part of Danske Bank).</p>	

Source: Sundorph and Gregersen (1990).

Inpayment forms

Denmark has two types of inpayment form: the joint inpayment form and the giro inpayment form, the reason being that the former postal giro office was for a long time the only institution to offer a manual, nationwide, paper-based payment system, cf. Box 7.1. When the postal giro office was converted into GiroBank, agreements were concluded between Danish Bankers Association and Girobank in 1991 to give the same status to the two inpayment forms. These agreements were later passed on to BG Bank and subsequently to Danske Bank.¹

The joint inpayment form of the Danish banks is currently the most commonly used collection method for settlement of bills. The paper-based joint inpayment form can be used at the post office, at the bank and via online banking. The inpayment form allows for the payment to be transferred directly to the creditor's bank account.

There are different types of inpayment forms: the fully automatic form, which has a code to identify the debtor (payer); the manual form, which the debtor needs to fill in with his name and possibly some free

¹ Cf. Danish Bankers Association (2001).

text; and the combined form, which has both an identification code and a free text field.

A further development of the inpayment form is the electronic inpayment form whereby the bill is sent directly to the debtor's online banking system. With this form, all the debtor has to do is authorise the payment, which has all the payment data of the paper-based form.

The inpayment form is used mainly for non-recurring payments. For recurring payments, the debtor may opt to register the payment with Betalingsservice (direct debit), cf. below.

Denmark also has systems for electronic exchange of invoices, called e-invoicing systems. e-invoicing allows a business enterprise to receive electronic invoices from other business enterprises. The invoices are booked automatically and paid when accepted by the business enterprise via its office banking system¹.

Betalingsservice (direct debit)

Direct debit is an easy way for the consumer to pay recurring bills. Once the consumer has registered a bill for payment via direct debit, the creditor always initiates the future payments of the same bill. By registering a bill for payment via direct debit, the debtor authorises the creditor to draw an outstanding amount directly from the debtor's account. Once a month the debtor receives a payment summary from the direct debit system, specifying the amounts to be paid to various creditors. Prior to that, the creditors have sent information about the payments to PBS (Payment Business Services), cf. section 7.3.3. On the date of payment, the amounts in question are debited to the debtor's account and credited to the accounts of the respective creditors. If the debtor does not wish to pay one of the bills specified, he has the right to refuse payment.

LeverandørService (supplier service) is the equivalent of direct debit for private and public business enterprises. LeverandørService is a system of automatic payment collection for recurring bills for goods or services between business enterprises. The supplier may draw an outstanding amount directly from a business enterprise's account, provided that a payment agreement has been established between the two business enterprises.

Credit transfers

Using a payment order, a debtor can initiate a payment transfer from his own bank account to the recipient's bank account, called a credit trans-

¹ Office banking can be used by business enterprises in the same manner as online banking by private clients.

fer. The transfer may be effected via the debtor's online banking system or via a physical bank, the precondition being that the recipient's account number is known. Credit transfers may take the form of person-to-person transfers, customer-to-business transfers or business-to-business transfers¹. Customer-to-business payments are used mainly for e-commerce. As an additional functionality of their online banking services, some banks offer an online shop, in which selected businesses can advertise special offers to the bank's e-banking customers. The customer then buys the advertised goods via a credit transfer in his online banking system and the payment is authorised via the customer's personal digital signature.

Cash card

Previously, salary-account holders were issued with a pass book, but in the mid-1980s plastic cash cards were introduced to replace pass books. The introduction of magnetic stripe-based cash cards automated the transaction process and allowed the banks to reduce their transaction costs. Cash cards can be used to withdraw cash via the cash dispensers, ATMs², of the account holder's bank. A cash card cannot be used to purchase goods or to withdraw cash from the ATMs of other banks. All private customers holding a bank account are entitled to be issued with a cash card.

Debit card

A debit card is a payment card that is directly linked to the account holder's bank account. When the card holder uses the card, the amount is typically debited to his account on the following banking day. In Denmark, the banks issue debit cards. The Dankort, which is the most widely used debit card in Denmark, is described in section 7.3. Visa Electron and Maestro are examples of international debit cards, both of which are issued in Denmark by Danish banks. In contrast to the Dankort, Visa Electron and Maestro both have real-time balance control. To be eligible for a Dankort, the consumer has to be aged over 18 and be subject to a credit assessment. This is not the case with Visa Electron and Maestro, due, among other reasons, to the real-time balance-control feature.

"Co-branding" is possible between national and international debit cards, as seen with Visa and the Dankort. Co-branding enables the

¹ Also known as, respectively, (P2P), (C2B) and (B2B).

² Cash dispensers are known internationally as Automated Teller Machines, ATMs. ATMs can be used by customers with debit and credit cards to withdraw cash, check account balances, make transfers and, in some cases, to make deposits.

consumer to use the same card and the same PIN nationally and internationally.

Credit card

A credit card gives the card holder access to a credit facility, the maximum limit and duration of which are subject to agreement between the card holder and the issuer. Financial institutions as well as other private business enterprises, such as petrol companies or retail enterprises, may issue credit cards. Credit cards issued by private business enterprises can only be used for purchases in the business chain in question. Credit cards issued by financial institutions can be used for cash withdrawals from ATMs and as a payment instrument in shops nationally as well as internationally. Examples of international credit cards include MasterCard, which is issued by Danish banks, Diners, Eurocard and American Express, which are issued in Denmark by, respectively, SEB and Danske Bank.

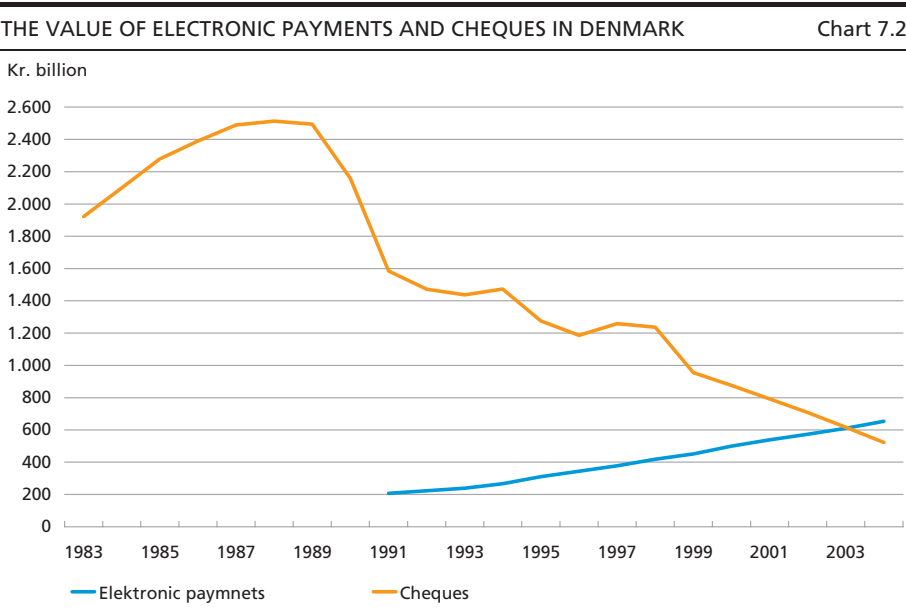
7.1.3 Use of payment instruments in Denmark

The number of cheque transactions has declined since the introduction of the Dankort in 1983, cf. Chart 7.1. The value of cheque transactions was, however, very high up until the introduction of electronic payments, e.g. in the form of Betalingsservice (direct debit) in 1974 and LeverandørService in 1981¹. Other, more recent electronic payment instruments, such as OverførselsService (transfer service) and e-invoice, and the use of online banking, have contributed further to the decline in cheque payments. Chart 7.2 illustrates the development in the value of payments by cheque compared with the total value of Dankort transactions and payments via direct debit and LeverandørService.

Since transactions between private business enterprises and the public sector have been mainly by cheque and the public sector previously made many payments to citizens by cheque, the value of cheque transactions was formerly high. The adoption by the Folketing (Parliament) of the Act on public sector payments is likely to further reduce the use of cheques. Under the act, all public-sector authorities must be able to receive and send electronic invoices as from February 2005. Moreover, the act requires all citizens and business enterprises to hold an account with a bank for receipt of electronic payments from the public sector.²

¹ Cf. www.pbs.dk.

² See *Act on public sector payments* (in Danish only) on the website of the the Danish Agency for the Governmental Management, www.oes.dk.



Note: Electronic payments comprise Dankort transactions, direct debit and LeverandørService. The three payment instruments were introduced in the 1970s and 1980s. The Chart shows electronic payments only from 1991, from which year consistent data is available for all three instruments. E-banking transfers, e-invoice and OverførselsService, etc., are not included in electronic payments in this Chart.

Source: PBS and Danish Bankers Association.

7.2 INFRASTRUCTURE FOR PAYMENT CARDS

In Denmark, clearing and settlement of payments using all the payment instruments described above are effected via the Sumclearing, cf. Chapter 6.

Payment cards (debit and credit cards) are used nationally and internationally by consumers to purchase goods and services. The account of a consumer who pays by payment card is debited with the amount of the payment, while the account of the retail enterprise is credited. Though the process seems uncomplicated, it does require an efficient infrastructure with a large number of agreements between the parties involved, i.e.

- *The card holder*; the person to whom the card is issued and thus the person authorised to use the payment card to gain access to own means of payment or to buy on credit.
- *The card issuer*; the business enterprise issuing the payment card to the card holder. The card issuer may be a financial institution or a retail enterprise¹.
- *The recipient*; a retail enterprise, restaurant, etc., selling goods or offering services against payment using a payment card.

¹ E.g. petrol companies or retail chains issuing charge cards to their customers.

- *The acquirer*; the financial institution ensuring that the recipient receives money for the sale.

The elements of the infrastructure for payments using payment cards are described below.

7.2.1 Payment cards

A payment card is developed and owned by a national or an international company. The company issues licences to financial institutions, authorising them to issue and accept payment cards bearing the logo in question, subject to a given set of rules. The issuer and the acquirer pay a licence fee for this right.

Payment cards were previously provided with a magnetic stripe, a signature and a PIN. However, the magnetic stripe has turned out to be relatively easy to copy, which has led to some fraud. As a countermeasure, the EMV security standards¹ have been developed. The standards recommend, among other things, that payment cards be equipped with an electronic chip to make copying more difficult.

7.2.2 Payment terminal

A recipient accepting payment cards must have a payment terminal. The terminals are required to be approved by certification to ensure they are equipped with the necessary software and hardware.

7.2.3 Terminal operator

A terminal operator is responsible for collecting the payment transactions from the recipient and forwarding them to the acquirer. The terminal operator is also in charge of authorising the transactions, i.e. for checking that the card is valid and has not been blocked and that the PIN is correct. This authorisation is based on information provided by the card issuer, who updates the information on a daily basis. In Denmark, the task of terminal operator is undertaken by PBS (Payment Business Services), cf. section 7.3.3.

7.2.4 Service provider

A service provider is a data centre that provides the infrastructure between the card issuer and the acquirer and ensures exchange of information between the parties. Against the background of the pay-

¹ The EMV security standards have been developed by Europay, MasterCard and Visa. The EMV chip card will be phased in gradually. In this connection, the card companies have introduced a liability shift. This entails that the party, i.e. the card issuer or the acquirer, who does not have a chip will be liable for any losses in the event of misuse of the card by a third party.

ment transactions collected by the terminal operator, the service provider clears the payment transactions. If a payment has been made using a foreign credit card, it is sent to the foreign service provider in question, cf. Box 7.2. PBS (Payment Business Services) is the service provider in Denmark.

7.2.5 Network

The network for exchanging payment data between the parties involved is often provided by a telecommunications company, e.g. TDC in Denmark.

7.2.6 Settlement system

When the payments have been cleared by the service provider, they are reported to a national retail payment system. The final settlement is effected in the retail payment system when the payment is debited to the card issuer's account and credited to the acquirer's account. For a description of the Danish retail payment system, the Sumclearing, see Chapter 6, and for a description of the international retail payment systems, see Chapter 8. The process behind a payment using an international credit card is described in Box 7.2.

A MASTERCARD PAYMENT BY A DANISH CARD HOLDER ABROAD	Box 7.2
<p>When a Danish card holder uses a MasterCard in a payment terminal in the USA, an electronic connection is immediately established to PBS International for authorisation of the card. The connection is established via the retail enterprise's acquirer and the service providers of respectively the USA region and the European region. The first four digits of the card number identify its country of issue. The payment is then authorised or rejected on the basis of the information from PBS International.</p> <p>The retailer's authorised payments are sent via the service providers of the two regions to an international private bank where payments are cleared for each licensee. PBS International, in its capacity as Danish licensee for a number of international credit cards, holds a settlement account with the international bank. All foreign use of the Danish credit cards for which PBS International is licensee, is settled via the settlement account. All payments made in Denmark using the equivalent foreign credit cards are settled via the same account.</p> <p>Once the settlement has been effected at the international bank, the payment has to be cleared in the Danish retail payment system, the Sumclearing. Since PBS International is not a settlement participant in the Sumclearing system, it uses a Danish bank as settlement bank. The card holder's MasterCard purchases are therefore debited to the card holder's issuer at the same time as PBS International's settlement bank is credited in the Sumclearing system. The card issuer handles the final collection from the card holder.</p>	

7.3 THE DANKORT

The Dankort is a nationwide card developed by the Danish banks in a joint venture. Thanks to the Dankort, all Danish banks, irrespective of size and number of branches, are able to offer their customers a payment card that is known and accepted across the country. The Dankort thus supports the Danish financial infrastructure with a large number of small banks.

7.3.1 The background to the introduction of the Dankort

The idea of creating a national Danish payment card was conceived in the late 1960s at which time Danish banks and savings banks set up a payment systems committee. The background was the fear that Danish or foreign card companies might introduce a payment card in Denmark, enabling them to control much of the payments system. The plan was for Pengeinstitutternes Betalingsformidlingscenter, PBC¹, to undertake the task. The idea was shelved, however, and not reintroduced until 1975, when the banks between them bought Eurocard². With this purchase, the banks acquired not only an international credit card, but also knowledge that could be applied to the development of a national payment card.

In 1979, Pengeinstitutternes Købe- og Kreditkortaktieselskab, PKK, was established with the main objective of designing the Dankort. PKK initially proposed that the Dankort should be a traditional credit card with interest-free credit from the date of purchase to the date of settlement. The card was to be financed by the retail enterprises via a commission on the turnover settled via the card. This proposal was met with fierce criticism from consumers and retail organisations. The criticism prompted the banks to withdraw their plans for a credit-based Dankort. Instead, they chose to develop the Dankort as an online-based debit card.³

7.3.2 The development of the Dankort

The Dankort was launched in 1983 as a voucher system using only manual imprinters. The Dankort was a debit card with the prescribed international measurements, a magnetic stripe and a PIN. The magnetic stripe was to be encoded with the card number, the card holder's bank and account number, the date of issue and security codes. The card

¹ PBC (Payment Business Services) was established in 1971 with the objective of developing and running computer-based, automatic payment systems on behalf of the banks. From its inception, PBC started to develop a joint infrastructure and in 1974 launched a nationwide system for collection of bills (Betalingservice – direct debit).

² Eurocard was later acquired by PBS International, which in June 2004 sold the issuing rights to SEB Kort.

³ Cf. The Danish Ministry of Industry (1985).

holder's civil registration number was to appear on the front of the card. Moreover, the Dankort carried the logo of the issuing bank on one side and the logo of PKK on the other.

In 1984, the banks introduced DK-Kontanten. DK-Kontanten was the first outdoor ATM, enabling Dankort holders to withdraw cash 24 hours a day, 7 days a week.

The electronic Dankort system, by which the Dankort was to be used online, was tested in 1984 and launched nationwide in 1985. The electronic Dankort system was to replace paper-based vouchers, thereby streamlining the payment procedure.

As a result of the Folketing (Parliament's) adoption of the Payment Cards Act in 1985, cf. Box 7.4, the civil registration number was removed from every Dankort. At the same time, the banks revised the appearance of the Dankort and introduced a new Dankort with the holder's photo as from 1 January 1986.

In 2003, the Danish banks introduced the eDankort that enables the consumer to make online payments without specifying card information. Use of the eDankort requires the online retailer to be connected to the system, which is indicated by an eDankort logo on the website. A click on the logo takes the consumer directly to his online banking system, where the payment can be authorised.

In the course of 2004, all magnetic stripe-based Dankort and Visa/Dankort were replaced by new chip cards. The laser engraved photo and signature were removed with the introduction of the new chip Dankort.

7.3.3 Ownership of the Dankort, PBS and Dankort A/S

In 1984, the Danish banks set up PBS¹ with a view to coordinating initiatives in the retail payment area. Two years later, PBS merged with PKK (Pengeinstitutternes Købe- og Kreditkortaktieselskab) and PBC (Pengeinstitutternes Betalingsformidlingscenter) and thus acquired the rights to the Dankort. In 1988, PBS Holding launched the Visa/Dankort in collaboration with Bankforeningen and Sparekasseforeningen (the former Bankers Association and the former Savings Bankers Association). As a result, consumers were given a choice between the traditional Dankort and a co-branded Visa/Dankort, which can be used both nationally and internationally.

In 1997, PBS was converted into a holding company, PBS Holding A/S², its shareholders being the Danish banks. PBS Danmark was in charge of

¹ Payment Business Services, PBS, which at that time stood for Pengeinstitutternes BetalingsSystemer.

² PBS Holding became the parent company of PBS Danmark, PBS Danmønt, PBS International, PBS multidata, PBS Data and PBS Finans.

running the Dankort system and acted as the only Dankort acquirer. In January 2001, the Dankort rights were spun off from PBS Danmark and transferred to the newly established Dankort A/S, which is owned by the Danish banks. Later that year, the Danish banks assumed the role of acquirer from PBS Danmark. Recipients were therefore able to choose which bank to use as acquirer. The present PBS A/S acts as acquirer when the Dankort is used for online payments.

In 2003, PBS Holding was divided into three separate groups: PBS, Multidata and PBS International. PBS is in charge of PBS clearing, cf. Chapter 6, and of various PBS products, e.g. Betalingsservice (direct debit), LeverandørService (supplier service) and e-invoice. PBS also acts as service provider to issuers and acquirers of the Dankort. Multidata provides products within staff and payroll administration, while PBS International acts as acquirer for MasterCard, Eurocard, Visa, Visa Electron, Maestro and JCB.

7.3.4 Payment terminals in Denmark

Recipients may choose between several payment terminals, not all of which have chip-reading technology. The first online payment terminals were magnetic stripe-based Dankort terminals, which only allowed use of the Dankort. The current Dankort terminals also accept international payment cards, provided the card holder has a PIN. Tele terminals, which can be used for the Dankort as well as other payment cards, are magnetic stripe-based and require the customer's signature or PIN. As a result of the launch of the chip card, the magnetic stripe-based terminals will in future be replaced by chip terminals. The most advanced chip terminals in the market are Flex terminals, which are able to read both magnetic stripes and chips on all national, international and private cards (cards issued by e.g. petrol companies or department stores). The flex terminal can be used for debit and credit cards as well as prepaid cards, and it accepts payment cards with several acquirers. As an additional feature, both PINs and signatures can be used in flex terminals.

The paper-based payment terminals, i.e. the manual imprinter, will be finally phased out in Denmark in 2005.

7.3.5 Costs and fee policy

The banks had as their financial objective a self-supporting, non-profit Dankort system. The Dankort was to be issued free of charge to all customers requiring a Dankort. The plan was for some of the banks' costs to be covered by recipients and card holders. On the implementation in 1983, card holders were therefore charged a fee of kr. 0.50 for each transaction. In addition, retail enterprises linking up to the system

were to cover their own costs of acquiring and operating the terminals, while the banks were to cover the costs of establishing and running the Dankort system.

Consumers found it difficult to accept the kr. 0.50 fee per transaction. Therefore, the banks and PKK agreed to abolish the fee on 1 January 1985. However, it was possible for a bank to charge a separate card holder fee and the parties agreed that the fee should be equal to the fee for a cheque payment¹.

In its start-up phase, the Dankort was, as mentioned earlier, a paper-based system. As a result, the processing of Dankort transactions was quite time-consuming. Therefore, the fee policy vis-à-vis retail enterprises was altered. Retailers that only returned transaction vouchers to PKK were to pay a fee of kr. 2 per transaction, while retailers that entered and submitted their transactions on magnetic tape could reduce their transaction fee to as little as kr. 0.15.

To induce the retail sector to support the launch of the electronic Dankort system, the transaction fee levied on the retail enterprises was suspended until 1 April 1985. After this date, the fee was to be reintroduced for retailers that had not signed an agreement to connect to the electronic Dankort system. The fee was never reintroduced, however, as the Folketing (Parliament) adopted a law in 1985 that prohibited the costs of the card issuer from being passed on to the recipients, cf. Box 7.4.

Under the Dankort agreement of 2003, the banks were entitled to charge retail enterprises a maximum fee of kr. 0.50 per Dankort transaction as from 1 January 2005, cf. Box 7.4. However, no fee was to be charged on the first 5,000 transactions, unless the retailer was part of a retail chain.²

In practice, the banks charged retailers the maximum fee of kr. 0.50 per transaction. Virtually all retailers chose to pass on the kr. 0.50 to the consumers, giving rise to harsh criticism. Up to the general election in February 2005, an electoral pledge was made to relieve the consumers of the fee. Against this background, the Ministry of Economic and Business Affairs invited Danish Bankers Association and Danish Commerce & Services to attend talks on the future of the Dankort. The talks resulted in a new Dankort model, cf. Box 7.3.

In addition to the costs of operating the Dankort system, the banks pay a licence fee to Dankort A/S and a transaction fee to the service

¹ The arrangement for cheques was often that a certain number of cheque payments were free and any cheque payments exceeding that number were subject to a small fee per cheque payment.

² In a report from 2005, the Danish Competition Authority calculated that the banks would be able to generate revenue of approximately kr. 180 million per year from the fee. The Danish Competition Authority calculated the costs of operating the Dankort system at just under kr. 600 million per year.

THE DANKORT MODEL 2005

Box 7.3

The three main elements of the Dankort model are:

- The kr. 0.50 fee charged to consumers was abolished on 1 March 2005.
- Retail enterprises contribute to the costs of the card's infrastructure via an annual subscription.
- The banks increase their financial contributions to running the Dankort.

The annual subscription payable by the retail enterprises is determined on the basis of size. Small retailers with less than 5,000 transactions a year pay approximately kr. 500 per year. Medium-sized retailers pay approximately kr. 2,700 and large retailers with more than 20,000 annual transactions pay approximately kr. 10,000 a year. The final terms of the subscription have not yet been determined (mid-2005). As a result of the Dankort model, the Act on Certain Means of Payment is amended, the date of expected commencement being 1 July 2005. The amendments are to apply until 2010.

provider (PBS). Moreover, the banks cover most of the card holders' losses in connection with misuse of the Dankort.

Throughout the history of the Dankort, the banks have sought to have recipients and Dankort holders cover some of the operating costs. However, the legislation in this area, cf. Box 7.4, entails that this goal has only been realised in part with the new Dankort model in 2005.

The impact of the Dankort fee on the consumers' payment behaviour is difficult to gauge as the use of the Dankort and the circulation of banknotes are subject to seasonal variations. Box 7.5 describes the development in Dankort payments and cash circulation in the period from January 2003 to April 2005.

7.4 NEW PAYMENT INSTRUMENTS

The increase in households' use of the Internet and mobile phones has opened up the market for non-physical trading and thereby e- and m-payments. E-payments are payments made via the Internet, while m-payments are payments made via mobile phone. The payment card remains the payment instrument most widely used in non-physical trading. Several system providers do offer alternatives, however, since payment cards are not designed for non-physical trading. These alternatives are explored below.

7.4.1 E-payments

Consumers often use debit or credit cards for Internet purchases. The consumer orders the goods on the Internet and chooses which payment card to use for the transaction. The consumer keys in the card number

As a result of the introduction of the Dankort in 1983, the Folketing (Parliament) adopted the Payment Cards Act in 1985. Below is an overview of subsequent amendments to the act.

Payment Cards Act 1985

The Payment Cards Act took effect on 1 January 1985. Section 20 read as follows: "The card issuer's costs of operating the payment system cannot be charged to the recipient". The act also stipulated that civil registration numbers could not be used on payment cards.

Payment Cards Act 1999

The amendments distinguished between physical and non-physical (e.g. online) trading. It was adopted that section 20 was to apply only to physical trading. This means that online retail enterprises may be charged a fee for the customer's use of a payment card.

The bill contained a revision provision, stipulating that the Folketing (Parliament) was to revise section 20 in autumn 2001. The revision was to determine whether full preconditions had been created for real competition in the market for payment cards. If that was the case, section 20 was to be abolished. The preconditions for full and real competition were as follows:

- A number of banks acted as issuers of the Dankort;
- A number of banks acted as acquirers of Dankort transactions;
- The banks did not make any technical requirements to prevent retailers from effecting transactions on the same terminals, regardless of whether a Dankort or other payment cards were used; and
- The acquirer of Dankort transactions did not make any technical requirements to prevent the recipient's Dankort terminal from being connected to the terminals of other acquirers/operators than the banks or PBS.

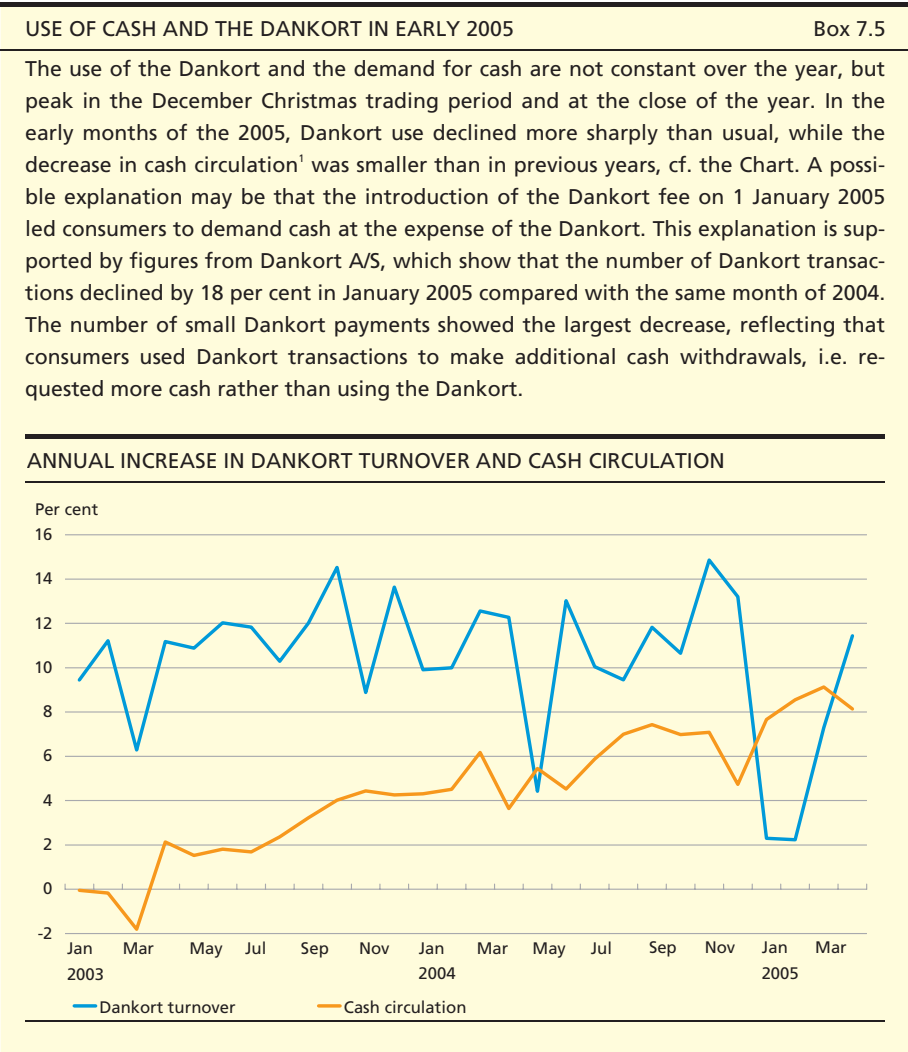
Under the amendments, retailers were authorised to pass on any fees to the card holders. Section 14 stated: "The recipient may charge the card holder a fee for the payment transaction. The size of the fee must not exceed the fee payable by the recipient to the acquirer for the payment transaction".

The Dankort agreement 2003

In April 2003, the Danish Ministry of Economic and Business Affairs entered into an agreement with Danish Commerce & Services, the Danish Consumer Council and the Danish Bankers Association on the new Dankort fee rules. As from 1 January 2005, the banks were authorised to charge of fee of up to kr. 0.50 from the businesses when chip Dankort were used. The retailers could opt to pass on the fee to the consumers, cf. section 14.

The Dankort agreement was adopted by the Folketing (Parliament) as an amendment to the existing Act on Certain Means of Payment which replaced the Payment Cards Act in 2000.¹

¹ Cf. www.oem.dk.



and the expiry date of the payment card, thereby authorising the creditor to debit the amount to the card.

As payment cards are not designed for non-physical trading, the rising popularity of e-payments has resulted in increased misuse. In non-physical trading, the recipient has no way of knowing whether the card used actually belongs to the consumer and whether the card is genuine. Therefore, efforts are under way to develop new security elements for non-physical trading. Two such examples are described in Box 7.6.

To offer an alternative to the use of payment cards in non-physical trading, several providers offer a solution based on an e-account. For the e-account solution, the consumer sets up an e-account on a central server. The consumer can then transfer money to the e-account from his

SECURITY ELEMENTS FOR NON-PHYSICAL TRADING	Box 7.6
<p>The security element CVV/CVC, which is applied by Visa and MasterCard, verifies the security digits on the reverse of the payment card. The use of security digits has been introduced in Denmark. Another security element, AVS, matches numbers from the card holder's address with information from the card issuer. AVS is currently not used in Denmark. The aim of CVV/AVS is to provide recipients with additional information to ensure that as few fraudulent e-payments as possible get through the system.</p> <p>Visa, MasterCard and JCB have implemented a payment solution based on the 3D-Secure standard, i.e. the rules and standards formulated by Visa and MasterCard for Internet-based card payment transactions. This solution is designed to ensure that only the authorised person uses the payment card.</p> <p>With the 3D-Secure standard, foreign card holders with international payment cards typically use a personal code for online payments. When Danish card holders with international payment cards make online payments, the solution provides for verification of the card holder's identity.</p>	

debit or credit card via the existing payments infrastructure. Once money has been transferred to the e-account, the consumer can shop online without revealing his card number; this ensures that the card information is not misused. To pay for online purchases, the consumer transfers money from his e-account to the vendor's e-account. The same procedure applies if the consumer wishes to make a credit transfer to another consumer. All transfers between e-accounts take place in a closed payment system outside the existing payments infrastructure.

The e-account principle is not currently very widely used in Denmark. The US system PayPal, on the other hand, is commonly used for national as well as cross-border payments. PayPal is an example of a payment system created to overcome the problems of the non-existent infrastructure for cross-border retail payments. Work is currently underway to create a joint infrastructure on the European retail payments market, cf. Chapter 8 on SEPA.

Visa and MasterCard have developed new methods for credit transfers, Visa Direct and MoneySend. The aim is for Visa Direct and MoneySend to simplify and streamline national and cross-border credit transfers for Visa and MasterCard customers. Using a mobile phone or the Internet, the card holder can initiate a transfer to another card holder from the same card company by stating the other card holder's e-mail address or card number. If the remitter only specifies the recipient's e-mail address, the card company sends an e-mail to the recipient, requesting the recipient to give the specific card information, after which the amount is transferred.

7.4.2 M-payments

Several mobile phone companies offer their customers various m-payment solutions for non-physical trading purchases:

- The customer pre-registers his payment card and subsequently needs only to authorise the payment. This means that the customer does not have to key in the card information for each payment.
- The customer purchases products via mobile phone and the purchases are charged to his next phone bill.
- The customer purchases prepaid airtime, which can be used for purchases of other goods from a third party. The telephone company then pays the third party and deducts the purchase amount from the remaining prepayment.

7.4.3. Danish examples of e- and m-payments

In Denmark, the e-payment systems, Valus and ewire, operate under the e-account principle. Valus was launched as the first e-payment system in Denmark in May 2002. Participants set up a Valus account to which transfers can be made from debit or credit cards. The only prerequisite to establishing a Valus account is that potential participants have an e-mail address. Via their Valus accounts, participants can make credit transfers to other Valus account holders and make online purchases from websites linked to the Valus system. Participants can initiate their transfers and purchases via the Internet or via mobile phone. Valus sends the participant a text message when a transfer is made to the Valus account or if the balance falls below a minimum specified by the participant.

Ewire is another Danish e-payment system that enables participants to make credit transfers and purchases from websites linked to the system. Overall, ewire functions in the same manner as Valus, the only difference being that with ewire, participants can make transfers to non-ewire participants, provided the recipient has an e-mail address.

M-pay is an example of a Danish m-payment solution, enabling the customer to use his mobile phone to place orders with and pay for goods from retail enterprises linked to the system. The customer pays for the purchases by stating his mobile phone number, after which the retailer sends a text message as confirmation. The customer authorises the purchase by replying to the text message. The purchases are subsequently received at the customer's address. M-pay is suspended in 2005.

Another Danish example is a parking-meter solution that allows the customer to make parking-meter payments by mobile phone. The customer signs up for the scheme and registers his payment card. The cus-

tomter then receives a bar-coded sticker, which is linked to the customer's mobile phone number and payment card. The sticker is placed on the front windscreen of the customer's car. When the customer wishes to park, a call is placed to an auto-dial service and the customer makes the payment. The customer receives a warning text message 10 minutes before his parking time expires. This text message also enables the customer to extend the parking time.

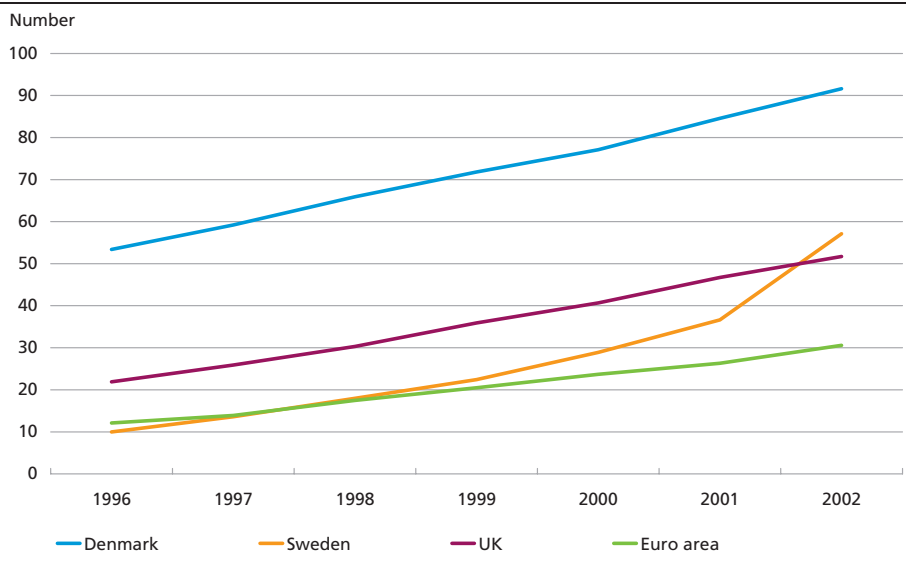
7.5 USE OF PAYMENT CARDS IN EU MEMBER STATES

In most EU member states use of debit cards is growing. Denmark, however, has the highest number of debit card transactions per capita, cf. Chart 7.3.

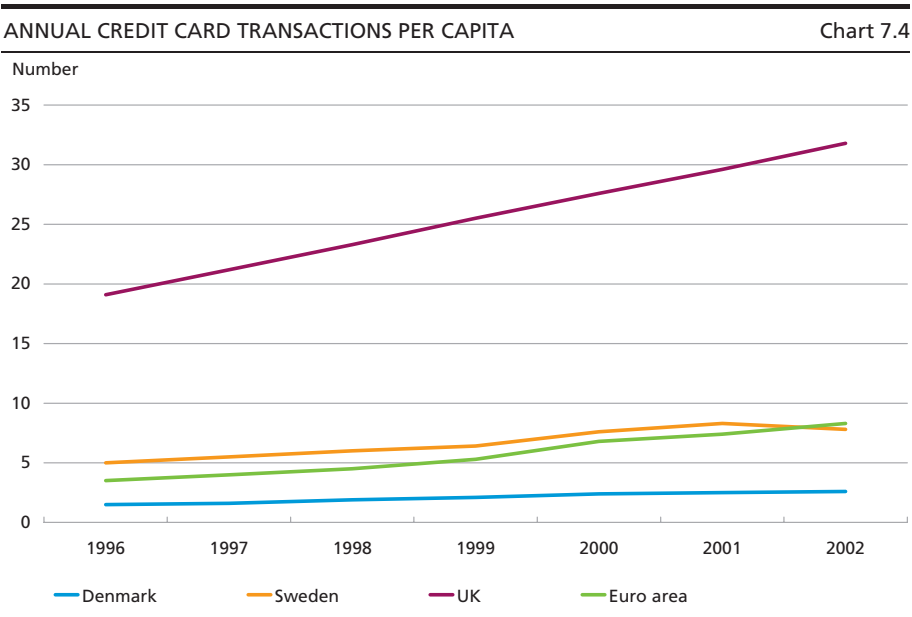
In some European countries, especially the UK, credit cards are used rather than debit cards, cf. Chart 7.4. Recently, there have been examples of multi-branding credit cards with payment cards issued by private retail enterprises. These multi-branded credit cards give the customer access to various discount schemes when the card is used frequently for purchases from the individual retailers.

Recent years have seen a slight upward trend in Danish credit-card use. The incentive for Danish consumers and retailers to use credit cards has been low due to the strong position of the Dankort as a joint national payment card. Denmark thus differs from other countries where pay-

ANNUAL DEBIT CARD TRANSACTIONS PER CAPITA Chart 7.3



Source: ECB (2004).



Note: The statistics for credit-card transactions in Denmark only include cards for which PBS International acts as acquirer, e.g. MasterCard and Eurocard.
Source: ECB (2004).

ment cards are typically issued by individual banks or by a few banks working together. The early establishment of the Dankort as a debit card has entailed that the opportunities to use credit cards for daily purchases have been limited in Denmark.

One reason for the success of the Dankort is that Danish legislation prescribed that the Dankort, unlike other debit cards, should be free of charge for consumers and retailers, cf. Box 7.4. Other EU member states do not have similar legislation and the recipients often pay a transaction fee to the acquirer for accepting debit and credit cards, cf. Table 7.1.¹

Whether or not recipients charge card holders a fee for using payment cards varies from one EU member state to the next. In some member states, the retail sector can pass fees on to the card holders, while other member states, such as Denmark, have imposed a ban on this practice.²

The banks often make it part of the terms of agreement that retailers are not entitled to pass on fees directly to the consumers. Visa has, for instance, adopted an international No-discrimination-rule (NDR), which prevents recipients from passing on taxes, fees, etc., payable to the

¹ Cf. The Danish Competition Authority (2002).
² Whichever fee policy is pursued, the costs must ultimately be assumed to be covered by the consumers.

TRANSACTION FEE FOR ACCEPTANCE OF PAYMENT CARDS, 2001

Table 7.1

Country	Average fee rate, debit card payment	Average fee rate, credit card payment
Denmark	kr. 0	3.25 per cent
Finland	kr. 0	1.35 per cent
Belgium	kr. 0.41	3,3 per cent
Sweden	kr. 1.25	kr. 1.75 + 2 per cent
Netherlands	kr. 1.50	3.5 per cent
Norway	kr. 0.00 – 4.00	3.2 per cent
UK	kr. 3.40	1.85 per cent
Italy	1.05 per cent	2.9 per cent
France	1.28 per cent	1.28 per cent
Austria	kr. 1.0 + 1.08 per	3.48 per cent
Germany	1.4 per cent	2.4 per cent
Spain	3.14 per cent	3.14 per cent
Portugal	4.0 per cent	4.0 per cent

Source: Danish Competition Authority (2002).

acquirer, to Visa card holders. The NDR rule is not used in countries in which the legislators or competition authorities have laid down a ban on the rule.

7.5.1 Multi-purpose card

Since the early 1990s, chips have been used in various types of prepaid cards in Denmark, e.g. telephone cards or Danmønt cards. Most of these cards have not been very successful. One example of a successful prepaid card is the London travel card, Oyster. This card gives access to all London buses and tube (underground) lines and is activated when the customer swipes the card through a card reader.¹

Some countries have sought to seize the opportunity provided by the banks' introduction of chip cards to develop a multi-purpose card² that integrates debit and e-money functions. It is possible to upload money onto an e-money card and use it in the same way as a prepaid card. The advantage of combining the two cards is that a payment transaction using an e-money card is significantly less expensive than a payment transaction using a debit card because the e-money card is used offline. An offline transaction is inexpensive because the card does not have to be authorised and settled in the payment system, since money is transferred directly from the e-money card to the recipient's account. Multi-purpose cards are often co-branded with an international debit

¹ Efforts are underway to establish a Danish travel card for all types of public transport in Denmark.

² According to the schedule, the implementation will start in 2008 and is due to be completed by 2010. The Belgian Boncontact/Mister Cash card, which is co-branded with Maestro, is an example of a successful multi-purpose card.

card, e.g. Maestro or Visa Electron, to allow the card to be used internationally. As an added benefit, the chip of a multi-purpose card may be encoded with data from other cards, such as driving licences and national health service cards. This means that the consumers will need far fewer cards than is currently the case. A larger chip than the one introduced in 2004 will be required to make the Dankort a multi-purpose card.

LITERATURE

Allen, Helen, 2003. Innovations in retail payments: e-payments, Bank of England *Quarterly Bulletin*, Winter 2003.

ECB, 2004. *Payment and securities settlement systems in the European Union – Addendum incorporating 2002 figures*, Blue Book, April 2004.

Danish Bankers Association, 2001. The Open Infrastructure of Banks (in Danish only), *Finansanalyse*, no. 13, 2001.

Hansen, K.E. and S.A. Svendsen, 1968, *Danish Monetary History*, vol. 1, 1700-1914 (in Danish only), Danmarks Nationalbank.

The Danish Ministry of Industry, 1982. *Report on Payment Cards* (in Danish only).

The Danish Competition Authority, 2002. *Competition Conditions in the Payment-Card Market 2002* (in Danish only).

The Danish Competition Authority, 2005. *The Danish Competition Authority's Analysis of the Dankort Fee* (in Danish only).

Sundorph, S. and J.J.K. Gregersen, 1990. *The History of the Danish Postal Giro System 1920-1990* (in Danish only).

Thorndal, J., 1994. Prepaid Cards, Danmarks Nationalbank, *Monetary Review*, August 1994.

Thygesen, C. and M. Kruse, 1998. Electronic Money, Danmarks Nationalbank, *Monetary Review*, 4th Quarter 1998.

www.finansraadet.dk.

www.dankort.dk.

www.oes.dk.

www.oem.dk.

www.pbs.dk.

www.videnskabsministeriet.dk.

8. International Payment and Settlement Systems

The introduction of the euro in January 1999 was one of the key prerequisites to the creation of a homogeneous market in which money can be transferred quickly and inexpensively within the euro area. To support this market, it was necessary to set up European payment systems. Chapter 6 describes the Danish payment and settlement systems in detail, while this chapter focuses on a number of important European systems with Danish participation. Three of the systems, Target, the future Target2 and EURO1, are large-value euro payment systems, while the remaining two, STEP1 and STEP2, are retail payment systems.

The chapter concludes with a description of the international foreign-exchange settlement system CLS, which clears and settles foreign-exchange transactions in 15 currencies.

8.1 TARGET

In connection with the introduction of Economic and Monetary Union in January 1999, the European Central Bank (ECB) and the central banks of the then 15 EU member states launched a trans-European euro payment system called Target¹. The objective of Target was to provide a fast and secure system for cross-border payments in euro, and thus to facilitate the ECB's monetary-policy transactions.

In technical terms, Target is a decentralised payment system comprising the 15 national RTGS systems plus the ECB's system. These 16 RTGS systems communicate via a shared module, the interlinking module, whereby participants can transmit payments in euro to each other via SWIFT, cf. Chapter 6, Box 6.2.

To become a direct participant in Target, the participant must hold an account in euro with its national central bank. In addition, all participating central banks hold accounts with each other. All cross-border payments in euro take place via these accounts, cf. Box 8.1. Danish participants send and receive their payments in euro via Danmarks Nationalbank's RTGS system, Kronos, cf. Chapter 6, section 6.1. Indirect participa-

¹ Trans-European Automated Real-Time Gross Settlement Express Transfer System.

TARGET AND TARGET2	Box 8.1
<p>Target is a decentralised payment system comprising a total of 16 RTGS systems communicating via a shared module, the Interlinking module. Communication is SWIFT-based. The direct participants hold accounts in euro with their national central banks, and the participating central banks all hold accounts with each other. Via the central banks' accounts, national participants' cross-border payments are received and forwarded. In addition, the central banks can settle their own payments on the same terms as the other participants. Ancillary systems settling e.g. securities transactions in euro are not directly linked to Target; they are primarily national.</p>	
<p>STRUCTURES OF TARGET AND TARGET2</p>	
<p>The diagram illustrates the structural differences between TARGET and TARGET2. On the left, the TARGET structure is shown as a decentralized network. It features a central 'Interlinking module' (a large circle) that acts as a hub. This module is connected to three separate Central Bank (CB) nodes (circles). Each CB node is further connected to its own set of participants: some are Direct participants (D) and others are Ancillary systems (AS). This creates a complex web of connections where all communication must pass through the central interlinking module. On the right, the TARGET2 structure is shown as a centralized system. It features a single 'Single shared platform' (a large circle) at the center. All participants, including Central Banks (CB), Direct participants (D), and Ancillary systems (AS), connect directly to this single platform. This simplifies the architecture by eliminating the need for a central interlinking module and direct participant accounts at other central banks.</p>	
<p>Target2 comprises a single shared RTGS system on a shared SWIFT-based platform. All direct participants hold accounts on the platform, from which payments are sent and received. Since Target2 is a shared system, there is no technical difference between national and cross-border payments, and so there is no need for special central-bank accounts for forwarding cross-border payments. For settlement of their own payments, central banks connect to Target2 in the same way as the direct participants. The ancillary systems are also linked directly to the single shared platform. From a technical point of view, the establishment of Target2 will thus make it considerably easier to participate in e.g. securities settlement systems in other member states.</p>	

tion in Target is possible via a direct participant that acts as settlement bank.

8.1.1 Target settlement cycle

Between 7.00 a.m. and 5.00 p.m. on all days that Target is open, customer payments can be submitted to Danmarks Nationalbank for immediate settlement. Interbank payments can be submitted until 6.00 p.m. Via

SWIFT, participants submit a payment instruction identifying the final recipient and its central bank. When Danmarks Nationalbank receives the SWIFT message, a check for adequate cover is first performed. If there is adequate cover for the payment, Danmarks Nationalbank debits the euro current account of the payment transmitter and credits the account of the recipient's national central bank. A SWIFT message is sent to the recipient's central bank, which then credits the recipient's account and forwards a message to the recipient via the national RTGS system. The payment then follows the description in Chapter 6 on Kronos.

8.2 TARGET2

Ever since the establishment of Target, various models for a new version of the system have been discussed. It has, however, proved to be difficult for the participating central banks to reach agreement on a concrete model since they have very different views on the extent to which tomorrow's Target should be centralised.

At a meeting in October 2002, the ECB's Governing Council¹ took a strategic decision on the elements of the next-generation Target, known as Target2. The decision primarily entails the establishment of a single shared platform (a common RTGS system) for all participants. However, the national central banks still handle customer relations with national participants.

The background to this decision was, *inter alia*, that users perceive the services offered under the current decentralised structure as very heterogeneous across national borders. In addition, the cost-effectiveness of the system as such is low, and finally it is doubtful whether the current system will be able to meet the future challenges, including new member states' adoption of the euro.

In July 2003 the central banks of Germany, Italy and France offered to jointly develop a new system as the single shared platform for Target2. In December 2004 the Governing Council of the ECB accepted the offer from these three central banks to develop and operate Target2, which is expected to be implemented in the second half of 2007.

It has been decided that migration from the existing Target to Target2 will take place in three waves, since it is deemed to be too risky both technically and operationally for all members to migrate to the new platform at the same time.

Box 8.1 compares the structures of Target and Target2.

¹ The Governing Council is the ECB's supreme decision-making body. It comprises the ECB's Executive Board and the central-bank governors of the euro area member states. The Governing Council lays down the common monetary policy within the euro area, and its 18 members have one vote each.

8.2.1 Participants in Target2

Both direct and indirect participation in Target2 will be possible. Direct participants will hold an RTGS account on the single shared platform, from which payments will be settled, cf. Box 8.1. Indirect participation in Target2 will take place via a direct participant. Indirect participants will be registered on the platform, but will not hold RTGS accounts themselves. Communication between the direct participants and the single shared platform will take place via the international payments network, SWIFT.

8.2.2 Structure of Target2

The common platform will comprise a number of modules, as seen in other RTGS systems, including Kronos. Some modules will be mandatory for the participating central banks, while others will be optional.

Target2 will offer participants a wide range of facilities for liquidity management, including prioritisation of payments, reservation of liquidity and setting of bilateral and multilateral limits vis-à-vis other participants. These limits will be debit limits, i.e. they will indicate the maximum amount a participant is willing to send to another participant (bilateral limit) or to all other participants (multilateral limits) without receiving payments first. Participants may also fix a specific time or period for execution of a given payment transaction. Furthermore, the system will apply various liquidity-saving mechanisms, which will continuously seek to settle queued payments – taking into account the reservations and limits determined. There will be a queue for each type of prioritisation.

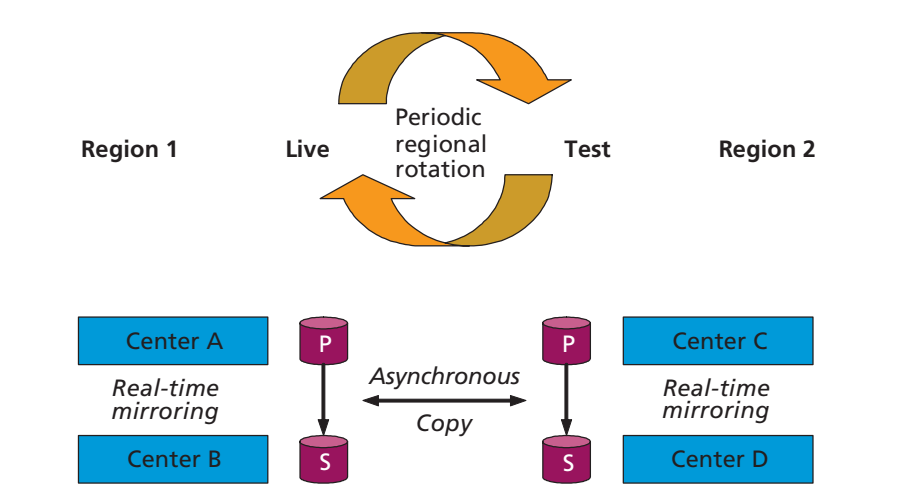
For participants represented in several countries it will be possible to centrally manage the aggregated liquidity available in the RTGS accounts on the single shared platform that are held by units within the same group. However, this only applies to euro area accounts. This facility, known as liquidity pooling, entails that it will no longer be necessary to transfer liquidity between various participants within the same financial group during the day. At the end of the day, a levelling-out procedure will ensure that none of the group's accounts show a deficit.

The single shared platform will have an information and control module where participants can monitor liquidity in their RTGS accounts, view queued incoming and outgoing payments, and change priorities, reservations and limits, etc.

The RTGS part of the single shared platform will be operated in both Germany and Italy on a rotation basis, cf. Chart 8.1. The region not operating the system will act as the back-up region. In each of the two regions a primary and a secondary operations site will be established,

IT STRUCTURE OF TARGET2

Chart 8.1



Source: ECB.

and data will be transferred between the two operations sites on a continuous basis (real-time data mirroring). If both sites in a region fail, it must be possible to resume operations in the other region within two hours. France will operate selected modules such as a data warehouse.

All ancillary payment and settlement systems, such as the VP System and the Sumclearing in euro, must settle the participants' positions on the single shared platform within four years of the launch of Target2. They will connect to the platform via a special interface offering a selection of settlement models, including real-time settlement (RTGS settlement) and bilateral and multilateral net settlement, cf. Chapter 3. One of the advantages of settling all systems on the single shared platform is that a Target2 participant that participates in several of these ancillary systems can settle all of its positions via one account and thus streamline its use of liquidity.

No participants are expected to have to pay more than 80 eurocents for a transaction, and the marginal price for the largest participants is expected to be 25 eurocents.

8.3 EURO1

In addition to Target and the future Target2, the EU member states have three other payment systems for handling large-value payments in euro. These are the French PNS, the Finnish POPS¹ and the pan-European

¹ The full names of these systems are: Paris Net Settlement (PNS) and Pankkien On-line Pikasiirrot ja Sekit-järjestelmä (POPS).

NUMBER OF PARTICIPANTS AND AVERAGE NUMBER OF DAILY TRANSACTIONS IN 2004 Table 8.1

	Number of transactions ('000)	Direct participants
Target	267	1,051
EURO1	161	73
PNS	27	21
POPS	2	9

Source: ECB.

EURO1. PNS and POPS offer continuous net settlement throughout the day, while EURO1 settles all transactions at the end of the day. As Table 8.1 shows, the majority of the transactions in euro are settled via Target or EURO1.

Table 8.2 shows the number and value of the transactions, as well as the respective market shares of Target and EURO1. STEP1 transactions (cf. below) are included in EURO1 transactions. As the Table shows, the total value of all Target transactions settled is significantly higher than the total value of all EURO1 transactions settled.

EURO1 is described in more detail below.

8.3.1 Background to EURO1

In the 1990s, the Euro Banking Association¹ (EBA) developed EURO1 to replace the ECU clearing. EBA Clearing was established in 1998 by 52 large international banks for the purpose of owning and operating EURO1. EURO1 was handed over to EBA Clearing and launched in January 1999, with the introduction of the euro. The infrastructure of EURO1 is SWIFT-based.

8.3.2 Structure of EURO1

EURO1 is a multilateral net settlement system in which each participant has one net position vis-à-vis all other system participants. This position changes continuously over the day as the participant sends and receives payments via the system. The net position is settled at the end of the day. A major difference in relation to ordinary net settlement systems is, however, that payments accepted by the system during the day are final and irrevocable. When a EURO1 payment has been accepted, it lies within the limits set by the participants vis-à-vis each other, cf. below. Payments which entail that these limits are exceeded are placed in a

¹ EBA comprises the European Investment Bank and 18 private banks.

PAYMENTS IN TARGET AND EURO1		Table 8.2
	2003	2004
<i>Target</i>		
Number of transactions, '000	66,608	69,213
Value of transactions, billion euro	420,749	443,993
Market share by value of payments, per cent	86.9	87.7
Market share by number of transactions, per cent .	57.8	57.9
<i>EURO1</i>		
Number of transactions, '000	38,852	41,724
Value of transactions, billion euro	44,734	44,125
Market share by value of payments, per cent	9.2	8.7
Market share by number of transactions, per cent .	33.7	34.9

Note: EURO1 payments include STEP1 payments, cf. section 8.4. The market shares of the systems are calculated as a ratio of all transactions in Target, EURO1, PNS, POP5 and SPI, which closed on 15 December 2004.

Source: ECB.

liquidity queue as in RTGS systems. The system continuously seeks to settle the queued payments on a FIFO basis, applying bypass, cf. Chapter 3, Box 3.1.

EURO1 payments for same-day settlement must be submitted to the system between 7.30 a.m. and 4.00 p.m. Within these hours participants can monitor changes in their net positions on an ongoing basis.

8.3.3 Participants in EURO1

EURO1 participants must meet the following criteria, among others:

- The participant's registered address must be in an OECD country or an EU member state.
- The participant must be a direct settlement participant in a payment system.
- The participant must have own funds of at least 1.25 billion euro.
- The participant's short-term credit rating must, as a minimum, be equivalent to P2 (Moody's) or A2 (S&P).
- The participant must have direct access to Target.
- The participant must be a member of the Euro Banking Association.
- The participant must unconditionally comply with the system's rules and related agreements.

8.3.4 Risk management in EURO1

As Chapter 4 describes, settlement in netting systems may involve a number of risks. Various risk management tools may be used to reduce or even eliminate these risks. In order to eliminate credit and liquidity risks, EURO1 applies two tools: a collateral pool and credit caps agreed between the participants.

Collateral pool

EURO1 has a collateral pool to which all participants have contributed an equal share. The pool is used in the event that one or several participants are unable to cover their negative net positions. If funds from the collateral pool are used for settlement, the pool must be re-established before new settlement cycles can begin. The value of the EURO1 collateral pool, which is deposited in an account with the ECB, is 1 billion euro. As a maximum, the pool will cover the situation where a single participant with the largest possible negative net position cannot meet its payment obligations. If several participants experience problems in the same settlement cycle, and the sum of these participants' negative net positions exceeds 1 billion euro, a number of supplementary measures¹ ensure that settlement can still take place.

Multilateral debit and credit caps

Each participant determines its own maximum exposure vis-à-vis each of the other participants, i.e. its credit caps. As a minimum, all EURO1 participants allocate each of the other participants a mandatory credit cap of 5 million euro. At its own discretion, each participant may increase the credit cap to 30 million euro per participant. A participant's multilateral credit cap is the sum of the bilateral credit caps allocated to the other participants by that participant and indicates the maximum amount that can be credited to (received by) that participant in EURO1. A participant's multilateral debit cap is the sum of the credit caps allocated to that participant by the other participants and indicates the maximum amount that can be debited to (sent by) that participant in EURO1. The multilateral debit and credit caps, respectively, of a participant may not exceed 1 billion euro.

It is currently sought to enable direct participants in EURO1 to increase their settlement capacity in the system via a "liquidity bridge". In practice this means that the participant, via Target, transfers a sum to EBA's account with the ECB before EURO1 opens. The participant's multilateral debit cap is then increased by the transferred amount.

8.3.5 EURO1 settlement cycle

At 4.00 p.m. SWIFT calculates the final net positions in EURO1 and advises the participants, EBA Clearing and the ECB. Via Target, participants with debit positions send a payment instruction to their national central banks to debit their current accounts and transfer the funds to EBA's

¹ The participants have concluded a loss sharing agreement whereby they are jointly and severally liable if the collateral pool of 1 billion euro is insufficient.

account with the ECB. The ECB credits the incoming payments to the account and advises EBA Clearing. When all payments have been received, EBA Clearing advises the ECB to pay participants with a credit position. The ECB debits EBA's account and sends payments via Target to these participants. When the central banks have credited the participants, confirmation is sent to the ECB, which forwards the message to EBA Clearing. When all confirmations have been received, EURO1 notifies all participants that settlement has taken place. EBA's account with the ECB zeroes every evening when settlement is completed.

8.4 STEP1

Shortly after the launch of EURO1, EBA decided to develop a retail payment system for handling retail payments in euro. This system was launched in November 2000 as STEP1. The system, which is operated by EBA Clearing, can be seen as a supplementary functionality for EURO1 since the two payment systems use the same platform. Settlement thus takes place in EURO1, but in a separate cycle called the Euro Retail Payment cycle (ERP).

All banks operating in the EU have access to STEP1. Participation is not subject to any credit rating or funds requirements, and the following two options are available: direct participation if the participant is a EURO1 participant, and indirect participation if settlement takes place via a direct EURO1 participant that acts as settlement bank.

Table 8.3 shows the number of direct participants in EURO1, STEP1 and STEP2, cf. section 8.5.

8.4.1 Risk management in STEP1

Since STEP1, cf. the above, can be seen as part of EURO1, the risk management tools used in EURO1 also apply to STEP1. In addition, the settle-

DIRECT PARTICIPANTS IN EURO1, STEP1 AND STEP2		Table 8.3
		2005
<i>EURO1</i>		
Direct participants		75
<i>STEP1</i>		
Direct participants		126
<i>STEP2</i>		
Direct participants		76
Prefund participants		8

Source: Euro Banking Association.

ment bank sets limits to the maximum single payments that can be received or sent by indirect participants. These limits are between 1 and 10 million euro per participant. The exact figure is determined by the settlement bank, which makes the necessary liquidity available for the indirect participant's net settlements. This is achieved via "capacity transfers", where part of the settlement bank's liquidity in EURO1 is reserved for the indirect STEP1 participant.

8.4.2 STEP1 clearing cycle

STEP1 participants have their own addresses on the EURO1 platform, from which they can receive and send payment instructions and monitor their net positions on an ongoing basis. When SWIFT registers a payment instruction with the ERP tag, it is retained while a copy is forwarded for processing in EURO1. The retained payment instruction is released when processing in EURO1 is complete. STEP1 participants can send payment instructions to the system for processing on day T from day T-5 until 2.00 p.m. on day T. Processing of payment instructions begins at 7.30 a.m. on day T. Single payments exceeding the individual limits of the remitter or recipient are rejected.

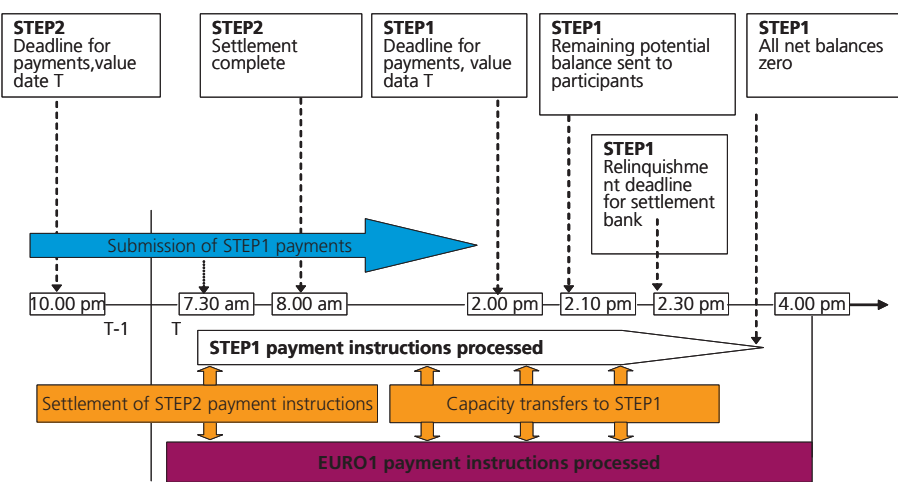
8.4.3 STEP1 settlement cycle

At 2.10 p.m. SWIFT notifies the STEP1 participant and the settlement bank, if any, of the potential net position. For indirect participants a negative potential net position represents the amount that the settlement bank must make available. Until 2.30 p.m. the settlement bank has the opportunity to relinquish this obligation, a request that can only be met under exceptional circumstances.

In order for transactions to be released, the settlement bank must make capacity transfers with the ERP tag to the indirect participant. The settlement bank can send one or more capacity transfers, provided that the total amount equals the indirect participant's potential net position. Subsequently the STEP1 participant's payments are released and the net position zeroes. Processing of STEP1 transactions must be completed by 4.00 p.m. when the EURO1 settlement begins. If the settlement bank does not make adequate liquidity available, the payments not covered are placed in a settlement queue with the value date T+1. The settlement queue operates on a FIFO basis, cf. Chapter 3, Box 3.3. The account between the indirect participant and the settlement bank as a consequence of the STEP1 settlement is settled outside the system.

The clearing and settlement cycles in EURO1, STEP1 and STEP2, cf. below, are shown in Chart 8.2.

CLEARING AND SETTLEMENT CYCLES IN EURO1, STEP1 AND STEP2 Chart 8.2



Note: Euro Banking Association

8.5 STEP2

STEP2, which is owned by EBA Clearing, was implemented in April 2003. STEP2 is not a replacement for STEP1, since STEP1 processes single payments, while STEP2 processes bulk payments, i.e. batches of payment instructions for several different payment recipients. Furthermore, STEP2 uses its own clearing house rather than the EURO1 platform. STEP2 was developed in cooperation by EBA Clearing, SIA (an Italian IT company) and SWIFT.

One of the advantages of STEP2 is that all customers holding a bank account with a European bank can be reached even if the customer's bank is not a STEP2 participant. STEP2 processes payments of up to 12,500 euro¹ containing the internationally approved identifications of customer and bank, i.e. the customer's IBAN (International Bank Account Number) and the bank's BIC (Bank Identifier Code).

8.5.1 Participants in STEP2

The number of participants in STEP2 is shown in Table 8.3. STEP2 offers four types of participation:

- Direct settlement participant – if the participant is a EURO1 participant and can therefore settle via EURO1. These participants can send and

¹ The limit will be raised to 50,000 euro as from 1 January 2006.

receive files with payment instructions directly to and from STEP2's central system.

- Direct non-settlement participant – if the participant is an indirect STEP1 participant and thus settles via a settlement bank in EURO1. These participants can also send and receive files with payment instructions to and from STEP2's central system.
- Indirect participant – if the participant is neither a EURO1 nor a STEP1 participant. These participants conclude settlement agreements with direct settlement participants to receive and send payments on their behalf.
- Prefund participant – if the participant does not wish to utilise one of the above three options. Every morning these participants must, via Target, transfer an amount equal to their payment instructions submitted to STEP2 to EBA's account with the ECB.

Banks that do not participate in STEP2 can receive payments from STEP2 participants through an "entry point". An entry point is a direct STEP2 participant that receives credit transactions and forwards them to the relevant recipients via the national retail payment systems. An EU member state may have several entry points.

8.5.2 STEP2 clearing cycle

All batches of payment instructions with a given value date, day T, can be submitted via SWIFT to STEP2 until 10.00 p.m. on day T-1. Each batch may contain many individual payment instructions for one or several recipients. The payment instructions are validated and then broken down into subfiles. Two subfiles are created for each pair of participants. One subfile includes all the credit transactions sent by participant A's customers to participant B's customers. Similarly, the other subfile includes all credit transactions sent by participant B's customers to participant A's customers. The breakdown into subfiles takes place between 10.00 p.m. on day T-1 and 7.30 a.m. on day T, cf. Chart 8.2.

By 8.30 p.m. on day T-1, prefund participants must notify STEP2 of the total sum of the transactions submitted. This sum must be transferred to EBA's account with the ECB by 7.00 a.m. on day T.

8.5.3 STEP2 settlement cycle

For each subfile, STEP2 generates a settlement instruction for processing in EURO1. These settlement instructions are forwarded to EURO1 at 7.30 a.m. on day T. Settlement then takes place in accordance with one of the following three models, depending on the status of the participants:

- Both parties to the STEP2 settlement are EURO1 participants. In this case the two settlement instructions become part of the individual EURO1 participant's net position in the system, cf. the section on the EURO1 settlement cycle.
- One party is not a EURO1 participant, but an indirect STEP1 participant. In this case the payment instructions are sent to STEP1 where they become part of the indirect STEP1 participant's settlement bank's net position in EURO1, cf. the section on the STEP1 settlement cycle.
- Prefund participants' payments are settled using the liquidity transferred.

Before 8.00 a.m. EURO1 and STEP1 advise STEP2 of whether the settlement instructions have been processed. When STEP2 receives these notifications, the subfiles are placed in "outboxes" by creditor address. At 8.00 a.m. STEP2 creates one file per participant containing all subfiles in the participant's outbox. These files are sent to the STEP2 participants, who can then credit their customers.

8.6 THE VISION OF SEPA – THE SINGLE EURO PAYMENT AREA

When Economic and Monetary Union was created and the single currency, the euro, introduced in January 1999, one of the objectives was to create a homogeneous market where liquidity could be transferred quickly and inexpensively throughout the euro area. As regards inter-bank payments this objective has been met as the smoothly operating payment systems Target and EURO1 have created a common euro payments infrastructure for large-value payments. These systems have increased efficiency and lowered the costs of large national and cross-border payments in euro. This is not the case for retail payments, where the service level for cross-border payments is substantially lower than for national payments.

The idea of a homogeneous retail payment market has existed since 1992 when the ECBS¹ was set up. From the outset, the ECBS has handled issues related to cross-border retail payments, and in this context it has contributed to developing common European standards such as IBAN and BIC.

With the Eurosystem's introduction of euro banknotes and coins in 2002, the foundations were laid for realising the Single Euro Payment Area, SEPA, for retail payments. The Eurosystem's vision of a homoge-

¹ The European Committee for Banking Standards, set up by the Banking Federation of the European Union, the European Association of Co-operative Banks, and the European Savings Banks Group.

neous European retail payment market is that the efficiency and pricing of cross-border retail payments will be comparable with the best-performing national payment system today.

Owing to the lack of progress by the banks in smoothing the differences in prices and service levels for national and cross-border retail payments, the European Parliament and the Council in December 2001 adopted a regulation on cross-border payments in euro, cf. section 9.7. The regulation¹ entails, *inter alia*, that the banks may not charge higher fees for cross-border electronic payment transactions² in euro than for equivalent national euro transactions. For the banks this means that the fee they may charge for cross-border transactions is lower than the actual costs of settling the transactions.

The regulation gave the European banking sector an impetus to move forward, and in May 2002 a strategy report, *Euroland: Our Single Payment Area*, was published. The objective is to create a single euro payment area where the payment services offered nationally and across borders are fully equivalent. The European Payment Council, EPC, was set up in 2002 by the European banking sector and is working to realise the SEPA vision. This work is based on the following key elements of the 2002 strategy report:

- The creation of a common euro infrastructure with Pan-European Automated Clearing Houses (PEACHes) for processing national and cross-border retail payments in euro.
- Adoption and implementation of a common set of pan-European standards, rules and conventions for retail payments so that all EU banks offer a service and automation level equivalent to the best national level today.
- Development and implementation of pan-European payment instruments (credit transfers, direct debit and payment cards).

The ECB is an observer on the EPC and most of its task forces, and the ECB has expressed clear visions as to what must be possible in SEPA by 2010.³ The ECB's primary objective is that all euro-denominated payments become "domestic". In other words, it should be just as easy, secure, efficient and inexpensive to make payments throughout the whole euro area as it is to make national payments today.

¹ The regulation was introduced on 1 July 2002 and applies to amounts of up to 12,500 euro. From January 2006 the limit is raised to 50,000 euro.

² From 1 July 2002 the regulation solely applied to card payments and cash withdrawals. From 1 July 2003 credit transfers were also included.

³ See the speech by Gertrude Tumpel-Gugerell, member of the Executive Board of the ECB, to the EPC on 6 September 2004 at www.ecb.int.

As a consequence of the EU regulation, the EPC has adopted two conventions for credit transfers:

- Credeuro (2002), which ensures that a credit transfer of an amount up to 12,500 euro will maximum take three days if the customers have stated IBAN and BIC codes. The objective is that all credit transfers in Europe are settled within one banking day from 2007.
- ICP¹ (2003), which is to ensure that the principal is always transferred in full. This means that no fee may be charged to the recipient for receipt of a European transfer.

The EPC also plans to implement a direct debit standard in 2005.

8.6.1 SEPA – status 2005

As of 2005, the retail payment infrastructure of the euro area is still fragmented, and the SEPA vision is still not a reality. The European Parliament and the Council have adopted the regulation on cross-border payments in euro, and the ECBS and ISO² have developed the IBAN and BIC standards, which customers must use for cross-border transactions. Furthermore, the European Commission plans to table a proposal for a comprehensive directive for all types of payment services within the EU, cf. Chapter 9, section 9.7. The aim is for the directive to remove a number of the current barriers to the implementation of SEPA.

The EPC's current challenge lies in standardising the payment process to make it identical for national and cross-border payments, in implementing standards for pan-European payment instruments and in creating Pan-European Automated Clearing Houses, PEACHes. These PEACHes must be at least as efficient as the existing national clearing houses in order to give the banks an incentive to move all transactions, even national ones, to the PEACHes. Without national transactions no PEACH would be able to achieve a critical mass.

One of the EPC's criteria for a clearing house to qualify as a PEACH is that all financial institutions in the EU can be reached. The clearing house must thus be able to process all euro credit transfers irrespective of which European bank the recipient's account is held with. In addition, the price of national and intra-EU payments must not differ if the service is the same. At present only STEP2 has been approved by the EPC as a PEACH.

¹ The Interbank Convention on Payments.

² The International Organization for Standardization.

THE BACKGROUND TO CLS

Box 8.2

In principle, a foreign-exchange transaction involves two opposite payments. A transaction in e.g. kroner against dollars involves a payment in kroner by one party to the other and a payment in dollars in the opposite direction. Foreign-exchange transactions have traditionally been settled as two independent payments executed via correspondent banks or via the RTGS systems for the currencies in question. Under this system, the parties to the transaction incur mutual credit risks equivalent to the amount traded. The credit risk arises because one party to the transaction may go into compulsory liquidation at a time when the purchased currency has been received, while the sold currency has not yet been delivered. Since the sums traded may be considerable, and since different time zones may extend the period of exposure, settlement of foreign-exchange transactions in the traditional manner could potentially involve systemic risks, cf. Chapter 1, Box 1.3, on the liquidation of Bankhaus Herstatt.

Under the auspices of BIS, the G10 central banks in 1996 laid down a strategy for reducing systemic risk in relation to settlement of foreign-exchange transactions.¹ It was a three-pronged strategy: 1) the individual private banks were to improve their own risk management, 2) the international banking community was to introduce new, risk-reducing settlement facilities, and 3) the central banks were to support the private initiatives under 1) and 2).

The introduction of CLS in 2002 was the international banking community's contribution to reducing settlement risk on foreign-exchange transactions. The development and implementation of CLS has taken place in an ongoing dialogue with the central banks of the currencies involved.

BIS (1996).

8.7 CLS

CLS¹ Bank International (CLS) is an international clearing and settlement system that settles foreign-exchange transactions in 15 currencies², including Danish kroner. CLS is a real-time system that enables simultaneous settlement globally, irrespective of time zones. CLS was established by some of the world's largest private banks as a bank owned by 71 shareholders, including five Scandinavian banks (Danske Bank and Nordea, among others). The background to the establishment of CLS is described in Box 8.2.

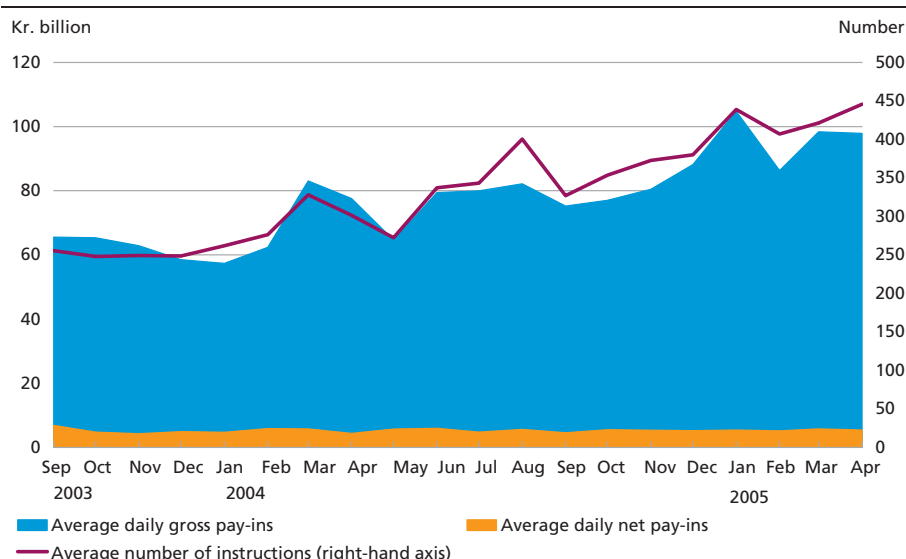
CLS' mission is to eliminate the principal risk on foreign-exchange transactions. Consequently, the core element of CLS is that the two eligible payment instructions relating to an FX transaction are settled simultaneously, i.e. Payment versus Payment (PvP). In CLS, the parties to a foreign-exchange transaction only supply the currency they have sold if

¹ Continuous Linked Settlement.

² US, Canadian, Australian, New Zealand, Singapore and Hong Kong dollars, euro, Japanese yen, pounds sterling, Swiss francs, Korean won, South African rands, Danish and Norwegian kroner and Swedish kronor.

SETTLEMENT OF DANISH KRONER IN CLS

Chart 8.3



Source: CLS Bank and own calculations.

they receive the currency they have bought. Another key element of CLS settlement is that Settlement Members pay in funds to CLS on a net basis in numerous small portions according to a Pay-In Schedule. This significantly reduces the Settlement Members' liquidity requirements

In April 2005, CLS settled approximately 95,000 foreign-exchange transactions daily, at a value of more than USD 1,000 billion. Statistics show that the global daily foreign-exchange trading volume is approximately USD 1,900 billion.¹ This figure is not directly comparable with the figures for CLS², but it is estimated that around one third of the global foreign-exchange trading now takes place via CLS. The remainder is still settled via the traditional channels for international payments, as described in Chapter 3.

Total daily Pay-Ins to CLS amount to around USD 25 billion. Pay-ins to CLS have been constant, although the value of the foreign-exchange transactions has increased since CLS went live in September 2002. This can be seen as an indication that netting within the system is becoming more effective as the number of transactions increases.

Since September 2003 it has been possible to settle transactions in Danish kroner via CLS. CLS settlement in Danish kroner is shown in Chart 8.3. In

¹ BIS Triennial Central Bank Survey, Foreign Exchange and Derivation Market Activity in April 2004.

² An FX Swap entails exchange of two currencies on a given day and an opposite transaction in the same two currencies on a future date. FX Swaps are e.g. included as two transactions in the CLS compilation and as one transaction in the BIS compilation.

April 2005 an average of 446 transactions in Danish kroner were settled daily, totalling kr. 98 billion in value. The average daily pay-ins to CLS were kr. 5.4 billion, equivalent to liquidity savings of almost 95 per cent.

8.7.1 CLS participants

CLS has three different types of participant, Settlement Members, User Members and Third Parties. Settlement Members participate directly in settlement and have a multi-currency account with CLS Bank. There are currently 58 direct participants in CLS. Only CLS shareholders can join as Settlement Members. User Members can submit Instructions directly to CLS, for themselves and their customers, but do not hold an account with CLS and must therefore settle their foreign-exchange transactions via a sponsoring Settlement Member. There are only few User Members at present. Only CLS shareholders can join as User Members. A Third Party is an indirect participant that submits and settles foreign-exchange Instructions via a Settlement or User Member. Third Parties are typically smaller banks, brokers, funds and large non-financial corporates. The number of Third Parties has risen significantly over the last year, and 480 Third Parties currently participate in CLS. Below, the term "participants" refers to Settlement Members.

8.7.2 CLS settlement

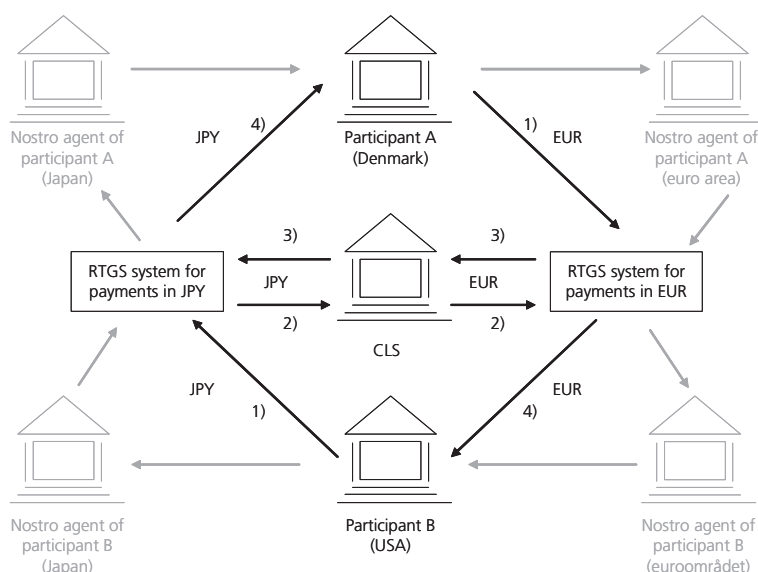
CLS participants hold a single multi-currency account with CLS. The participants' balances in the various currencies are registered to this account. On the basis of Instructions submitted, CLS calculates the participants' net positions in the various currencies. Foreign-exchange payments to CLS are effected in the national RTGS systems by transferring funds to CLS' accounts with the relevant central banks. Pay-Ins to CLS' central-bank accounts are automatically credited to the participant's account with CLS.

Foreign-exchange transactions are settled by transferring the foreign exchange traded between the relevant participants' accounts with CLS. When a foreign-exchange transaction is settled, the two sides are entered to CLS' books simultaneously (PvP). A transaction can only be settled if CLS' risk measures, cf. below, are met.

Foreign-exchange Pay-Outs to participants are effected by transferring funds from CLS' central-bank accounts to the participants' central-bank accounts via the national RTGS system. At the same time the pay-outs are debited to the participants' accounts with CLS. Pay-outs are subject to CLS' risk measures. Where participants do not hold accounts in an RTGS system or do not have access to sufficient liquidity in a

SETTLEMENT OF A FOREIGN-EXCHANGE TRANSACTION IN CLS

Chart 8.4



Participant A has sold EUR against JPY to participant B. The trade is settled via CLS:

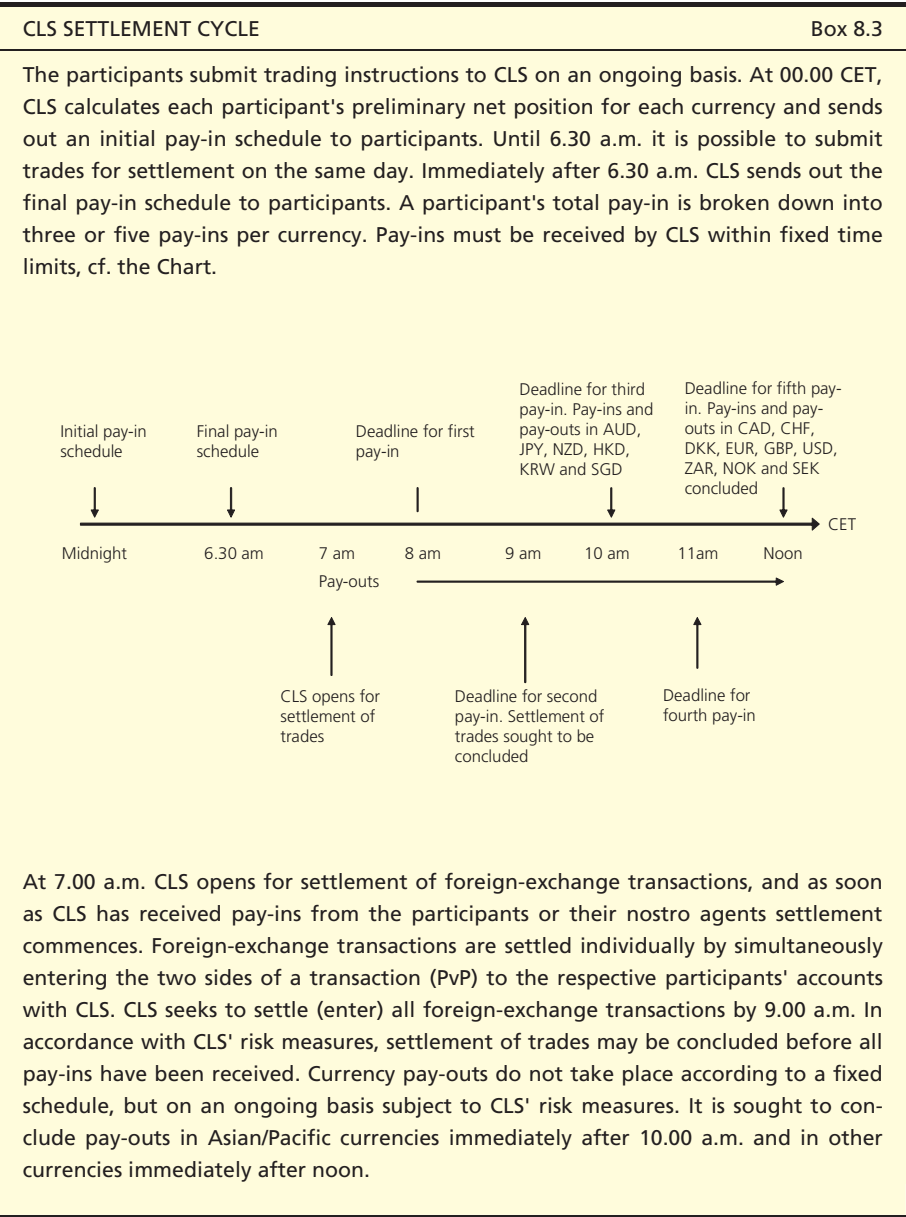
- Participant A pays in EUR to CLS in the RTGS system for EUR (Target). Participant B pays in JPY to CLS in the RTGS system for JPY.
 - CLS automatically registers the participants' pay-ins to their accounts with CLS.
 - When the trades have been settled, i.e. the amounts have been transferred between the participants' accounts with CLS, CLS notifies the RTGS systems.
 - CLS pays out EUR to participant B in the RTGS system for EUR and JPY to participant A in the RTGS system for JPY.
- If participants A and B do not participate in the RTGS systems for EUR and JPY themselves, they must use nostro agents to make pay-ins to and receive pay-outs from the respective RTGS systems.

given currency, they may use a nostro agent¹ in the currency in question. Chart 8.4 illustrates settlement of foreign-exchange transactions in CLS with and without the use of nostro agents.

As described, Pay-Ins and Pay-Outs are effected in the national RTGS systems for the relevant CLS currencies. To enable this, the RTGS systems must be open simultaneously across the relevant time zones. Settlement in CLS is therefore scheduled to take place between 7.00 a.m. and noon Central European Time (CET), i.e. afternoon/evening in Asia/Pacific and night/early morning in North America.² The settlement flow in CLS is described in more detail in Box 8.3.

¹ Nostro agents are typically CLS participants who offer to send and receive payments in their "domestic currency" to and from CLS on behalf of other participants.

² The RTGS systems in Asia/Pacific close before noon CET. Therefore it is sought to settle and effect payments in these currencies before 10.00 a.m. CET.



8.7.3 Risk management in CLS

By applying the PvP principle in CLS, the traditional credit risk between the parties to a foreign-exchange transaction is eliminated. However, the tight schedule for Pay-Ins to CLS and the consequential higher liquidity management requirements entail a liquidity risk for participants. The design of the CLS system attaches much importance to minimising this risk.

Settlement of foreign-exchange Instructions in CLS does not involve central-bank money since pay-ins by participants are held in CLS' ac-

Settlement of foreign-exchange Instructions in CLS does not involve central-bank money since pay-ins by participants are held in CLS' accounts with the central banks during settlement. It is therefore essential that CLS cannot incur losses in connection with settlement. Consequently, CLS settlement is subject to very tight risk management and the risk of losses to CLS is very small. CLS thereby complies with international recommendations that settlement assets should entail little or no risk to participants.

The concentration of global foreign-exchange settlement in CLS has led to a concentration of operational risk. With the establishment of CLS a link has also been created between the RTGS systems used for pay-ins and pay-outs to/from CLS. This means that operational problems experienced by CLS may have wide-ranging consequences, and problems within one national RTGS system may affect other countries' RTGS systems¹. For this reason the structure of CLS settlement emphasises operational stability.

The various elements of CLS risk management are outlined below.

The participants' liquidity risk

To minimise the participants' liquidity risk, the CLS system seeks to reduce the liquidity required and to facilitate liquidity management. A key element of the system is that foreign-exchange transactions are settled gross, i.e. individually, while Pay-Ins to CLS are netted. This reduces the liquidity requirement in CLS considerably.² In addition, the individual participant's Pay-Ins to CLS in a given currency are split into several smaller, time-lagged Pay-Ins. Finally, liquidity management is supported via a number of online facilities, issue of initial Pay-In Schedules, etc.

In the event that participants have inappropriately large negative positions and must thus make large pay-ins, they can undertake In/Out swaps to reduce their positions, cf. Box 8.4.

CLS' credit and liquidity risk

Settlement of Instructions in CLS is subject to tight risk management in order to limit the credit and liquidity risk incurred by CLS in the event of delayed payment or non-payment by one or more participants, and to ensure that settlement can take place even if one or more participants

¹ If participants in one country are unable to effect their Pay-Ins to CLS due to operational problems, CLS may not be able to effect pay-outs in other currencies on time. Consequently, problems within one national RTGS system may mean that other national RTGS systems must stay open for longer.

² A CLS member has submitted two foreign-exchange transactions: purchase of USD 100 million against sale of EUR, and purchase of CHF against sale of USD 100 million. The two USD positions eliminate each other so that the member in question pays only EUR to CLS and receives only CHF from CLS.

IN/OUT SWAP AND LIQUIDITY CONTINGENCY PLANNING IN CLS	Box 8.4
<p>In/out swap</p> <p>If the preliminary pay-in schedule indicates that the net positions of some participants are inappropriately large, the participants in question may conclude in/out swaps to reduce their net positions. In an in/out swap, two participants conclude two opposite foreign-exchange transactions for settlement on the same day, one of which is settled in CLS and the other outside CLS. For instance, if a participant has an excessive negative position in USD, a foreign-exchange transaction to buy USD and sell DKK is concluded with another participant, who has an excessive negative position in DKK. In this way the negative positions in, respectively, USD and DKK are reduced in the CLS settlement. To keep the foreign-exchange portfolio of the participants unchanged, a foreign-exchange transaction in the opposite direction is concluded for settlement outside CLS. Using an in/out swap thus reintroduces a (small) part of the settlement risk on foreign-exchange transactions.</p> <p>Liquidity contingency planning</p> <p>To ensure that settlement can always be completed before the national RTGS systems close, CLS has for each currency concluded agreements with at least 2-3 liquidity providers who can provide extra liquidity at short notice if one or more participants or nostro agents do not meet their payment obligations. These liquidity providers take over the relevant participant's pay-in obligation to CLS in return for receiving its pay-outs.</p>	

do not meet their pay-in obligations. CLS operates with three risk measures that must be met before an Instruction can be settled and pay-outs made. CLS' risk measures are:

- A participant's net balance across currencies must always be positive or zero.
- A participant's short position limit in a given currency may not exceed CLS' limit for that currency.
- The sum of a participant's short position limits may not exceed a limit stipulated by CLS which reflects the participant's credit standing.

The risk management tests entail that settlement of Instructions can begin, irrespective of the currency paid in, and that settlement can be concluded even if some pay-ins have not yet been received.

To protect CLS against market risk on exchange-rate fluctuations in the event that a member does not meet its payment obligations, CLS operates with market volatility haircuts, which are deducted from positive and added to negative positions in the respective currencies.

In addition, liquidity contingency planning by CLS ensures that settlement can be concluded even if the participant with the largest negative net position does not meet its payment obligations, cf. Box 8.4.

If a participant does not meet its obligations, and the exchange rates fluctuate more than the haircuts provide for, CLS may incur a loss. To hedge this risk, a loss distribution agreement has been concluded with participants, whereby the loss is covered by the counterparties of the participant in question.

Operational risk

The structure of the CLS system attaches great importance to limiting operational risk by ensuring a high degree of operational stability. Should losses, nevertheless, arise as a consequence of operational errors, they are covered jointly by the participants.

Initially, CLS has been established with primary and secondary operating and data centres in the south of England. To comply with recommendations from the US authorities¹, cf. Chapter 10, section 10.6, CLS has established a parallel operating and data centre in New York.

Operational stability is also ensured via extensive uniform security requirements of participants and of the RTGS systems of the participating currencies, and via comprehensive procedures for the handling of operational aspects by the parties involved.

¹ The Federal Reserve supervises CLS and is overall responsible for CLS oversight. Oversight takes place in cooperation with the other central banks whose currencies are settled via CLS.

LITERATURE

BIS, 1996. Settlement Risk in Foreign Exchange Transactions, March 1996.

CLS website, www.cls-services.com.

CLS Bank International, Regulator's Summery, International Rules and Member Handbook.

Euro Banking Association's website, www.abe.org.

9. The Legal Framework for the Payments Infrastructure

This Chapter initially introduces the contractual basis for Danish payment and securities settlement systems, cf. Chapter 6. The most important elements of the contractual basis are outlined, followed by a review of the general legal rules regulating payment and settlement in Denmark. Particular attention is attached to legislation on netting systems, since these systems are subject to special protection requirements, especially in relation to insolvency legislation. The rules on payment and settlement are based mainly on EU directives and to some extent on international conventions.

Against this background, the Settlement Finality Directive, the Financial Collateral Directive and the Hague Convention on the Law Applicable to Certain Rights in Respect of Securities Held with an Intermediary are reviewed. Subsequently, the implementation in the Danish Securities Trading Act is described, and finally other legislation relating to payment systems are mentioned. The final section accounts for EU directives and regulations on electronic retail payments.

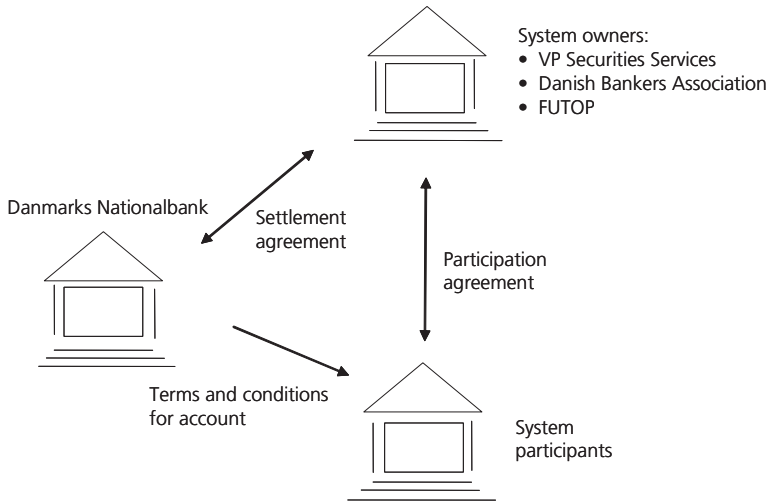
9.1 CONTRACTUAL AND LEGAL BASIS OF THE SYSTEMS

The legal basis for settlement via the Danish payment and securities settlement systems includes an extensive set of agreements between the settlement parties. The agreements document the settlement concepts of the various systems with settlement in central-bank money via accounts held at Danmarks Nationalbank, cf. Chapters 5 and 6.

9.1.1 Contractual basis

The contractual basis for the operation of the systems is comprised of three sets of agreements. Firstly, standardised participation agreements are concluded between the system owners and their participants. Secondly, the participants responsible for cash settlement in a given system are required to hold settlement accounts with Danmarks Nationalbank.

This requirement is regulated by the terms and conditions for accounts at Danmarks Nationalbank. Thirdly, Danmarks Nationalbank enters into settlement agreements with the individual systems on the terms for cash



Note: The Chart illustrates the full contractual basis between the Danish system owners, their participants and Danmarks Nationalbank. The relationship between the system owners and the participants is governed by participation agreements. System owners have entered into settlement agreements with Danmarks Nationalbank, which has established the terms and conditions for accounts.

settlement via the participants' settlement accounts with Danmarks Nationalbank. Chart 9.1 illustrates the overall contractual basis.

The contractual basis specifies the services to be performed by each party and when and how these services are to be performed, and includes agreements on emergency procedures, as well as provisions on how the participants are to act in the event of insolvency, etc. among the participants.

The terms and conditions for accounts specify how participants may reserve liquidity for settlement either by transferring liquidity to specific settlement accounts via Danmarks Nationalbank's payment system, Kronos, or by utilising automatic collateralisation, cf. Chapter 5.

The key element of the settlement agreements between Danmarks Nationalbank and the systems is that Danmarks Nationalbank submits the individual participants' line in the settlement, equivalent to the liquidity reserved by the participants for each settlement. Danmarks Nationalbank then guarantees to pay an amount per participant equivalent to its reserved liquidity. This applies even if one of the participants is subsequently subject to insolvency proceedings. After the clearing, the systems check whether the net positions of the individual participants are within their lines and subsequently send the book-entry basis to Danmarks Nationalbank for approval. Danmarks Nationalbank's submission of irrevocable lines assures the system that Danmarks Nationalbank

CONTENT OF PARTICIPATION AGREEMENTS

Box 9.1

Payment systems' participation agreements typically include:

- Requirement stipulating that the participants responsible for payment under the payment systems must be able to open accounts with Danmarks Nationalbank.
- Requirement regarding technical specifications to be met by the participants.
- Emergency procedures in the event of system failures, etc.
- Exemptions and limitations of liability to exempt the payment system from liability for indirect losses and consequential damage.
- Remedial obligations under which the payment systems, in return for the exemption from liability, generally undertake to remedy the actual errors but not their consequences.
- Force majeure clauses that suspend the obligations of the parties in case of certain external events.
- Netting clauses to ensure that the net position of a participant can be effected even if the participant becomes insolvent, etc.
- Requirements regarding legal opinions from certain foreign participants to document that the agreement, including the netting clauses, is effective – also in relation to the participants' insolvent estates, if any.
- Governing law and venue provision, establishing that the agreement is to be governed by Danish law, entailing, among other things, that disputes arising between the parties as a result of the agreement are in some cases to be settled by arbitration.

will accept the book-entry basis received and will settle the participants' net positions, whereby settlement is completed.

Box 9.1 provides an overview of a number of issues that are usually governed by participation agreements.

9.1.2 The legal framework for the contractual basis

It is essential that the agreements can be taken at face value in every conceivable situation in order to minimise the legal risks related to settlement. Otherwise, the system owner or Danmarks Nationalbank may be liable in damages. This could e.g. be the case if the legal basis of netting in the systems is not valid in case of insolvency.

Since settlement is effected in the netting system despite the insolvency of a participant, incoming payments to the insolvent participant will not form part of this participant's estate, but will instead be used to cover its outgoing payments. In the event of an inadequate legal basis, the insolvent participant's liquidator may subsequently demand that the payments be paid into the estate. Alternatively, if the settlement process is stopped, the other participants may demand compensation for their losses if the settlement is not effected in accordance with the contractual basis. Consequently, it is vital that the contractual settlement concept is supported by a well-founded legal basis.

The legal basis of the Danish settlement systems is comprised mainly of ordinary private law, rendering agreements legally binding and upholding the principle of contractual freedom, especially in relation to commercial factors. The existing legal system is also included, under which a party to a contract is able to enforce its contractual rights.

In some cases, ordinary legislation has proved to be insufficient to ensure settlement via the systems and it has been necessary to supplement ordinary legislation by way of special legislation. The special protection requirement for settlement systems is not a unique Danish problem. Therefore, the special legislation is based primarily on European legislation, particularly the EU Settlement Finality Directive. This Directive is implemented in the Securities Trading Act¹, which constitutes the main legal framework for payment and securities settlement systems in Denmark.

The Settlement Finality Directive is extended in the Financial Collateral Directive and in the Hague Convention on the Law Applicable to Certain Rights in Respect of Securities Held with an Intermediary. The Financial Collateral Directive and the Hague Convention are aimed mainly at enhancing the possibilities for collateralisation in European financial markets and for cross-border transfer of securities.

9.2 THE SETTLEMENT FINALITY DIRECTIVE

The netting provisions contained in the systems' participation agreements will achieve their intended effect only if they are legally valid, also in the event that a participant is subject to insolvency proceedings or suspends its payments. The Lamfalussy Standards² of 1990 already focused on this issue. The first Standard prescribed that netting schemes should have a well-founded legal basis under all relevant jurisdictions. Consequently, netting rules were introduced in a number of countries, including Denmark, and the European Commission started work on the Settlement Finality Directive, properly known as the Directive on Settlement Finality in Payment and Securities Settlement Systems. The Directive was finally adopted in May 1998 (1998/26/EC)³.

The primary objective of the Directive is to protect settlement in payment and securities settlement systems, including settlement by netting. This is achieved predominately by ensuring the finality of payment requests and by ensuring that payment requests can be effected by the system, provided that the transfer orders have been placed before the

¹ The Danish Securities Trading Act, cf. Consolidated Act no. 171 of 17 March 2005.

² See Chapter 10.

³ For a more detailed description of the Settlement Finality Directive, see Restelli-Nielsen and Sterkel (1998).

opening of insolvency proceedings against a participant. The Directive also protects the collateral arrangements for participation in a system, to the effect that such arrangements will not be affected by insolvency proceedings against the institution providing the collateral. Finally, in the area of property law¹ a conflict of laws rule was introduced for book-entry securities, whereby any issues regarding rights in collateral would be governed by the legislation of the country in which the register is kept or the securities account is held.

9.2.1 Netting protection

The protection of net settlement follows from Article 3 of the Settlement Finality Directive, stating that netting shall be binding on third parties, including an estate, provided that transfer orders were entered into a system before the moment of opening of insolvency proceedings. According to the same Article, this also applies where transfer orders are entered into a system after the moment of opening of insolvency proceedings and are carried out on the day of opening of such proceedings, provided that those responsible for the system can prove they acted in good faith. The moment of entry of a transfer order into a system is defined by the rules of the system in question.

The protection of settlement entails that a liquidator cannot demand that incoming payments be made to the estate, with the effect that recipients of outgoing payments sue for damages at the insolvency dividend rate. This ensures that the system will not have to unwind payments, i.e. cancel netting to recalculate net positions. Similarly, the liquidator cannot rely on the rules on adoption of contracts², e.g. by adopting securities transactions that are considered to be profitable and repudiating other transactions, known as cherry picking.

In contrast, Article 5 states that other participants in the settlement cannot revoke payments to e.g. an insolvent participant to the detriment of settlement. In other words, not only insolvent estates, but all participants in the system, are bound by a netting agreement.

The netting protection is supplemented by a general conflict of laws rule in Article 8, which ensures that the estate of a participant cannot, referring to the insolvency legislation of his country, known as *lex con-*

¹ Issues relating to property law involve the relationship with a third party and – in connection with collateralisation – especially the relationship between the pledgee and the creditors of the pledgor and any other assignees with competing rights. Right of protection of transfer is known also as protection *in rem* and refers to a privileged position e.g. in pledged assets such as securities, the maintenance of which typically requires an act of perfection. In relation to assets registered by VP Securities Services, the act of perfection takes the form of registration of transfer for the purpose of ownership or collateral.

² The rules to this effect are stated in Chapter 7 of the Danish Insolvency Act on synallagmatic agreements.

cursus, prevent agreements which the insolvent participant has concluded with the system from being effected. Thus any disputes between a liquidator and a system are to be determined by the insolvency law governing the system.

9.2.2 Designation of systems

The prerequisites for achieving the privileges of the Directive in relation to insolvency legislation are regulated by Articles 1 and 2, establishing the scope and definitions of the Directive. It appears from these Articles that one prerequisite for qualifying as a system within the scope of the Settlement Finality Directive is that the member state whose law governs the system designates it as such after the member state in question has ensured that the rules of the system are satisfactory.

In order to qualify as satisfactory, the system must, according to the Directive, have common rules and standardised procedures for execution of transfer orders between participants – the aim being to ensure that the rules do not contain any discretionary powers for the parties involved; in an insolvency situation, this could create opportunities to act against the interests of the estate.

According to Article 10, each member state is required to notify the European Commission of the systems it has designated under the Directive. The Commission publishes a list of all designated systems¹ on its website.

9.2.3 Protection of collateral

Article 9(1) states that collateral security provided to a system or a central bank in connection with the central bank's extension of credit shall not be affected by the insolvency of a participant. The main objective of this provision is to prevent that, in an insolvency situation, the law of one member state (e.g. the home country of a parent bank) does not recognise the validity of the collateral security provided in another member state (the home country of the system). The Settlement Finality Directive does not, however, regulate the formalities of collateralisation; guidelines to this effect were subsequently implemented in the Financial Collateral Directive, cf. below.

The rules on collateralisation are still in compliance with the principle of *lex rei sitae*. According to this principle, collateralisation is governed by the law of the member state in which the collateral security is located. Today, the securities of many countries are held in book-entry form and their localisation may be difficult to determine when securities

¹ www.europa.eu.int/comm/internal_market/payments/index_en.htm under Clearing & Settlement.

are moved across national borders via links between various central securities depositories. Therefore, Article 9(2) states that if securities are recorded on a register, account or with a central securities depository in a member state, the determination of the rights within the scope of the Article shall be governed by the law of that member state. When a security has been transferred via a link to a foreign central securities depository, the rights in the securities may then be recorded by this central securities depository under normal procedures and in accordance with national law. This conflict of laws rule has subsequently been extended in the Financial Collateral Directive and in the Hague Convention, cf. below.

9.3 THE FINANCIAL COLLATERAL DIRECTIVE

The Directive on financial collateral arrangements, also known as the Financial Collateral Directive, was adopted on 6 June 2002 (2002/47/EC). The objective of the Directive is to create a better framework for cross-border financial collateral arrangements in the EU by extending the protection enshrined in the Settlement Finality Directive to include bilateral arrangements. Consequently, the Directive contributes to protecting financial collateral arrangements between market participants in the EU financial system, including the use of standardised master agreements on provision of collateral¹.

Before the adoption of the Financial Collateral Directive, the EU member states had different – and in some cases outdated – rules for collateralisation. This prevented consistent use of master agreements in the EU. A European market participant thus had to be familiar with various national rules on collateralisation and with the insolvency law of all EU member states in order to assess the possible impact of the insolvency of a participant on the financial collateral arrangement. This complexity increased the legal risks of cross-border financial collateral arrangements and thus the probability that problems in one financial institution could spread to other institutions. The Financial Collateral Directive enhanced financial stability by resolving this complexity.

In the euro area, the Financial Collateral Directive has improved the implementation of monetary policy by ensuring that financial institutions balancing the overall amount of euro liquidity among them in the European euro payment system, Target, have easier access to collateralise short-term liquidity loans. The Directive has enhanced the possibili-

¹ E.g. Global Master Repurchase Agreement (GMRA) issued by the Bond Market Association and the International Securities Market Association (ISMA), and the International Swaps and Derivatives Association's (ISDA's) ISDA Master Agreement (including Credit Support Annex).

ties of central banks for obtaining financial collateral in excess of the protection provided by the Settlement Finality Directive, which protects financial collateral arrangements from the influence of a collateral provider's possible insolvent estate. In general, the improvement affects financial collateral arrangements in connection with the placement of central banks' foreign-exchange reserves and in connection with the administration of cross-border financial collateral arrangements, cf. the review in Chapter 5.

The content of the Directive can be divided into three parts. Firstly, an administrative part in which the formalities of collateralisation are essentially limited to depriving the collateral provider of the right of disposal of the collateral. In the Danish VP settlement system, this is effected by registering the collateral in a VP account. Secondly, certain characteristics of financial collateral arrangements are protected against the impact of insolvency of one of the parties. Thus the possibility is opened of receiving top-up collateral to substitute collateral, and of quickly realising collateral. Thirdly, the scope of application of the conflict of laws rule set out in Article 9(2) of the Settlement Finality Directive is extended, entailing that it will apply also to matters governed by the Financial Collateral Directive. This is significant for collateralisation via cross-border links between various central securities depositories.

9.4 THE HAGUE CONVENTION ON THE PRIMA PRINCIPLE

The Hague Convention¹ on the Law Applicable to Certain Rights in Respect of Securities Held with an Intermediary² was finalised on 13 December 2002, but it has not yet been ratified by Denmark or any other EU member state.

The Convention extends the conflict of laws rule of the Settlement Finality Directive and the Financial Collateral Directive to apply globally. Like the Directives, the Convention is based expressly on the PRIMA principle (Place of the Relevant InterMediary Approach), i.e. the applicable law is the one which governs the securities account of the intermediary. In order to further enhance legal certainty in the form of predictability of governing law, and as part of a global compromise between European law and US law, the Hague Convention took its definition of the PRIMA principle further.

¹ Hague Conventions are international treaties negotiated and formulated by the Hague Conference. The objective of the Hague Conference is to harmonise international private law. In its work, the Conference has, in particular, focused on the area of family law. At the beginning of 2005, the Hague Conference numbered 64 members, including all 25 EU member states.

² An intermediary is a person that in the course of a business maintains accounts on behalf of others, entailing that the securities are credited to an account held by the intermediary. One example is bonds held in custody by a bank.

The Convention's enhancement of legal certainty entails that where the governing law explicitly appears from the safe-custody agreement there shall be no doubt whatsoever as to the law to be applied to transactions involving book-entry securities. Otherwise, the law of the country in which the account agreement was concluded shall apply.

The bill implementing the Financial Collateral Directive into Danish law also authorises the Minister of Economic and Business Affairs to ratify the Convention.

9.5 PROTECTION OF THE PAYMENTS INFRASTRUCTURE IN DANISH LAW

The specific legal regulation of payment and securities settlement systems in Denmark is contained in the Securities Trading Act, in which Title III deals with clearing, settlement and collateralisation.

9.5.1 Netting protection

Section 57 of the original Securities Trading Act from 1995 already contained a netting provision that generally meets the requirements subsequently made by the Settlement Finality Directive, cf. Box 9.2, which shows the current provision.

It appears from section 57 of the Securities Trading Act that a multi-lateral netting agreement may include a provision to the effect that all proved claims are to be netted, cleared and settled or reversed in full if one of the parties is ordered to be wound up, or a notice of suspension of payments has been given, or negotiations for a compulsory composition are opened. The wording chosen could give the impression that – in the event it is not possible to settle all proved claims – settlement is to be cancelled, i.e. unwound. This is not the case, cf. the explanatory notes to bill on the original netting provision¹ and section 57(5). It appears that netting agreements are to contain objective conditions stipulating when netting is to be carried out in accordance with the agreement and when claims are to be reversed in full.

The original explanatory notes also emphasise that the netting agreement is to establish the circumstances in which netting may be carried out, respectively be reversed, in the event of insolvency, etc. and that the Danish Financial Supervisory Authority is to ensure that the agreement's criteria to this effect are objective. Consequently, the wording of the statutory provision does not preclude that – as agreed in VP Securities Services' clearing rules – only transactions for which cover is avail-

¹ These explanatory notes should still be assigned value as a source of law since the subsequent implementation of the Settlement Finality Directive did not encompass any amendments on points of fact, which is emphasised in several places in the explanatory notes to the implementation act.

THE MULTILATERAL NETTING PROVISION OF THE DANISH SECURITIES TRADING ACT	Box 9.2
<p>57(1). An agreement between two or more parties to the effect that all proved claims pertaining to the securities clearing business carried out by a clearing centre, cf. Section 50(4), or pertaining to clearing of payments carried out by Danmarks Nationalbank or a registered payment system, shall be set off against each other (netted), may with legal effect towards the estate and the creditors also include a provision to the effect that such claims shall be netted, cleared and settled or reversed in full if one of the parties is ordered to be wound up, or a notice of suspension of payments has been given, or negotiations for a compulsory composition are opened.</p> <p>(2) Agreements on netting with foreign clearing centres and payments systems notified to the Commission pursuant to Article 10, first paragraph, of the European Parliament and Council Directive 98/26/EC will have legal effect as the agreements specified in subsection 1 hereof.</p> <p>(3) The Financial Supervisory Authority shall be entitled to approve that agreements on netting with foreign clearing centres and payment systems or corresponding foreign undertakings which carry out securities clearing business or clearing of payments outside of the European Union or countries with which the European Union has made an agreement will have legal effect pursuant to subsection 1 hereof.</p> <p>(4) Agreements as specified in subsection 1 hereof shall in order to have legal effect against the estate and creditors be submitted to the Financial Supervisory Authority prior to the winding-up, notification of suspension of payments or opening of negotiations for a compulsory composition.</p> <p>(5). Agreements pursuant to subsections 1 and 3 hereof shall contain objective conditions pertaining to the cases in which claims, which have been entered into the system, but not yet satisfied shall either</p> <ul style="list-style-type: none">1) be satisfied in accordance with the netting agreement or2) be reversed in full.	

able in terms of cash and securities are carried out; this also applies in the event of insolvency etc. of one of the parties.

Section 57c of the Securities Trading Act specifies that it should appear from the rules and participation agreements of a system when a transfer order is considered to have been entered into the system and the point(s) in time after which a registered transfer order can no longer be revoked by a participant or a third party.

9.5.2 Designation of systems

The other provisions of Chapter 18 of the Securities Trading Act on payment systems, netting etc. regulate the circumstances surrounding the Danish Financial Supervisory Authority's designation procedure, whereby the systems comprised by the legal protection are announced by ex-

ecutive order¹ and reported to the European Commission, cf. the section on the Settlement Finality Directive above.

9.5.3 Protection of collateral

Under Section 57b of the Securities Trading Act, collateralisation in favour of Danmarks Nationalbank, a system or participants in such systems is, in some cases, protected against being rendered null and void. Moreover, access is provided, if agreed, to immediate realisation of collateral security, which reduces the risk of systemic effects, etc. This provision marks a departure from section 538a(2) of the Danish Administration of Justice Act, from which it appears that a pledgee, before steps are taken to satisfy a claim, must request the pledgor, by registered mail giving a week's notice, to satisfy the claim, unless immediate sale is necessary in order to avoid or limit a loss.

Part 18a of the Securities Trading Act implements the Financial Collateral Directive, thus enhancing the already good opportunities under Danish law for protecting claims through collateralisation, both in the form of traditional pledging of collateral and in the form of title transfer. As stipulated by the Directive, the Act provides access to swift and flexible realisation of collateralised cash and securities, as well as substitution hereof and provision of top-up collateral.

Section 55 of the Securities Trading Act provides a special statutory basis for automatic collateralisation referred to in Chapter 5 for loans granted in connection with clearing centres and payment systems. This has enhanced the basis for market participants' provision of collateral for short-term settlement credit facilities.

Automatic collateralisation enables pledging of collateral without observance of VP Securities Services' traditional act of perfection which would entail that no securities comprised by the collateral could be disposed of. Under the automatic collateralisation arrangement, collateral is provided in the form of a collateral value of the account holder's portfolio of securities and not by way of specific assets. Thus the provider of collateral is able to dispose of its portfolio of securities, provided that the collateral safekeeping account at all times provides cover for the overall claim. Consequently, automatic collateralisation does not hamper the securities turnover to the same extent as traditional pledging of collateral.

¹ Executive Order no. 1157 of 13 December 2002 on the clearing centres and payment systems with which legally effective agreements can be concluded pursuant to Section 57(1) and Section 57 b(1) and (2) of the Securities Trading Act. The Executive Order covers the following systems: VP Securities Services, FUTOP Clearing Centre, the Sumclearing, Kronos and DN Inquiry and Transfer System.

9.6 OTHER LEGISLATION ON PAYMENT SYSTEMS

In addition to the rules on contractual freedom, the binding nature of agreements and the special rules on the protection of the payments infrastructure specified above, Danish law contains special legislation on means of payment.

There are separate acts on traditional alternatives to cash payments, e.g. cheques and bills of exchange. With the development of new payment instruments, such as payment cards and electronic money, legislation on these instruments has also been adopted. Today payment cards and electronic money are governed by the Danish Act on Certain Means of Payment and the Financial Business Act.¹

Issuance of payment cards, including the Dankort, is governed primarily by an extensive set of agreements between the issuing bank, the card holder, the recipient/retailer and the acquiring bank. This agreement structure is supplemented by the Act on Certain Means of Payment, the objective of which is to balance various social interests – not least the need for consumer protection and continued product development of secure and efficient payment instruments.

In order to increase consumer protection, the Act on Certain Means of Payment includes provisions to ensure that users are provided with the necessary information material, and provisions relating to division of responsibility and liability in order to provide protection against extensive losses as a result of e.g. misuse of the card. The Act also stipulates that issuers must report their payment systems to the Consumer Ombudsman, who is responsible for supervising that the Act is observed; some areas do, however, fall under the remit of the Danish Competition Authority. The Act also includes rules on system providers' possibilities of covering their operating costs.

Electronic money also falls under the Act on Certain Means of Payment, in which it is referred to as electronically registered claims. Electronic money is characterised by not being linked to an individualised account from which payments are drawn, as is the case with Dankort payments. Instead, electronic money has an electronically registered value that may be stored on a prepaid card, e.g. the Danmønt card, or on a computer, known as network money. Since these prepaid means of payment are typically of limited value, they are generally exempt from the rules on cost coverage and liability specified above.

¹ Previously, payment cards and electronic money were governed by the Danish Payment Card Act and the Danish Act on Electronic Money Institutions.

Company-specific requirements of issuers of electronic money are found in the Financial Business Act. Pursuant to this Act, banks and a special category of electronic money issuers have the exclusive right to issue electronic money. Electronic money issuers must be limited liability companies that engage exclusively in such issuance or closely related activities. Like the banks, these issuers are under the supervision of the Danish Financial Supervisory Authority, which supervises the solvency and liquidity of the companies.

9.7 EU LEGISLATION ON ELECTRONIC RETAIL PAYMENTS

Recent years have seen a number of EU directives and regulations on electronic retail payments, a significant objective of which is to facilitate cross-border payments, thereby supporting the single market for goods and services in the EU.

Directive 97/5/EC of January 1997 on cross-border credit transfers establishes a number of minimum requirements for credit transfers between two EU member states. Among these are requirements governing the maximum execution time of credit transfers and the use of charges. The Directive also includes certain provisions on information to be provided to the customer making the payment. The Directive, which came into force on 14 August 1999, applies to transfers up to the equivalent of 50,000 euro.

In September 2000 the European Parliament and the Council adopted Directive 2000/46/EC on the taking up, pursuit of and prudential supervision of the business of electronic money institutions, known as the e-money directive. With this Directive, the special category of electronic money issuers is comprised by the rules on the European passport, including the right to carry on business in all EU member states and mutual recognition of supervision.

9.7.1 Regulation on cross-border payments in euro

Regulation (EC) No. 2001/2560 on cross-border payments in euro was adopted in November 2001. The objective of the Regulation is to harmonise the charges for cross-border credit transfers in euro with those for internal transfers in euro. Following the implementation of the Regulation, it is no longer permitted to charge a higher cost for effecting a cross-border payment in euro than for effecting an internal payment.

The rationale for implementing the Regulation was that the European Commission had demonstrated in a number of studies that it continued to be much more expensive to make cross-border payments in the EU

than it was to make internal payments. With the Regulation, the Commission wished to strengthen the incentive of European banks to establish a single infrastructure for retail payments in euro in order to reduce the costs of these payments. The European banking sector subsequently launched a project designed to create a single retail-payment area in the euro area member states, known as the Single Euro Payment Area, SEPA, cf. Chapter 8.

The Regulation applies to credit transfers, cash withdrawals and card payments in euro in all EU member states, including non-euro area member states. Sweden has taken up the option in the Regulation of extending the Regulation's application to other currencies, in this case Swedish kronor. The Regulation applies to all cross-border payments up to 12,500 euro. With effect from 1 January 2006, this amount will be raised to 50,000 euro.

9.7.2 Directive on payment services (New Legal Framework)

The European Commission is planning to submit a proposal for one overall directive to cover all types of payment services in the EU, to be known as the New Legal Framework. In a Communication in December 2003, the Commission raised a number of issues in this respect¹. The planned directive forms part of the Commission's Financial Services Action Plan, which is designed to remove legislative and regulatory barriers to creating a single financial market.²

The Directive's objective is to contribute to the creation of a Single Payment Market for retail payments in the EU. The Directive is to consolidate existing legislation, which is currently divided into often conflicting national legislation and EU legislation, cf. above. By harmonising national legislation, the Directive will eliminate a number of well-documented barriers to the creation of SEPA.

The Directive is to ensure, among other objectives, that issuers of payment services in one EU member state are able to carry out cross-border business in another EU member state by virtue of the European passport. The Directive will also include provisions on the information that issuers of payment services are required to provide to users. Other issues to be regulated by the Directive are the maximum execution time of payments, the application of value dates, the allocation of losses in case of misuse of payment instruments and the possibilities of cancelling authorised payment orders.

¹ Cf. The European Commission (2003).

² For an overview of the Financial Services Action Plan, see Kurek (2004).

LITERATURE

Andersen, Lennart Lynge (ed.), 2002. *Money Supply and Payment Systems* (in Danish only), Law Department, Copenhagen Business School.

Andersen, Niels C., 2004. Clearing and Settlement in a Legal Perspective (in Danish only), Danmarks Nationalbank, *Working papers*, 20/2004.

Andersen, Niels C. and Kirsten Gürtler, 2003. The Provision of Collateral to Danmarks Nationalbank in a Legal Perspective, Danmarks Nationalbank, *Monetary Review*, 3rd Quarter.

Hesthaven, Christian Dahl, 2002. *Netting from an Insolvency Law Perspective* (in Danish only), *Rettid*, Thesis 6, www.rettid.dk.

Kurek, Dorte, 2004. The EU's Financial Services Action Plan, Danmarks Nationalbank, *Monetary Review*, 1st Quarter.

Restelli-Nielsen, Peter M., 1996. The Netting Provisions of the Securities Trading Act, Danmarks Nationalbank, *Monetary Review*, May 1996.

Restelli-Nielsen, Peter M. and Ulla Sterkel, 1998. The Finality Directive (in Danish only), Danmarks Nationalbank, *Monetary Review*, 2nd Quarter.

Thygesen, Christian and Mogens Kruse, 1998. Electronic Money, Danmarks Nationalbank, *Monetary Review*, 4th Quarter.

10. Oversight

During the last 20 years, many countries have developed a payments infrastructure with relatively few systems, in which very large volumes of payments as well as foreign-exchange and securities transactions are settled. This development can be viewed as a result of the rapid advances in the IT area, which have enabled significant streamlining of payment systems. However, the concentration of payments and settlements on few systems also means that problems within the systems may threaten financial stability. This is clearly illustrated by the three incidents outlined in Chapter 1.

It is the responsibility of central banks worldwide to oversee systemically important payment and settlement systems. The oversight function is primarily aimed at supporting the smooth functioning of the systems by contributing to their security and efficiency. Oversight relates to the overall system complex, taking into account that the participants are usually subject to financial supervision too. Since the late 1980s a number of international standards for systemically important payment and securities settlement systems have been developed. Compliance with these standards is the starting-point for the central banks' oversight of existing and new systems.

This Chapter initially describes the role of central banks as overseers of systemically important payment and settlement systems. Next, the main principles of Danmarks Nationalbank's oversight and the international standards for systemically important payment and settlement systems are outlined, followed by the main conclusions of the most recent assessments of systemically important systems in Denmark, i.e. the Sum-clearing, Kronos and the VP settlement system, in relation to the international standards. Finally, the Chapter discusses the reflections which the events in the USA on 11 September 2001 gave rise to, including in Denmark.

The international standards for, respectively, payment and securities settlement systems are further described in the Annexes to this Chapter. The Memorandum of Understanding between Danmarks Nationalbank and the Danish Financial Supervisory Authority concerning Payment Systems and Clearing Centres is also included as an Annex.

10.1 CENTRAL BANKS AS OVERSEERS

As international standards have been laid down, central banks have worked to develop the framework for oversight, in order to ensure that payment and settlement systems comply with these standards.

The central banks' oversight of payment and settlement systems is linked to their responsibility for financial stability. In this connection it is important that the systems are designed to significantly reduce systemic risk, i.e. the risk that problems experienced by one participant may spread to other participants, cf. Chapter 4.

Payment and settlement systems handling retail payments and transactions are often owned and operated by private enterprises on commercial terms, with a focus on developing facilities to meet the participants' requirements in the most cost-effective manner, cf. Chapter 1. However, it is important that the systems are regularly compared with best practice internationally so that they do not pose a threat to financial stability.

Oversight involves tasks extending beyond financial supervision and audit. Unlike supervisory authorities and auditors, the central bank in its capacity as overseer also considers how a system functions in relation to alternative options. Consequently, proposals may be made that are not purely based on a risk assessment, but can also be aimed at creating a payment system with added value to society.

As opposed to the operator, the overseer does not actually check day-to-day operations. However, the results of the operator's system checks constitute valuable input in connection with the oversight of a system.

10.1.1 Main principles for oversight

BIS has laid down four general principles for oversight of systemically important payment systems by central banks, cf. Box 10.1.¹ One of the objectives of these principles is for other stakeholders in the payment systems to become aware of and understand the central bank's oversight function. Consequently, the principles stipulate that central banks should publicly disclose their major policies with respect to payment systems (and the payments infrastructure as such). This allows other stakeholders to take initiatives to improve system compliance with these policies.

Oversight of payment systems by central banks takes place in cooperation with other relevant authorities. Otherwise different authorities could potentially order system operators to comply with contradictory objec-

¹ The role of central banks in the oversight of securities settlement systems is described in BIS/IOSCO Recommendation no. 18, cf. Box 10.5.

OVERSIGHT OF PAYMENT SYSTEMS BY CENTRAL BANKS

Box 10.1

- The central bank should define clearly its payment system objectives and should disclose publicly its role and major policies with respect to systemically important payment systems.
- The central bank should ensure that the systems it operates comply with the Core Principles.
- The central bank should oversee compliance with the Core Principles by systems it does not operate and it should have the ability to carry out this oversight.
- The central bank, in promoting payment system security and efficiency through the Core Principles, should cooperate with other central banks and with any other relevant domestic or foreign authorities.

Source: BIS (2001) and Thygesen (2001).

tives. This problem becomes particularly evident if the authorities do not attach the same importance to, respectively, efficiency and security. In some situations, efficiency can only be improved at the expense of security and vice versa. Besides the system owners, the participants, the central bank and the national competition authorities and supervisory authorities are important stakeholders. Where a system has foreign participants, foreign central banks and authorities are also stakeholders – to the extent that the foreign participation can cause systemic problems to be channelled to and from other countries.

Besides ensuring compliance with international standards, central banks may – as part of their policies for payment systems – determine national objectives for oversight of payment systems. In many cases the international standards are minimum standards that should preferably be exceeded by the national payment systems.

Initially, oversight by central banks was to a large extent based on "moral suasion", i.e. the central bank sought to exert influence without having any formal legal backing. Since the central banks acted as settlement banks for systemically important systems, they were usually able to impose requirements on systems and participants via settlement agreements and terms and conditions for accounts, cf. Chapter 9. However, the trend is for the oversight function of central banks to be regulated by law. In the EU this development is based on, *inter alia*, the Maastricht Treaty from 1992, which defined oversight as a basic task of the ESCB.¹

¹ According to the Treaty Establishing the European Community, Article 105(2) one of the basic tasks of the ESCB is "to promote the smooth operation of payment systems". Furthermore, the Statute of the ESCB and of the ECB in Article 22 on Clearing and payment systems states that "the ECB and national central banks may provide facilities, and the ECB may make regulations, to ensure efficient and sound clearing and payment systems within the Community and with other countries.". These provisions only apply to euro area member states.

Since the major financial crises in Asia in 1997-98, the International Monetary Fund, IMF, and the World Bank have conducted Financial Sector Assessment Programs (FSAP) in their member countries. An FSAP often includes an assessment of whether the systemically important payment systems comply with the BIS Core Principles, as well as an assessment of securities settlement systems' compliance with the BIS/IOSCO Recommendations. An FSAP is often based on the system assessment reports prepared by the national central banks, cf. section 10.5. In addition, the central bank and other relevant authorities must answer a number of questions and provide an account of a country's systems.

In relation to payment systems the FSAPs performed show considerable differences between countries in respect of compliance with international standards; generally less developed countries tend to be less compliant. The greatest problems typically concern the systems' liquidity and credit risk management. This is particularly true in relation to the possibility of effecting fast and final settlement, and it is often assessed that multilateral netting systems will have difficulty in ensuring timely settlement if the participant with the largest single settlement obligation is removed. Few problems are observed in terms of the quality of the settlement asset, which is usually central-bank money. Some problems have been identified in relation to rules and procedures. The recommendations concerning operational stability and efficiency have proved to be the easiest to observe, although a relatively large number of systems have problems with corporate governance.

Source: IMF (2002).

At the global level, the IMF and the World Bank also play an important role in the oversight of payment systems, in that assessment of payment systems forms part of their Financial Sector Assessment Programs, cf. Box 10.2.

10.1.2 Which systems are subject to oversight?

Oversight by central banks comprises only systemically important systems. To provide guidance on how to identify systemically important systems, BIS suggests that at least one of the following criteria should be met:

- It is the only payment system in a country, or the principal payment system in terms of the aggregate value of payments.
- It handles mainly payments of high individual value.
- It is used for the settlement of financial market transactions or for the settlement of other payment systems.¹

Consequently, real-time gross settlement (RTGS) systems are typically viewed as systemically important owing to the value of payments settled.

¹ Cf. BIS (2001).

Net settlement systems, which settle retail payments of a significantly lower value, are, however, also systemically important if there are no suitable alternatives.

Likewise, the national securities settlement systems are often systemically important. Even where there are several securities settlement systems in a country, each system tends to have a dominant position in relation to settlement of one or several groups of securities, e.g. equities, government bonds, etc.

10.1.3 Implementation of oversight

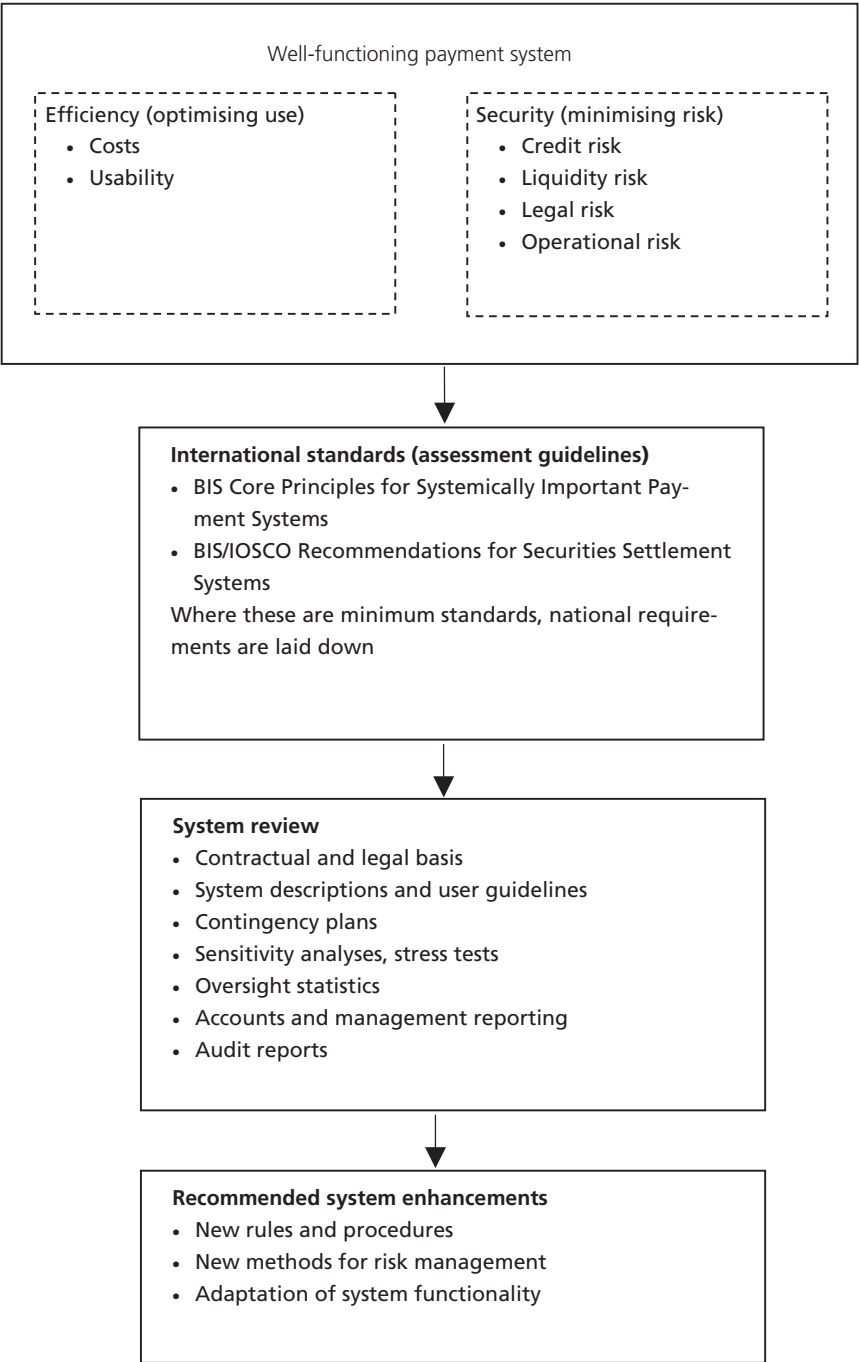
The overall objective of oversight is to contribute to the efficiency and security of payment and settlement systems and thus to prevent problems within these systems from threatening financial stability.¹ In order to assess whether this objective is met, it is necessary to develop specific targets and benchmarks. Chart 10.1 provides an example of how the oversight task may be structured.

The first step is to specify the overall objective of a well-functioning payment system in more detail. This is done by identifying the criteria to be applied when assessing the system. In the example, assessment is performed on the basis of two efficiency criteria, while risks are assumed to fall within four categories, cf. Chapter 4.

Step two is to determine standards to be met by a well-functioning system. International standards are e.g. the BIS Core Principles and the BIS/IOSCO Recommendations, which are described in sections 10.3 and 10.4 and elaborated on in Annexes 10.A and 10.B. National standards are typically further specification or tightening of the international standards. Subsequently the standards must be incorporated in guidelines describing the sources and methods to be used for assessing system compliance with the standards.

Step three is the actual review of the system on the basis of the assessment guidelines. The list in the Chart is not necessarily exhaustive, and often an assessment focuses on a limited number of issues. For example, an assessment of the impact of a regulatory amendment on a system could be based on a legal expert opinion and a review of relevant parts of the system's legal and contractual basis, often supplemented with discussions with the system owner and operator as well as any other relevant stakeholders.

¹ Cf. Bilotft (2002).



The central bank's assessment may result in various recommendations, and the fourth and final step is to suggest changes with a view to enhancing the system.

10.2 OVERSIGHT BY DANMARKS NATIONALBANK

The primary objective of Danmarks Nationalbank's oversight is to ensure the efficiency and stability of the Danish payment and settlement systems so that they do not pose a threat to financial stability. This is enshrined in section 1 of the Danmarks Nationalbank Act, stating that Danmarks Nationalbank shall "maintain a safe and secure currency system in this country, and [...] facilitate and regulate the traffic in money and the extension of credit".

Danmarks Nationalbank's oversight of the Danish payment and settlement systems is based on international standards and recommendations, first and foremost the BIS' Core Principles for Systemically Important Payment Systems and the BIS/IOSCO Recommendations for Securities Settlement Systems. The three systemically important systems in Denmark – Kronos, the Sumclearing and the VP settlement system – have been assessed in relation to these standards.

Danmarks Nationalbank ensures that different units handle system operation and oversight, in that Accounting is responsible for day-to-day operations while Payment Systems is responsible for system oversight and development. This applies in relation to Kronos, where Danmarks Nationalbank handles all operator functions, but also in relation to the other two systems, in which Danmarks Nationalbank only acts as settlement bank.

Oversight takes place on an ongoing basis, and Payment Systems must regularly report to the governors of Danmarks Nationalbank on operations, including any system failures or other incidents that have caused problems. The regular oversight is supplemented by more extensive system reviews from time to time, aimed at assessing whether the systems comply with international and national standards.

Where required, oversight takes place in cooperation with other national and international authorities. Danmarks Nationalbank and the Danish Financial Supervisory Authority have concluded a Memorandum of Understanding concerning Payment Systems and Clearing Centres, cf. Annex 10.C.

10.3 INTERNATIONAL STANDARDS FOR PAYMENT SYSTEMS

The work to develop international standards for payment and settlement systems commenced in the late 1980s prompted by the substantial

volume of payment and trading transactions settled via the systems. The need for international standards was highlighted by several serious incidents threatening the settlement of payments and trading transactions, cf. Chapter 1. In a few cases the problems were of a nature and scope that made it necessary for central banks to provide considerable extra liquidity to participants in order to prevent problems from spreading to other participants, thereby threatening financial stability.

10.3.1 The Lamfalussy standards

BIS' publication of the Lamfalussy Report¹, named after the chairman of the Committee, in 1990 was a milestone in the development of international standards for payment systems. The Report listed six minimum standards for net settlement systems, all of which have also been found in subsequent reports in this area.

The main objective of the Lamfalussy Report was for participants to understand and manage the risks involved when settling payments via net settlement systems. The systems should rest on a well-founded legal basis in all relevant areas, and procedures should encourage participants to manage and limit all significant risks on payment settlement. This was to ensure timely daily settlement even if the participant with the largest net settlement obligation was unable to settle. Finally, access criteria should be objective and publicly disclosed in order to ensure fair and open access for participants. The Lamfalussy standards also led to the adoption of the Settlement Finality Directive in 1998, cf. the description in Chapter 9.

In 1993 the central banks of the EU member states agreed on a number of standards for national payment systems, cf. Box 10.3, including that netting systems should comply with the Lamfalussy standards.

10.3.2 BIS Core Principles for Systemically Important Payment Systems²

The Core Principles for Systemically Important Payment Systems issued by BIS in 2001, cf. Box 10.4, attached more importance to system efficiency than previous standards had done since it had become clear that the introduction of security measures could take place at the expense of system efficiency or at an excessive cost. The development of very secure, but inefficient payment systems could therefore entail a risk that the participants would not use the systems to a sufficient degree. Instead, they might be tempted to settle payments outside the systems, so that the systems would not have the desired risk-reducing impact on

¹ Cf. BIS (1990).

² For a more detailed review of the BIS Core Principles, see Annex 10.A.

MINIMUM COMMON FEATURES FOR DOMESTIC PAYMENT SYSTEMS IN EMU

Box 10.3

As part of the preparation of Economic and Monetary Union (EMU) and the new single currency, the euro, the central banks of the EU member states in 1993 under the auspices of the EMI (the precursor of the ECB) prepared a report, Minimum Common Features for Domestic Payment Systems. Among other things, the relevant central banks were to encourage compliance with the Lamfalussy standards by their domestic payment systems. Another primary aim of the EMI report was to harmonise the rules of the payment systems that were to constitute a coherent system for payment transfers between the EU member states, in particularly those that had opted to substitute the euro for their national currencies.

Common general criteria for system participation were to limit the risk that less stringent access criteria in one national system would attract cross-border participants from other member states, thereby increasing the overall risk in the euro payment system. The access criteria stipulated that, subject to a few exceptions, direct system participants should be credit institutions only. More specifically, national access criteria could include requirements as to financial strength, minimum payment transaction volume, and participation fees. The criteria laid down should be publicly disclosed and objective, e.g. to counteract discrimination by nationality. With a view to limiting credit risk on payment settlement, the EMI report recommended that member states without any RTGS system should develop one, and that the central bank should limit access to uncollateralised credit.

When the report was issued, Denmark already had an RTGS system (DN Inquiry and Transfer System), cf. Chapter 6. However, extension of credit was to a relatively large degree based on uncollateralised intraday credit. This option was phased out from 1995 and completely abolished in 1998.

The report placed the responsibility for oversight with the central bank of the system's home country. As regards cross-border participants from other EU member states, the Second Banking Coordination Directive provides for authorities in the home countries of, respectively, the payment systems and the foreign participants to exchange the necessary information, under normal conditions as well as in crises.

Source: EMI (1993) and Berg (1994).

payment settlement. The Core Principles also take account of the more widespread use of RTGS systems since the publication of the Lamfalussy Report in 1990.

Today most important payment systems are assessed in relation to the 10 Core Principles, which can be broken down on three main groups according to their target areas:

- rules and procedures
- risk management
- efficiency

The Core Principles are described in more detail in Annex 10.A.

BIS' 10 CORE PRINCIPLES FOR SYSTEMICALLY IMPORTANT PAYMENT SYSTEMS	Box 10.4
<div><div><div>I. The system should have a well-founded legal basis under all relevant jurisdictions.</div><div>II. The system's rules and procedures should enable participants to have a clear understanding of the system's impact on each of the financial risks they incur through participation in it.</div><div>III. The system should have clearly defined procedures for the management of credit risks and liquidity risks, which specify the respective responsibilities of the system operator and the participants and which provide appropriate incentives to manage and contain those risks.</div><div>IV. The system should provide prompt final settlement on the day of value, preferably during the day and at a minimum at the end of the day.</div><div>V. A system in which multilateral netting takes place should, at a minimum, be capable of ensuring the timely completion of daily settlements in the event of an inability to settle by the participant with the largest single settlement obligation.</div><div>VI. Assets used for settlement should preferably be a claim on the central bank; where other assets are used, they should carry little or no credit risk and little or no liquidity risk.</div><div>VII. The system should ensure a high degree of security and operational reliability and should have contingency arrangements for timely completion of daily processing.</div><div>VIII. The system should provide a means of making payments which is practical for its users and efficient for the economy.</div><div>IX. The system should have objective and publicly disclosed criteria for participation, which permit fair and open access.</div><div>X. The system's governance arrangements should be effective, accountable and transparent.</div></div><div>Core Principles IV and V are minimum standards, and payment systems should preferably aim higher.</div></div>	

Source: BIS (2001) and Thygesen (2001).

10.4 INTERNATIONAL REQUIREMENTS FOR SECURITIES SETTLEMENT SYSTEMS

As regards securities settlement systems, a major contribution to the development of international standards was made in 1989, when the Group of Thirty (G30) published a report, *Clearance and Settlement Systems in the World's Securities Markets*.¹ The report included nine recommendations which subsequently set the standard for securities settlement worldwide.

The background to the report was increasing awareness that many securities markets, including some in OECD countries, were inefficient and

¹ Cf. Group of Thirty (1989).

exposed participants to unnecessary risks. At the time of the publication of the report, there was a specific need to shorten the settlement cycle for securities transactions. Trade confirmation should be received the day after the trade is concluded, at the latest, while settlement should take place within three days. In addition, the report encouraged settlement via simultaneous exchange of securities and cash (Delivery versus Payment, DvP). Finally, the report recommended the establishment of central securities depositories (CSDs) so that transactions could be settled without physical transfer of securities, but solely by book entry.

The establishment of VP Securities Services in 1983 meant that Denmark complied with the G30 recommendations from day one, cf. Chapter 6.

10.4.1 BIS/IOSCO Recommendations

In 2001, BIS and IOSCO, the International Organization of Securities Commissions, issued a joint report containing 19 Recommendations for Securities Settlement Systems, cf. Box 10.5.¹ Like the Core Principles, the Recommendations were intended to contribute to increased security and efficiency in securities settlement systems. Compared with the G30 report from 1989, recommendations pertaining to risk management, as well as rules and procedures, had been added.

The Recommendations can be broken down on five main groups according to their target areas:

- rules and procedures
- risk management prior to securities settlement
- risk management during securities settlement
- risk management when providing custody services, etc. in relation to securities
- efficiency

The Recommendations are described in more detail in Annex 10.B.

10.4.2 ESCB/CESR Standards

In October 2004, CESR (the Committee of European Securities Regulators) and the ECB published a report aimed at ensuring uniform, harmonised European implementation of the BIS/IOSCO Recommendations for Securities Settlement Systems.²

The BIS/IOSCO Recommendations are aimed at securities settlement systems worldwide, i.e. a relatively broad and heterogeneous target

¹ Cf. BIS/IOSCO (2001).

² Cf. ECB-CESR (2004).

BIS/IOSCO'S 19 RECOMMENDATIONS FOR SECURITIES SETTLEMENT SYSTEMS

Box 10.5

1. Securities settlement systems should have a well-founded, clear and transparent legal basis in the relevant jurisdictions.
2. Confirmation of trades between direct market participants should occur as soon as possible after trade execution, but no later than trade day (T+0). Where confirmation of trades by indirect market participants (such as institutional investors) is required, it should occur as soon as possible after trade execution, preferably on T+0, but no later than (T+1).
3. Rolling settlement should be adopted in all securities markets. Final settlement should occur no later than T+3. The benefits and costs of a settlement cycle shorter than T+3 should be evaluated.
4. The benefits and costs of a CCP should be evaluated. Where such a mechanism is introduced, the CCP should rigorously control the risks it assumes.
5. Securities lending and borrowing (or repurchase agreements and other economically equivalent transactions) should be encouraged as a method for expediting the settlement of securities transactions. Barriers that inhibit the practice of lending securities for this purpose should be removed.
6. Securities should be immobilised or dematerialised and transferred by book entry in CSDs to the greatest extent possible.
7. CSDs should eliminate principal risk by linking securities transfers to funds transfers in a way that achieves delivery versus payment.
8. Final settlement should occur no later than the end of the settlement day. Intraday or real-time finality should be provided where necessary to reduce risks.
9. CSDs that extend intraday credit to participants, including CSDs that operate net settlement systems, should institute risk controls that, as a minimum, ensure timely settlement in the event that the participant with the largest payment obligation is unable to settle. The most reliable set of controls is a combination of collateral requirements and limits.

Continues

group, while the ESCB/CESR Standards are aimed at the EU and are more stringent in a number of areas. For instance, the ESCB/CESR Standards have tightened the requirements for operational reliability by prescribing a recovery time not exceeding two hours after large system disruptions. In practice this means that central securities depositories must have a "hot" backup centre. To further protect the investors, all records of entities holding securities in custody should, at least once a day, be reconciled with the entity administering the ultimate record of holdings of particular securities issues.

The ESCB/CESR report also established a set of standards comprising other standards and recommendations in this field. To a large extent the

BIS/IOSCO'S 19 RECOMMENDATIONS FOR SECURITIES SETTLEMENT
SYSTEMS – CONTINUED

Boks 10.5

10. Assets used to settle the ultimate payment obligations arising from securities transactions should carry little or no credit or liquidity risk. If central bank money is not used, steps must be taken to protect CSD members from potential losses and liquidity pressures arising from the failure of the cash settlement agent whose assets are used for that purpose.
 11. Sources of operational risk arising in the clearing and settlement process should be identified and minimised through the development of appropriate systems, controls and procedures. Systems should be reliable and secure, and have adequate, scalable capacity. Contingency plans and backup facilities should be established to allow for timely recovery of operations and completion of the settlement process.
 12. Entities holding securities in custody should employ accounting policies and safe-keeping procedures that fully protect customers' securities. It is essential that customers' securities be protected against the claims of a custodian's creditors.
 13. Governance arrangements for CSDs and CCPs should be designed to fulfil public interest requirements and to promote the objectives of owners and users.
 14. CSDs and CCPs should have objective and publicly disclosed criteria for participation that permit fair and open access.
 15. While maintaining safe and secure operations, securities settlement systems should be cost-effective in meeting the requirements of users.
 16. Securities settlement systems should use or accommodate the relevant international communication procedures and standards in order to facilitate efficient settlement of cross-border transactions.
 17. CSDs and CCPs should provide market participants with sufficient information for them to identify and evaluate accurately the risks and costs associated with using the CSD or CCP services.
 18. Securities settlement systems should be subject to transparent and effective regulation and oversight. Central banks and securities regulators should cooperate with each other and with other relevant authorities.
 19. CSDs that establish links to settle cross-border trades should design and operate such links to reduce effectively the risks associated with cross-border settlements.
-

report can therefore replace the ESCB's user requirements for central securities depositories used in the ESCB's open-market operations.

When the report was adopted, certain issues were deferred for treatment in a separate Methodology Report, which is due at the end of 2005. In particular, the regulation of CSD functions handled by large custodian banks was deferred for later decision. Other issues included regulation of credit risk, particularly in credit institutions, which is also comprised by the new Basel II solvency requirements.¹ The new standards will not take effect until the Methodology Report has been published.

¹ Cf. Borup and Lykke (2003).

10.5 ASSESSMENT OF DANISH PAYMENT AND SETTLEMENT SYSTEMS

This section describes the results of the most recent assessments of the Danish payment and settlement systems in relation to international standards. Danmarks Nationalbank assessed Kronos and the Sumclearing, while the assessment of the VP settlement system took place in co-operation with the Danish Financial Supervisory Authority.¹

The assessments are updated from time to time so as to reflect changes in both international and Danish system requirements. In addition, the systems must be reassessed after implementation of major changes.

10.5.1 Assessment of Kronos

Danmarks Nationalbank has reviewed whether its RTGS system, Kronos, complies with the 10 BIS Core Principles. In the most recent review of Kronos, in 2002, all Core Principles were assessed to have been observed without any real shortcomings, except for Core Principle V, which does not apply to RTGS systems.

Rules and procedures

The legal basis for Kronos is assessed to be adequate and well-documented, which limits the legal risk pertaining to Kronos. Procedures, price structure, guidelines, etc. for Kronos are accessible at Danmarks Nationalbank's website. Kronos participants have been through training sessions, and for new participants a series of mandatory tests must be performed to ensure that the participants meet the technical requirements and can use Kronos in practice.

Risk management

Kronos' structure, rules and procedures, the use of central-bank money for settlement, and the access to intraday liquidity ensure that participants do not incur any credit risk on settlement of payments in Kronos, and that the liquidity risk is limited. Since Kronos is an RTGS system, cf. Chapters 4 and 6, the period from a payment is ready for settlement until it has been finally settled has been minimised. Operational risk is limited thanks to Kronos' structure and general security policy. System operations can be reestablished within four hours, and continuous data mirroring ensures that transactions can still be settled by Danmarks Nationalbank after a Kronos system failure.

¹ The assessments can be found at www.nationalbanken.dk (under Tasks/Payment systems/Oversight).

Since the review in 2002, Danmarks Nationalbank has performed stress tests of Kronos with a view to assessing the risk of gridlock and dead-lock, which could have a negative impact on system performance and thus on financial stability.¹

Efficiency

Kronos incorporates state-of-the-art technology and is regularly updated to match technological advances and user requirements. The modular structure enables a pricing policy under which participants' costs reflect their use of the system. Virtually all monetary financial institutions in Denmark have access to Kronos, provided that they meet certain system requirements and know how Kronos functions. As mentioned above, Kronos' rules and procedures are publicly disclosed.

10.5.2 Assessment of the Sumclearing

In cooperation with the Danish Bankers Association, which owns the Sumclearing net settlement system, Danmarks Nationalbank has reviewed whether the Sumclearing complies with the 10 BIS Core Principles.

In the 2002 review of the Sumclearing, all Core Principles were assessed to be observed, except for Core Principles III and VII, which were broadly observed, i.e. minor shortcomings were found but did not give rise to major concerns. The results of the Sumclearing review are outlined below.

Rules and procedures

The legal basis for the Sumclearing is assessed to be adequate, which limits the legal risk in the Sumclearing. The structure, rules, procedures and agreements of the Sumclearing are available to members of the Danish Bankers Association, who also have access to a general information system. The Danish Bankers Association conducts regular training sessions and information meetings for Sumclearing participants.

Risk management

The Sumclearing operates with a number of procedures for limiting the participants' liquidity risk. The risk that payments are not settled on time is limited via the number and scheduling of settlement cycles in the Sumclearing. The use of central-bank money limits the credit and liquidity risks on the settlement bank.

¹ Cf. Chapter 6, section 6.1, Appendix C and Danmarks Nationalbank (2002a).

Stress tests show that if the participant with the largest single settlement obligation is removed, other participants will not experience problems since the excess liquidity in the Sumclearing is considerable.¹

Operational risk is limited via the security policy. Operations can be re-established within 24 hours after system failure, which is deemed to be a little on the slow side.

Another shortcoming is the lack of adequate procedures to counter the credit risk incurred by participants who choose to credit recipient accounts on the basis of bookkeeping data received one day before the funds are actually received from the remitter's bank. The latter issue is only relevant for payments included in PBS settlement, cf. Chapter 6.

Efficiency

The Sumclearing is owned by the Danish Bankers Association and thus by the participants. Major decisions are made by the Board of the Danish Bankers Association. The Sumclearing is based on the common payments infrastructure, which limits the costs and increases efficiency in payments settlement.

Access to the Sumclearing requires, *inter alia*, access to accounts at Danmarks Nationalbank and thus observance of the Kronos access criteria. The participation costs are low and not linked to system use.

10.5.3 Assessment of the VP settlement system

In 2004, Danmarks Nationalbank and the Danish Financial Supervisory Authority conducted a review of the VP settlement system's compliance with the BIS/IOSCO Recommendations. 17 of the 19 Recommendations were assessed to be observed, i.e. all criteria were met with no real shortcomings. The exceptions were Recommendation 5, which does not apply to the system, and Recommendation 17 on sufficient information for identification and evaluation of risks, which was broadly observed, i.e. minor shortcomings were found but did not give rise to major concerns. The results of the review are outlined below.

Rules and procedures

The statutory basis for VP settlement is assessed to be adequate, which limits the legal risk. Information on VP's statutes and rules, including procedures and guidelines for participation in clearing and settlement, etc., and descriptions of the risks related to the VP settlement are available at VP's website. However, only parts of the information are avail-

¹ Cf. Danmarks Nationalbank (2002a) and Appendix D.

able in English, which is why Recommendation 17 is assessed to be only broadly observed.

Risk management prior to securities settlement

A number of procedures minimise the risk that securities transactions are not ready for settlement on the value date. It is an established practice that trades are confirmed for VP settlement immediately after their conclusion, and normally with three days' value, T+3. In addition, securities can be borrowed in the market, and certain government and mortgage-credit bonds can be borrowed from Danmarks Nationalbank.

Risk management during securities settlement

The credit risk in VP settlement is limited by using the DvP principle, by settling in central-bank money and by VP not extending credit to participants. The settlement procedure for net settlement of securities transactions and the possibility of real-time gross settlement minimise the risk that securities transactions are not settled on time. The excess liquidity requirement and VP's automatic collateralisation, cf. Chapter 5, limit the risk that other participants are affected if a participant is removed from settlement owing to insufficient cover in cash or securities. The use of lines reduces the risk to primary cash providers related to unexpectedly large liquidity withdrawals by indirect payment participants. Operational risk is limited via VP's security policy. Operations can be resumed at a second operating centre within an hour, and at a third operating centre within a few days. VP's links to other central securities depositories are also assessed in the regular risk analyses.

Risk management when providing custody services, etc. in relation to securities

All securities issued by VP are dematerialised, and registration, custody and settlement of securities take place electronically in VP. This minimises the risk of handling errors and supports fast clearing and settlement of securities transactions. Efficient segregation of titles to securities in VP is e.g. ensured by using single-investor accounts. In addition, legislation ensures the investors' rights, including the title to securities deposited in omnibus accounts, in the event that an account controller becomes subject to insolvency proceedings.

Efficiency

Participation in VP is chiefly limited to securities dealers, major customers and foreign central securities depositories. Legislation ensures that access requirements are objective and non-discriminatory. Via system

ownership, VP users are represented on the Board of VP, and the interests of the public are safeguarded via legislation. VP is subject to supervision by the Danish Financial Supervisory Authority and oversight by Danmarks Nationalbank. VP's access criteria, rules, objectives, etc. are published at VP's website. The structure of the VP settlement system, which e.g. support STP (Straight-Through Processing) and international communication standards, enables a high degree of automation in securities settlement, thereby reducing costs.

10.6 OVERSIGHT OF THE RISK OF MAJOR OPERATIONAL DISRUPTIONS

The terrorist attacks on New York on 11 September 2001 clearly demonstrated the vulnerability of payment and settlement systems, cf. Chapter 1, Box 1.1. Oversight of systemically important payment and settlement systems has therefore increasingly focused on the risk of extreme events causing major disruptions of systems for settlement of payments, securities transactions, etc. since the potential negative impact can be so large that a contingency plan should be in place even though the risk is very small. Examples of extreme events are provided in Box 10.6.

Major operational disruptions to payment and settlement systems are characterised by having either:

- *systemic consequences*, i.e. a participant's inability to meet its payment or delivery obligations triggers a chain reaction, whereby other participants are also unable to meet their obligations, cf. Chapter 4, or
- *wide-ranging consequences to society*, i.e. a wide-scale disruption of the execution of payments and transactions (falling short of having a systemic effect) that cannot immediately be handled in alternative ways.¹

The consequences are, however, not purely a result of the actual events. In relation to payment systems, the impact may be amplified if participants already have serious doubts as to the creditworthiness of one or several participants.

10.6.1 The objectives of contingency plans

The overall purpose of establishing contingency plans for payment and settlement systems is to prevent systemic consequences or other wide-ranging consequences to society as a result of extreme events. After the terrorist attacks on 11 September 2001, the US authorities have, in consultation with the sectors in question, prepared recommendations for all relevant parties to draw up contingency plans, so that the overall finan-

¹ Cf. Bank of England (2003).

A number of events in recent years have demonstrated that the global flow of payments is subject to risks that cannot be handled via ordinary financial and operational risk management. Several of the events do not require special contingency measures on the part of the financial institutions if they occur on a small scale. On a large scale, however, they can have serious consequences if the necessary measures have not been taken. This also applies to settlement of payments and trading transactions, since these are often concentrated on a few key systems and enterprises.

Examples of events that could lead to major disruptions to payment and settlement systems include:

- *IT system failures:* Virtually all modern payment systems are IT-based, and in a worst-case scenario system errors may stop all incoming and outgoing payments. IT system failures can be a result of human errors, as well as hardware or software errors.
- *Telecommunication failures:* Modern payment systems are heavily dependent on a well-functioning telephone network. If the telephone network breaks down, it is no longer possible for financial institutions to send and receive the messages on which entries to the remitters' and recipients' accounts and safekeeping accounts are based. When one of the world's largest telephone operators, Worldcom, collapsed in March 2002, the consequences to the financial sector would have been huge if traffic via its network had been stopped. However, measures were taken to prevent this.
- *Power outages:* Power outages such as those affecting north-eastern USA and Ontario, Canada, as well as southern Sweden and the Danish island of Zealand in 2003 also affect payments infrastructure installations. As regards the Danish payment and settlement systems, the consequences of the power outage, which affected Greater Copenhagen for several hours, were minimal, since all major installations rapidly switched to back-up power generators.
- *Natural disasters:* No natural disasters in the western world are known to have affected the functionality of payment and settlement systems. The floods in central Europe in August 2002 did, however, lead to reassessment of the risks related to extreme weather conditions, including requirements to install a backup IT system at a separate location from the primary system.
- *Diseases:* In extreme cases, epidemics can have global consequences, as when the lung disease SARS in the spring of 2003 spread from China to other parts of the world. If an epidemic of a potentially lethal disease breaks out, there is a risk that many people are infected, and that many are quarantined. Even if an epidemic only affects a small geographical area, the impact on the financial markets could be substantial if that area is a financial centre.
- *Terrorism and crime:* The financial sector has been hit by several acts of terrorism in recent years, cf. the attacks on New York on 11 September 2001. Besides attacking physical constructions and people, terrorists may also launch IT virus attacks, from external sources (via the Internet) or internal sources (company employees). Outbreaks of diseases may also be a result of terrorism, as was the case with the anthrax letters in the USA in 2001-02.

cial system will still function in the event of any wide-scale disruption.¹ In relation to payment and settlement systems, the contingency plans should provide for:

- Rapid recovery and timely resumption of critical operations following a wide-scale disruption, e.g. within two hours after the event.
- Rapid recovery and timely resumption of critical operations following the loss or inaccessibility of staff in at least one major operating location.
- A high level of confidence, through ongoing use or robust testing, that critical internal and external continuity arrangements are effective and compatible.

On resumption of operations it should be ensured that new settlement orders can be placed in the systems and that the settlement transactions that were interrupted are completed. In this context it is important that the contingency measures are aimed at reestablishing the business activities in question, not merely on IT system recovery.

Contingency plans must also be drawn up for those parts of the payments infrastructure that are not directly controlled by the financial sector, e.g. telephone networks used for transmission of payment instructions, etc. Generally, contingency plans should also be prepared for outsourced parts of the payments infrastructure. The payment system provider is responsible for ensuring that the subcontractors' contingency plans also comply with the above objectives.²

10.6.2 Sound practices for counteracting major operational disruptions

Sound practices for counteracting major operational disruptions comprise four elements:

- Identification of payment and settlement systems used by business segments of major significance to society.
- Establishment of relevant targets for resumption of payments and settlements that were interrupted.
- Establishment of backup facilities at sufficiently geographically dispersed locations.
- Regular use and testing of resumption arrangements.

Identification of the critical parts of the payments infrastructure is the task of the individual enterprise. Critical parts comprise not only the enterprises operating key payment and settlement systems³, but also

¹ Cf. Board of Governors et al. (2003).

² Cf. for example Rosenoer (2004).

³ In Denmark these are PBS, VP Securities Services and Danmarks Nationalbank.

parts of systems and installations in enterprises with a substantial market share of payments, etc., e.g. large banks.

Establishment of targets for resumption of payments and settlements affected by system disruption is primarily a question of the acceptable time lapse before payment and settlement can be resumed. In large-value payment systems the time factor is particularly critical since non-settlement of payments is more likely to have a systemic impact. In such systems, operations should preferably be resumed or transferred to alternative systems within a few hours.

Separate backup facilities have already been established to a large extent. Mergers in the financial sector have often been taken as an opportunity to establish IT backup facilities. When the business operations of the merging banks have been integrated on a single platform, the IT system of one of the parties has been reclassified as a backup system. However, this does not provide full security since the backup system often applies the same software as the primary system, and consequently software bugs can potentially disrupt both systems at the same time.

The efficiency of the resumption arrangements can only be ensured if they are tested and applied on a regular basis. The above example, viz. a software bug in both the primary system and the backup system, illustrates the need to test new software thoroughly before releasing it.

Implementation of contingency plans to make payment and settlement systems more resilient to extreme events often requires extensive resources. It is therefore important that the enterprises operating critical parts of the payments infrastructure integrate contingency measures in their long-term planning. This allows them to develop the contingency measures to match initiatives in the business segments. In addition, this is often less expensive than to implement the contingency plans subsequently.

10.6.3 Intervention by public authorities

The authorities must acknowledge that the contingency plans of business enterprises cannot envisage all situations. Where payments using critical parts of the payments infrastructure cannot be resumed in a timely manner, special precautions may have to be taken. One option could be to declare a normal working day a "bank holiday" as the US authorities did on 11 September 2001. This gives the participants in the payments infrastructure more time to reestablish their systems or put alternative systems into operation.

Finally, central banks may have to supply participants with substantial extra liquidity, as was also the case in the USA following 11 September 2001. Such liquidity may have to be provided on extraordinary terms, e.g. by relaxing the collateral requirements.

LITERATURE

Bank of England, 2003. Do we need new statutory powers?, Report of the Task Force on Major Operational Disruptions in the Financial System.

Bech, Morten L., Bo Madsen and Lone Natorp, 2002. Systemic Risk in the Danish Interbank Netting System, Danmarks Nationalbank, *Working Paper* no. 8.

Berg, Jesper, 1994. International Observations concerning Payment Systems, *Monetary Review*, August 1994.

Biltoft, Karsten, 2002. The Objectives of oversight – what are they?, *E-money and Payment Systems Review*, Pringle, Robert et al. (eds.), Central banking Publications.

BIS, 1990. Report of the Committee on Interbank Netting Schemes of the Central Banks of the Group of Ten Countries (Lamfalussy Report).

BIS, 2001. Core principles for Systemically Important Payment Systems, January 2001.

BIS/IOSCO, 2001. Recommendations for Securities Settlement Systems, *Report on the CPSS-IOSCO Joint Task Force on Securities Settlement System*, CPSS publication No. 46, November 2001.

Board of Governors et al., 2003. Interagency Paper on Sound Practices to Strengthen the Resilience of the U.S. Financial System, recommendations published by the Board of the Governors of the Federal Reserve System, Office of the Comptroller of the Currency, and the Securities and Exchange Commission.

Borup, Lisbeth and Morten Lykke, 2003. New Capital-Adequacy Rules for Credit Institutions, Danmarks Nationalbank, *Monetary Review*, 3rd Quarter.

Danmarks Nationalbank, 2002a. *Financial stability*.

Danmarks Nationalbank, 2002b. Second assessment of KRONOS in relation to the Core Principles for Systemically Important Payment Systems.

Danmarks Nationalbank, 2002c. Review of the Sumclearing in relation to Core Principles for Systemically Important Payment Systems.

Danmarks Nationalbank and the Danish Financial Supervisory Authority, 2004. Review of VP Securities Services in relation to Recommendations for Securities Settlement Systems.

Danmarks Nationalbank and the Danish Financial Supervisory Authority, 2001. Memorandum of Understanding between Danmarks Nationalbank and the Danish Financial Supervisory Authority Concerning Payment Systems and Clearing Centres, published in Danmarks Nationalbank, *Monetary Review*, 2nd Quarter.

ESCB-CESR, 2004. Standards for Securities Clearing and Settlement in the European Union.

EMI, 1993. Minimum Common Features for Domestic Payment Systems.

Swedish Financial Supervisory Authority, 2004. Från elavbrott till 11 september (From power outage to 11 September) (in Swedish only).

Group of Thirty, 1989. Clearance and Settlement Systems in the World's Securities Markets.

IMF, 2002. Financial Sector Assessment Program – Experience with the Assessment of Systemically Important Payment Systems.

Rosenoer, Jonathan, 2004. Outsourcing and operational risk management, *Financial Regulation International*, Issue 7.10.

Thygesen, Tobias, 2001. International Standards for Payment Systems, Danmarks Nationalbank, *Monetary Review*, 1st Quarter.

ANNEX 10.A

BIS' CORE PRINCIPLES FOR SYSTEMICALLY IMPORTANT PAYMENT SYSTEMS

This Annex presents a brief overview of the BIS Core Principles for Systemically Important Payment System. A more detailed review can be found in BIS (2001) at the BIS website, www.bis.org, under Publications.

Rules and procedures

Core Principles I and II specify requirements for payment system rules and procedures. The legal basis must be clear and unambiguous in order to limit legal risk, i.e. the risk of loss as a result of unforeseen interpretations of the systems' contractual basis or the legislation regulating the contracts, which is ultimately the basis for the mutual claims of the participants in the systems.

The legal basis must be applicable to all participants, irrespective of their geographical location.

The rules and procedures of a payment system must also be concise and easy to understand, so as to avoid any doubt about the risks involved in participating in the payment settlement procedure. Clear rules and procedures thus facilitate adequate risk management on the part of the participants.

Risk management

Core Principles III to VII specify requirements for payment systems, with a view to limiting the risks that may arise during settlement of payments.

Payment systems should have clearly defined procedures and facilities for management and limitation of the credit and liquidity risks incurred by participants during settlement. Examples include access to intraday credit, extension of credit against collateral only, loss-sharing agreements and use of optimisation routines and other queue facilities.

To limit the systemic risk, net settlement systems should, as a minimum, be capable of settlement in the event that the participant with the largest single settlement obligation is unable to settle.

To limit credit and liquidity risks, the period from a payment is ready for settlement until it has been finally settled should also be minimised. As a minimum, a payment that is ready for settlement should be settled on the value day, *inter alia* in order to limit the types of credit and liquidity risk that might otherwise arise, e.g. if insolvency proceedings are initiated between settlement days.

If the volume of payments settled is large, it should be possible to settle via RTGS systems.

The use of central-bank money in payment systems eliminates the credit and liquidity risks on the settlement bank. Where payment systems use other assets than central-bank money, the credit and liquidity risks on the settlement bank should be limited.

In order to limit operational risk, the structure of payment systems and their rules, procedures, etc. should be designed and updated to match technological advances.

Efficiency

Core Principles VIII-X concern the efficiency of payment systems, since a payment system should not only be secure, but also efficient. All other things being equal, participants will feel more inclined to use a secure payment system if it also meets user requirements in terms of functionality, is fast and practical to use, provides access to adequate liquidity and is cost-effective.

Open access criteria for a payment system, with due consideration of security aspects, will enhance competition and thereby efficiency among system participants. Transparency regarding payment-system objectives and decisions supports effective governance and makes it easier for participants and other stakeholders to exert influence on the system.

ANNEX 10.B**BIS/IOSCO RECOMMENDATIONS FOR SECURITIES SETTLEMENT SYSTEMS**

This Annex presents a brief overview of the BIS/IOSCO Recommendations for Securities Settlement Systems. A more detailed review can be found in BIS/IOSCO (2001) at the BIS website, www.bis.org.

Rules and procedures

Recommendations 1 and 17 concern the rules and procedures of securities settlement systems. The legal basis should be adequate and transparent in order to limit the legal risk arising from uncertainty as to e.g. the consequences to other participants if a participant is subject to insolvency proceedings.

The legal basis should be applicable to all participants, irrespective of their geographical location. Securities settlement systems should also ensure that participants have a clear understanding of and are fully aware of the system rules and procedures and thus the risks involved in securities settlement. This supports efficient risk management by participants.

Risk management prior to securities settlement

Recommendations 2-5 concern measures to limit the risks prior to settlement of a securities transaction.

Minimising the period from conclusion to settlement of a securities transaction reduces the replacement risk, since it limits the risk that the counterparty is unable to meet its financial obligations on the value date. To ensure that a securities transaction is ready for settlement on the value date, reporting, matching and confirmation should take place as soon as possible after the conclusion of the agreement.

The use of central counterparties is encouraged, whereby the credit risk is transferred to a known counterparty, and anonymous securities trading is enabled. However, the central counterparty should rigorously control the risks assumed in order to limit the systemic risk related to the concentration of transactions on a central counterparty.

Securities lending is also encouraged. This limits the risk that a securities transaction cannot be settled on the value date, as well as the consequences if timely settlement cannot be effected.

Risk management during securities settlement

Recommendations 7-11 and 19 are aimed at limiting risks during settlement of securities transactions.

The use of central-bank money limits the risk on the settlement bank. If other means of payment are used for settlement, the risk on the settlement bank should be minimised.

If the parties to a transaction exchange cash and securities simultaneously (Delivery versus Payment, DvP), the principal risk is eliminated.

Final settlement of securities transactions should, as a minimum, take place at the end of the value date. Final settlement several times during the settlement day or in real time offers several advantages, e.g. by enabling cross-border settlement of securities transactions back-to-back. In addition, several settlement cycles and the option to settle in real time limit the liquidity risks that might occur at the end of the day, just before the system closes.

To limit the systemic risk, securities settlement systems applying netting or extending credit to their participants, should, as a minimum, ensure timely settlement in the event that the participant with the largest single settlement obligation is unable to settle.

Operational risk should be limited through ongoing development of the systems and updating of security policies to match technological advances. Cross-border links between securities settlement systems generally reduce the risk on settlement of transactions across national borders, but entail special risks. The risks relating to cross-border links should be handled via procedures incorporated in the risk-management policies.

Risk management when providing custody services, etc. in relation to securities

Recommendations 6 and 12 concern registration and custody services, etc. in relation to securities.

Electronic registration, safekeeping and settlement of securities offers a number of advantages, including cost and efficiency gains, and supports rapid settlement, securities lending and DvP settlement.

The rights of investors should be protected when securities are held by custodian banks or central securities depositories. In particular, investors should not lose their title to the securities in the event of insolvency proceedings.

Efficient securities settlement systems

Recommendations 13-16 and 18 relate to the efficiency of securities settlement systems.

A securities settlement system should be secure to use, as cost-effective as possible and take the users' functionality requirements into account.

Fair and open access to securities settlement systems and central counterparties, with due consideration for system security, enhances compe-

tition between participants, as well as efficient and inexpensive clearing and settlement. Transparency concerning rules and decisions supports efficient and responsible management and makes it easier for participants and other stakeholders to exert influence on management decisions in relation to the settlement system. The use of internationally recognised procedures and standards for communication also facilitates efficient cross-border securities settlement.

Central banks and supervisory authorities must have the necessary resources to ensure efficient oversight and supervision. The objectives and key elements of their policies in these areas should be clear and publicly disclosed, and the central banks and supervisory authorities should cooperate with relevant authorities at home and abroad. Securities settlement systems operated by central banks must naturally also observe the above international recommendations for securities settlement systems.

ANNEX 10.C

MEMORANDUM OF UNDERSTANDING BETWEEN DANMARKS NATIONALBANK AND THE DANISH FINANCIAL SUPERVISORY AUTHORITY CONCERNING PAYMENT SYSTEMS AND CLEARING CENTRES

Objective and delineation

- Well-functioning payment systems and clearing centres are vital to financial stability. Systemically important systems have the potential to trigger financial disruptions or to spread financial problems to the financial system in a broader perspective, thereby threatening financial stability. The objective of the Memorandum of Understanding is to contribute to efficient and stable payment systems and clearing centres in Denmark. One aspect is to ensure that systemically important systems adhere to internationally recognised standards. The Memorandum of Understanding concerns functions which interface between the Danish Financial Supervisory Authority and Danmarks Nationalbank in this respect. The Memorandum of Understanding does not reduce the system owners' responsibility to ensure that their systems fulfil their relevant obligations.
- The tasks and responsibilities of the Danish Financial Supervisory Authority in connection with payment systems and clearing centres are set out in the Danish Securities Trading Act etc. The Act stipulates the obligations and rights of the Financial Supervisory Authority in connection with establishment, registration and supervision.
- Pursuant to the Danmarks Nationalbank Act the task of Danmarks Nationalbank as the central bank of Denmark is to maintain a safe and secure currency system and to facilitate and regulate the traffic in money. Danmarks Nationalbank considers this to entail contributing to the efficiency and stability of payment systems and clearing centres.

Definitions

The following definitions shall apply in this Memorandum of Understanding:

- Payment system: A system of which the sole purpose is clearing and settlement of money transactions.
- Clearing centre: A securities clearing enterprise which clears and settles transactions in securities and derivatives thereof, including related payments.
- Internationally recognised standards: Standards and recommendations adopted by international organisations and forums directed at payment systems and clearing centres.

- Supervision: The statutory obligations of the Danish Financial Supervisory Authority vis-à-vis payment systems and clearing centres, including supervision of whether the systems and the participants therein fulfil their statutory obligations.
- Oversight: Danmarks Nationalbank's task of contributing to the efficiency and stability of payment systems and clearing centres.

Payment systems and clearing centres comprised by the Memorandum of Understanding

- This Memorandum of Understanding comprises all systemically important payment systems and clearing centres which at the same time are approved or registered by the Danish Financial Supervisory Authority and which use Danmarks Nationalbank as settlement bank, cf. Annex 1. The Memorandum of Understanding does not include Danmarks Nationalbank's own payment systems.
- The Danish Financial Supervisory Authority and Danmarks Nationalbank may decide to add other systemically important payment systems and clearing centres to the scope of the Memorandum of Understanding.
- Under this Memorandum of Understanding, a payment system or clearing centre shall be considered systemically important if this is agreed between the Financial Supervisory Authority and Danmarks Nationalbank.

Coordination of tasks and consultation

- To the greatest possible degree, the Financial Supervisory Authority and Danmarks Nationalbank shall coordinate their joint tasks concerning verification of the compliance of payment systems and clearing centres with the internationally recognised standards stated in Annex 2.
- To the greatest possible degree, the Financial Supervisory Authority and Danmarks Nationalbank shall consult each other prior to any ruling or decision of vital importance to the payment systems or clearing centres covered by the Memorandum of Understanding.

Collection and exchange of information

- To the greatest possible degree, the Financial Supervisory Authority and Danmarks Nationalbank shall coordinate the collection of information in connection with supervision or oversight of the payment systems and clearing centres covered by the Memorandum of Understanding.
- To the greatest possible degree, the Financial Supervisory Authority and Danmarks Nationalbank shall exchange information of significance to the supervision or oversight of payment systems and clearing centres covered by the Memorandum of Understanding. The information shall be exchanged with due regard for current provisions on confidentiality, etc.

Amendment and termination of the Memorandum of Understanding

- Either party may at any time propose amendments to the Memorandum of Understanding or its annexes. On amendment of an annex to this Memorandum of Understanding, the date of the annex shall be amended, while the date of the Memorandum of Understanding shall remain unchanged. Adoption of amendments to the Memorandum of Understanding or its annexes shall be subject to the consent of the other party.
- Either the Danish Financial Supervisory Authority or Danmarks Nationalbank may at any time terminate this Memorandum of Understanding in its entirety at 30 days' notice.

Annex 1: Payment systems and clearing centres covered by the Memorandum of Understanding

The following payment systems and clearing centres are covered by the *Memorandum of Understanding between Danmarks Nationalbank and the Danish Financial Supervisory Authority concerning Payment Systems and Clearing Centres*:

Sumclearing
c/o the Danish Bankers Association
Finansrådets Hus
Amaliegade 7
DK-1256 Copenhagen K

VP Securities Services
Helgeshøj Allé 61
DK-2630 Taastrup

Annex 2: Internationally recognised standards covered by the Memorandum of Understanding

The following internationally recognised standards are covered by the *Memorandum of Understanding between Danmarks Nationalbank and the Danish Financial Supervisory Authority concerning Payment Systems and Clearing Centres*:

- Core Principles for Systemically Important Payment Systems
The standards are reproduced in the report of 15 January 2001 from the Committee on Payment and Settlement Systems of the G-10 central banks.
- Recommendations for Securities Settlement Systems
The recommendations are presented in the draft report of January 2001 from the Committee on Payment and Settlement Systems of the G-10 central banks in cooperation with IOSCO (International Organization of Securities Commissions).

Appendix A: Definition of Gridlock and Gridlock Resolution in Kronos

As described in Chapter 3, situations can arise where payments in an RTGS system are blocked due to inappropriate distribution of liquidity among the participants, even though overall there is sufficient liquidity in the system to settle the payments. This situation is called gridlock. Gridlock can be resolved if there is a subset of pending payments that can be settled simultaneously without any of the participants ending up with an overdraft. An algorithm that selects this subset is called a gridlock resolution mechanism.¹

Gridlock resolution

Assume that there are n participants and let Q_i be the number of payments in participant i 's queue. The overall queue in the RTGS system is given as $Q = \cup_{i=1}^n Q_i$. In the same way, a subset of payments for simultaneous settlement in order to resolve gridlock is given as $X = \cup_{i=1}^n X_i$, where X_i is the contribution from each participant's queue. Ex ante and ex post balances, including the overdraft access on each participant's account, are given as respectively \bar{B}_i and $B_i(\bar{B}_i, X)$, i.e. the balance of participant i 's account before and after a gridlock resolution. The value of the payments received by participant i is given as $R(X_{-i})$, where $-i$ signifies non- i , and the value of the payments remitted by participant i is given as $S(X_i)$.

A gridlock resolution is a situation where there is a non-empty subset $X \subseteq Q$, so that if the payments were settled simultaneously then

$$B_i(\bar{B}_i, X) = \bar{B}_i - S(X_i) + R(X_{-i}) \geq 0, \text{ for } i = 1, \dots, n \quad (1)$$

Condition (1) ensures that if the payments are settled simultaneously the ex-post balance for all participants will be non-negative. The ex post balance is given by the ex ante balance less the value of payments remitted from participant i , $S(X_i)$ plus the value of payments received by participant i , $R(X_{-i})$.

¹ The Appendix is based on Bech and Soramäki (2001) and the Kronos System Specifications.

The definition does not take account of the sequence of the payments in the liquidity queue. This means that any possible gridlock resolution will not respect any prioritised sequence that participants in the payment system can allocate to their payments. Therefore let \succ_i indicate a preference relation for participant i with regard to the sequence in which the payments are required to be settled.

By adding the following condition (2) to the gridlock resolution it is ensured that the participants' prioritised sequence is complied with:

$$\forall x \in X_i \exists q \in Q_i \setminus X_i \text{ so that } q \succ_i x_i \text{ for } i = 1, \dots, n \quad (2)$$

Gridlock resolution presents the maximisation challenge of settling as many payments as possible, so as to minimise the waiting time for the queued payments. The maximisation challenge is therefore to select the largest possible subset of queued payments that can be settled simultaneously, given the two sub-conditions defined above.

Let $V(X)$ be the value or number of payments in X . Resolution of the gridlock is

$$\max_{X \subseteq Q} V(X),$$

on condition that the liquidity condition stated in (1) and the sequence condition stated in (2) are fulfilled.

The subconditions ensure that both the value and the number of simultaneously settled payments are maximised.

GRIDLOCK RESOLUTION IN KRONOS

As described in Chapter 6, Kronos has an algorithm that can search the liquidity queue for possible gridlock resolutions, as well as a functionality that can resolve the gridlock itself. The algorithm takes account of the sequence of payments so as to respect the participants' prioritisation. The participants' liquidity management is thus not interfered with.

In Kronos, the algorithm can either be activated to search the current liquidity queue once, or to monitor the liquidity queue on an ongoing basis. Ongoing monitoring entails that the algorithm seeks to find a solution each time a participant changes the sequence of its payments in the liquidity queue, or if a payment is either added to or removed from the liquidity queue. The algorithm will also seek to find a solution each time there is a change in the disposable current-account balances of the relevant participants.

Calculation of the optimum solution in Kronos¹

Gridlock resolution in Kronos adheres to the same principles and sub-conditions as are given in equations (1) and (2).

Let n be the number of direct participants.

Let m_i be the number of queued payments for the i 'th participant.

Let $p_{ij}^{(k)} > 0$ be the amount of a queued payment where

$1 \leq i \leq n$ identifies the remitter,

$1 \leq j \leq n$ identifies the recipient, and

$1 \leq k \leq m_i$ indicates the position in the queue.

Let $d_i \geq 0$ indicate the disposable amount for the i 'th participant's current account².

Let $0 \leq x_i \leq m_i$ indicate the number of payments in the i 'th participant's queue included in the solution $x = \{x_1, x_2, \dots, x_n\}$

$V(x)$ is the value of the payments that are settled

$$V(x) = \sum_{i=1}^n \sum_{\substack{j=1 \\ i \neq j}}^n \sum_{k=1}^{x_i} p_{ij}^{(k)}$$

$S_i(x)$ and $P_i(x)$ indicate the total amount that the i 'th participant is respectively to remit and receive.

$$S_i(x_i) = \sum_{\substack{j=1 \\ i \neq j}}^n \sum_{k=1}^{x_i} p_{ij}^{(k)} \quad \text{for } i = 1, \dots, n$$

$$P_i(x) = \sum_{\substack{j=1 \\ i \neq j}}^n \sum_{k=1}^{x_j} p_{ji}^{(k)} \quad \text{for } i = 1, \dots, n$$

Let $b_i(x)$ be the new disposable amount³ for the i 'th participant.

$$b_i(x) = d_i - S_i(x_i) + P_i(x) \geq 0 \quad \text{for } i = 1, \dots, n$$

¹ The algorithm was designed in cooperation with the Department of Informatics and Mathematical Modelling at the Technical University of Denmark.

² If the balance of the account is kr. 20 million and the overdraft access is kr. 50 million the disposable amount is kr. 70 million.

³ The overdraft access is assumed to be constant.

The maximisation task can now be written as:

$$\begin{aligned} \max_x \quad & V(x) \\ \text{s.t.} \quad & b_i(x) = d_i - S_i(x_i) + p_i(x) \geq 0 \quad \text{for } i = 1, \dots, n \\ & x_i \in \{0, 1, \dots, m_i\} \quad \text{for } i = 1, \dots, n \end{aligned}$$

The solution is an algorithm that in view of the sub-conditions is considered to be fair since respecting the sequence entails that no participant is favoured at the expense of others. The algorithm furthermore finds the optimum solution for both the system overall and for the individual account holder. No account holder or group of account holders will be able to settle more payments by coming up with their own solution compared to the solution found by the algorithm.

In practice, the algorithm first calculates each participant's ex post balance if all payments in the liquidity queue are settled simultaneously. If this leads to a negative ex post balance for one or more participants the algorithm will remove the last payment belonging to one of the participants with a negative ex post balance. The algorithm then calculates the result of simultaneous settlement of the rest of the payments in the liquidity queue. If one or more participants once again end up with a negative ex post balance, another payment will be removed from the calculations, and the algorithm runs again. This will continue until all participants that are part of the solution end up with a positive ex post balance.

LITERATURE

Bech, Morten Linnemann and Kimmo Soramäki, 2001. Gridlock Resolution in Payment Systems, Danmarks Nationalbank, *Monetary Review* 4th Quarter 2001.

Danmarks Nationalbank, 2001. Kronos System Specifications.

Appendix B: Liquidity Management by the RTGS System Participants

Participants in payment systems can normally procure liquidity either by pledging collateral to the central bank in order to obtain intraday credit, or by receiving payments from other participants. Finally, some systems give participants the opportunity to obtain overdrafts on their accounts against payment of a fee.

On pledging collateral to the central bank the participant incurs the opportunity cost of pledging securities as collateral. On the other hand, it is likely to be less expensive/free of charge to use payments received to finance outgoing payments. However, it will always be uncertain whether the expected payments are actually received. In view of this uncertainty the participants must continuously assess whether it is worth their while to wait to settle payments until liquidity is contributed via these payments. The alternative is to accept the opportunity cost or a fee for the immediate settlement of the payment.

This Appendix¹ sets out a game theoretical model for liquidity management by Bech and Garratt (2002). The model has two identical participants that do not know each other's payment instructions. The game extends over three periods: morning, afternoon and end-of-day. The model operates with three different credit regimes: free intraday credit, collateralised credit (where the credit cost is an opportunity cost), and priced credit. Finally, there is the postponement cost.

It is seen that participants will tend to postpone their payments if liquidity is priced. Another result is that it is to the participants' advantage to coordinate their payments and thereby minimise their liquidity costs.

Framework for the Bech & Garratt model:

The game is set up in an economy with an RTGS system subject to the following:

- Two identical participants: A and B.
- Liquidity is obtained either by pledging collateral to the central bank or by paying overdraft interest.
- The day comprises three periods: morning, afternoon and end-of-day.

¹ The Appendix is based on Bech and Garratt 2002 and Bech and Soramäki 2001.

- A and B receive payment instructions at the start of the morning and afternoon. They do *not* know each other's payment instructions.
- The participants do not charge any fee for settlement of payments.
- Payments all have the value of 1.

Let the participants be stated as $P = \{A, B\}$. Each participant can be of the following type: $\theta_i \in \Theta_i = \{0, 1\}$, where 0 signifies that participant i does not receive any payment instruction in the morning, while 1 signifies that the participant does. Let $\theta = (\theta_A, \theta_B) \in \Theta = \times_{i \in P} \Theta_i$ be called the profile type.

For each $i \in P$, let $A_i(\theta_i)$ be the options the participant has given its type. So for $\theta_i = 0$ $A_i(0) = \{n\}$, where n signifies no action/activity, while for $\theta_i = 1$ $A_i(1) = \{m, a\}$, where m and a are morning and afternoon. Let the action profile α be given as $\alpha = (\alpha_A, \alpha_B) \in A(\theta) = \times_{i \in P} A_i(\theta_i)$.

Participant i 's situation in the afternoon is given as $\psi_i \in \Psi_i = \{0, 1\}$ where respectively 0 and 1 indicate whether there is a payment instruction or not. Let $\psi = (\psi_A, \psi_B) \in \Psi = \times_{i \in P} \Psi_i$ be the afternoon state of the world.

Finally, let $I \in \{F, C, P\}$ be the intraday credit regime where F is free liquidity, C is collateralised liquidity, which has an opportunity cost, and P is priced liquidity, i.e. subject to payment of interest.

Each participant has a profit function $\pi_i^I : \Theta \times A(\theta) \times \Psi \rightarrow \mathbb{R}$, that depends on the credit regime, profile type and action profile. Since the banks do not charge any fee for settling payments in the game, the profit function corresponds to the negative cost function $c_i^I(\cdot)$, so that

$$\pi_i^I(\alpha, \theta, \psi) = -c_i^I(\alpha, \theta, \psi) \quad (1)$$

The cost function depends on the credit regime prevailing in the game. The difference lies in whether the cost is imposed before or after the payment instruction arrives. In a regime with collateralisation the participants will have to reserve collateral for liquidity in advance, which must be expected to entail an opportunity cost, in the following called y . In a credit regime where liquidity is priced this cost is called x , and finally the cost of deferring a payment is defined as w .

A strategy is defined for participant $i \in P$ as a function whereby $s_i : \Theta_i \rightarrow A_i(\theta_i)$ and the outcomes for the strategies are $S_i = \{m(\cdot), a(\cdot)\}$ where

$$m(\theta_i) = \begin{cases} \text{event in the morning, if } \theta_i = 1 \\ \text{no event,} & \text{if } \theta_i = 0 \end{cases}$$

and

$$a(\theta_i) = \begin{cases} \text{event in the evening, if } \theta_i = 1 \\ \text{no event,} & \text{if } \theta_i = 0 \end{cases}$$

It is assumed that complete information is not available in the game (participants do not know each other's instructions), so the condition for a Bayesian equilibrium can be set up¹:

A strategy profile $s^*(\cdot) = (s_A^*(\cdot), s_B^*(\cdot))$ is a Bayesian equilibrium for the intraday liquidity management game given the intraday credit policy if and only if $\forall i \in P \wedge \forall \theta_i \in \Theta_i$ occurring with positive probability then

$$s_i^*(\theta_i) \in \arg \max_{\alpha_i \in A_i(\theta_i)} E_{\Theta_{-i}} [E_{\Psi} [\pi_i^I(\alpha_i, s_{-i}(\theta_{-i}), \theta, \Psi)] | \theta_i], \text{ where } -i \text{ means}$$

not i .

So participants seek to maximise their profits, which corresponds to minimising their costs, cf. equation (1) on the basis of expectation, E , of the other participants' expected strategies.

Outcomes for the game:

A participant of type 0 has no options. The participant's strategy depends completely on which strategy the other participant (type 1) has opted for. We can therefore set up the 2x2 matrix with the following outcomes:

		Participant B	
		m	a
Participant A	m	$-E_{\Theta_A} [E_{\Psi} [c_B^I(m(\theta_A), m, \cdot)] \theta_B = 1]$ $-E_{\Theta_B} [E_{\Psi} [c_A^I(m, m(\theta_B), \cdot)] \theta_A = 1]$	$-E_{\Theta_A} [E_{\Psi} [c_B^I(m(\theta_A), a, \cdot)] \theta_B = 1]$ $-E_{\Theta_B} [E_{\Psi} [c_A^I(m, a(\theta_B), \cdot)] \theta_A = 1]$
	a	$-E_{\Theta_A} [E_{\Psi} [c_B^I(a(\theta_A), m, \cdot)] \theta_B = 1]$ $-E_{\Theta_B} [E_{\Psi} [c_A^I(a, m(\theta_B), \cdot)] \theta_A = 1]$	$-E_{\Theta_A} [E_{\Psi} [c_B^I(a(\theta_A), a, \cdot)] \theta_B = 1]$ $-E_{\Theta_B} [E_{\Psi} [c_A^I(a, a(\theta_B), \cdot)] \theta_A = 1]$

¹ A Bayesian equilibrium is an equilibrium in a game with incomplete information where each player only knows its own type and profile and previous games. The player therefore seeks to maximise its own profits via a strategy based on the other players' expected strategy.

It is seen that participant A's profit depends on the expectation of B's expectation of A, and vice versa for participant B.

Intraday money market:

A participant with surplus liquidity can offer to lend the surplus liquidity to other participants at interest rate e . It is assumed that this loan will always be less expensive than intraday credit from the central bank, the difference being called ε .

It is seen that:

$$e = \begin{cases} x - \varepsilon & \text{if } I = P \\ y - \varepsilon & \text{if } I = C \end{cases},$$

where x is the relative price of overdrawing an account, y is the opportunity cost of depositing collateral, and $\varepsilon > 0$.

This implies that the money market is the optimum place to borrow money in the afternoon. Here money-market loans are set up as over-night loans.

Probability of arrival of payments:

It is assumed that the arrival of payments in the afternoon is independent of the arrival of payments in the morning, so let p be the probability of the arrival of payments in the morning and q be the probability of the arrival of payments in the afternoon, so that:

$$P(1,1) = p^2, P(0,1) = P(1,0) = p(1-p), P(0,0) = (1-p)^2, \\ Q(1,1) = q^2, Q(0,1) = Q(1,0) = q(1-q), \text{ and } Q(0,0) = (1-q)^2$$

Expected costs:

The following defines the expected costs to a participant that receives a payment instruction in the morning and performs the action α_i and therefore plays vis-à-vis a player that plays the strategy $s_{-i}(\cdot)$:

$$\hat{c}^I(\alpha_i, s_{-i}(\cdot)) = E_{\Theta_{-i}} \left[E_{\psi} \left[c_i^I(\alpha_i, s_{-i}(\theta_{-i}), \theta, \psi) \mid \theta_i = 1 \right] \right]$$

while the unconditional expected costs for a participant playing the strategy $s(\cdot)$, vis-à-vis a participant with the strategy $s_{-i}(\cdot)$:

$$\hat{c}^I(s_i(\cdot), s_{-i}(\cdot)) = E_{\Theta} \left[E_{\psi} \left[c_i^I(s_i(\theta_i), s_{-i}(\theta_{-i}), \theta, \psi) \right] \right]$$

Based on these expressions of cost, the value of the outcomes in the game under the various credit regimes can be calculated.

Scenario: free intraday credit

In a situation with free intraday credit there are no costs of settling payments. The outcomes are as follows:

		Participant B	
		m	a
Participant A	m	0	0
	a	$-w$	$-w$

So free liquidity means that both players should settle their payments as quickly as possible. There is no reason to postpone the payments until the afternoon as this merely implies a cost of w . The equilibrium in the game is therefore $s^*(\cdot) = (m(\cdot), m(\cdot))$.

Scenario: credit against collateral

The expected settlement costs for credit against collateral comprise several stages. The first is either the opportunity cost (y) of pledging collateral or the cost of delaying the payment (w). Then there is the expected cost of liquidity on postponing the payment until the afternoon, given the other player's action in the morning. If the other player has settled a payment in the morning, the postponed payment will be financed via the incoming liquidity from the payment and will thus be free. Alternatively, it will cost the same as in the morning, i.e. y . Finally, there is the cost that with the probability q , payment instructions will arrive in the afternoon for settlement on the same day.

The cost functions are:

$$\tilde{c}^c(m, m(\cdot)) = y + (1-p)y + qy$$

$$\tilde{c}^c(m, a(\cdot)) = y + y + qy$$

$$\tilde{c}^c(a, m(\cdot)) = w + (1-p)y + qy$$

$$\tilde{c}^c(a, a(\cdot)) = w + y + qy$$

This gives the following outcomes:

		Participant B	
		m	a
Participant A	m	$-(1-p)y$	$-w + py$
	a	$-w + py$	$-w$

The equilibrium is determined solely by whether the opportunity costs y exceed the cost of postponing a payment (w).

If $(1-p)y < w < y$ there is a situation where the above becomes a classic prisoner's dilemma. In that case the equilibrium will be $(m(\cdot), m(\cdot))$ ¹. In a collateralisation situation the optimum course is therefore to settle payments immediately for as long as the opportunity cost of collateralisation is less than the cost of postponing a payment.

Scenario: priced credit

The cost functions are divided into a number of elements. The first stage is the cost of either postponing the payment (w), or settling the payment immediately. If the payment is settled immediately, there is a probability p that the other bank also remits a payment in the morning and thereby finances the payment. The second stage comprises the liquidity cost to the bank of postponing a payment until the afternoon. Finally, we have the cost that with the probability q instructions will arrive for payments in the afternoon.

The costs for the four strategies are:

$$\tilde{c}^P(m, m(\cdot)) = (1-p)x + (1-p)(1-q(1-q))x + (1-q)qx$$

$$\tilde{c}^P(m, a(\cdot)) = x + (1-p)(1-q(1-q))x + (1-q)qx$$

$$\tilde{c}^P(a, m(\cdot)) = w + (1-p)(1-q(1-q))x + (1-q)qx$$

$$\tilde{c}^P(a, a(\cdot)) = w + (1-p)(1-q(1-q))x + (1-q)qx$$

¹ Cf. Bech and Garratt (2002) for the proof.

This gives the following outcomes:

		Participant B	
		m	a
Participant A	m	$-(1-p)x$	$-w$
	a	$-w$	$-w$

If there is no uncertainty ($p=1$) of what happens in the morning, $(m(\cdot), m(\cdot))$ is an equilibrium exactly as if $w > x$, where it is most worthwhile to settle the payments in the morning immediately. On the other hand, $(a(\cdot), a(\cdot))$ is an equilibrium if $w < (1-p)x$, which can be the case in situations with great uncertainty of what takes place in the morning (small p).

In the case where $(1-p)x < w < x$ there is a coordination game, also known as stag hunt game¹. A characteristic of this game is that there are two possible equilibria, of which one is clearly preferable since it gives the best payoff for both players, although it does involve risk. The other equilibrium is considerably more secure, but not as profitable.

The Bech and Garrats model has shown the game that reflects the deliberations of a participant on receipt of a payment instruction. Should the payment be settled immediately or should it be deferred until later? It is seen that the participants have a tendency to postpone the payments if liquidity is priced. There is also another important result, namely that in special circumstances the participants can save liquidity by coordinating their payments.

¹ Stag hunt game was introduced by Jean Jacques Rousseau, who described the situation where two hunters can work together and shoot a stag, or each shoot a hare. The stag provides the community with more food than two hares. However, stag hunting is a difficult art and requires the hunters to cooperate. Otherwise, there is little chance of one of the hunters bringing down a stag.

LITERATURE

Bech, Morten Linnemann and Kimmo Soramäki, 2001. Gridlock Resolution in Payment Systems, Danmarks Nationalbank, *Monetary Review*, 4th Quarter 2001.

Bech, Morten Linnemann and Rod Garratt, 2002. The Intraday Liquidity Management Game, Danmarks Nationalbank, *Working papers*, 2/2002.

Appendix C: Effect of Queue Facilities for Kronos Participants

Not all of the payments settled via a systemically important payment system, an e.g. RTGS system, require immediate settlement. Some payments are normally only required to be settled within the same day. This means that the participants do not have to immediately obtain liquidity to cover all payments. Instead, they can wait for incoming payments and deploy this liquidity, thereby avoiding e.g. the alternative costs of pledging collateral in return for intraday credit. Participants can also make use of the liquidity-saving functionalities offered by certain RTGS systems.

In this Appendix¹ the effect of the queue facility and gridlock resolution mechanism is reviewed. First the participants' choice of liquidity amount is defined, and a method to measure delays in a payment system is set up. Hereafter a payment system simulator is introduced that is then used to simulate payment patterns in four simple RTGS systems, of which three have varying liquidity-saving functionalities. The analysis uses actual payments in Kronos over a 3-month period.

The results show that the queue facilities and gridlock resolution mechanisms reduce the participants' liquidity requirement, and that the individual facilities each present advantages. The simulations also show that there is no shortage of liquidity for Kronos participants.

PARTICIPANTS' CHOICE OF LIQUIDITY AMOUNT

In principle an RTGS system participant is obliged to have liquidity equivalent to the sum of the participant's outgoing payments. The participant can, however, typically manage with significantly less liquidity since the participant can expect to receive liquidity as incoming payments in the course of the day.

In an RTGS system with queue facilities and end-of-day netting the minimum requirement of a participant's liquidity amount can be defined as:

¹ The Appendix is based on Koponen (1998) and Olsen (2004).

$$MiL = \min \left[0, \left(\sum_{t=0}^T P_t^I - \sum_{t=0}^T P_t^U \right) \right], \text{ where}$$

P_t^I : incoming payment and P_t^U : Outgoing payment

The minimum limit, MiL, is 0, if the participant is a net recipient, and otherwise corresponds to the liquidity the participant requires for net settlement of its payments. The maximum limit, MaL, denotes the liquidity a participant requires if it settles all of its outgoing payments, less any incoming payments at the same time.

$$MaL = \min \left[0, \sum_{t=0}^{\min t} (P_t^I - P_t^U) \forall t \in [0, T] \right]$$

The delay of the payments in the payment systems can be compiled as the delay factor, which measures the average time it takes a payment to be settled in relation to the time of transmission.

$$\rho = \frac{\sum_{i=1}^T Q_i}{\sum_{i=1}^T \sum_{i=1}^t P_i^U}$$

The numerator is the sum of the value of the queues, the denominator is the accumulated value of the outgoing payments.

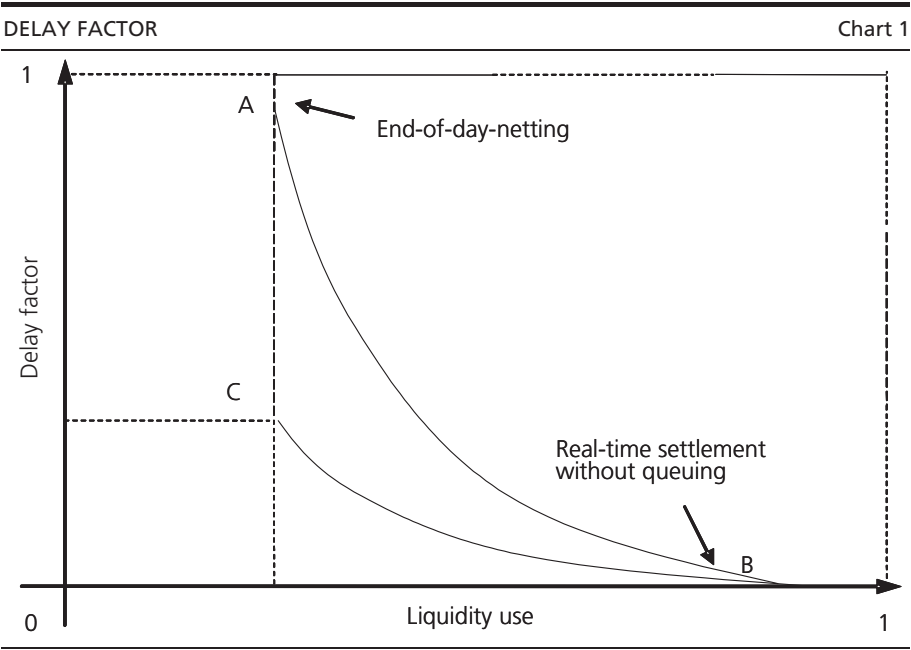
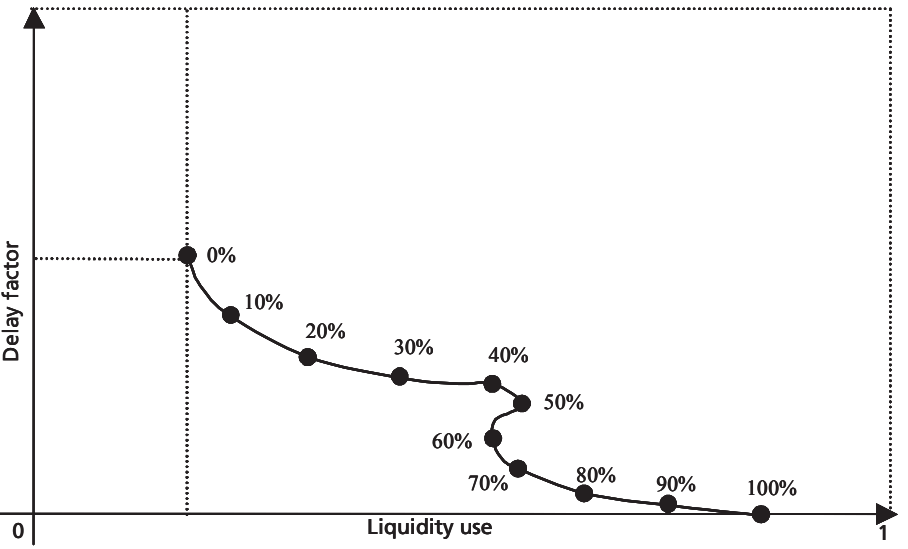


Chart 1 shows the outcomes for the delay factor where point A is the maximum delay, while point B denotes that there is no delay. In a payment system with no liquidity-saving functionality other than an end-of-day netting routine, a participant with only minimum liquidity available (MiL) will be found at point A. A participant in the same system with sufficient liquidity to settle all outgoing payments immediately (MaL), will be at point B. In an RTGS system with queuing, point C will be the maximum delay. C can lie at any point on or below the curve AB.

THE RELATION BETWEEN LIQUIDITY USE AND POSSIBLE SETTLEMENT
DELAY IN A SYSTEM WITH TIME-CRITICAL PAYMENTS

Chart 2



In payment systems where some payments are time-critical and/or the sequence of the payments is respected, MiL and MaL will change on an ongoing basis. Chart 2 shows an example. The percentage rates show the overall liquidity in the sector, while the actual graph shows a random participant's liquidity requirement. From 80 per cent to 70 per cent, the overall liquidity in the sector is reduced and the participant's payments are delayed. From 60 per cent to 50 per cent, the sector's overall liquidity is again reduced. However, the participant's liquidity requirement increases, and we move towards the right-hand side of the Chart. This is because the participant does not receive liquidity from the other participants in the system since their payments are queued due to the shortage of liquidity. The participant itself therefore has to procure extra liquidity in order to e.g. settle its time-critical payments. This corresponds to raising MiL during the day.

PAYMENT SYSTEM SIMULATOR

Suomen Pankki (Bank of Finland) has developed a model to simulate payment and securities settlement systems. The model is called BOF-PSS

(Bank of Finland Payments and Settlement system Simulator). The model is subject to ongoing development¹.

In the model, a complete payments infrastructure can be set up with several payment systems and related securities settlement systems. A number of parameters help to adapt the payments infrastructure so as to reflect e.g. the Danish RTGS system, Kronos, very precisely.

Besides definition of the actual payments infrastructure the model must have data read in for the simulation. The model requires master data on the participants, e.g. account numbers, as well as information on the participants' (daily) opening balances and the value of any collateral pledged by the participants. Finally, the payments to be included in the simulation must be read into the model.

The model seeks to settle as many payments as possible, given the data and the conditions/parameters set up. After running the simulation the model generates various statistics for e.g. spreadsheet analysis.

SIMULATION OF LIQUIDITY-SAVING FUNCTIONALITY

In this analysis three different simple RTGS systems are set up in order to show the strengths/weaknesses of various types of liquidity saving in terms of both the number and value of settled payments and the delay factor. The three systems, each with its own type of liquidity saving, are held up against a fourth system that has no special functionality.

The payments included in the analysis are the actual payments in kroner that the Kronos participants made in the period January-March 2003², in total 141,048 payments for an accumulated value of kr. 10,020 billion. The results of the simulations are all presented as average values. In the simulations the participants' liquidity is reduced gradually. The participants thus start with 100 per cent of their actual liquidity³, after which the liquidity is reduced by 5 percentage points per simulation.

The four RTGS systems

The four systems have an identical framework. All have Kronos' opening hours (at that time) of 8.00 a.m. to 3.30 p.m.⁴, and payments that are not settled intraday are cancelled. Participants, payments and the participants' liquidity are all identical for all systems.

¹ BOF-PSS2 website: www.bof.fi/eng/ under Financial Markets -> Payment Systems -> Development of payment systems -> BOF-PSS.

² Anonymised data from Danmarks Nationalbank's bookkeeping system, DN-Bogføring

³ The participants' liquidity for day t corresponds to their disposable amounts at the end of day $t-1$. No account is thus taken of any incoming or outgoing liquidity from settlements in the Sumclearing and VP settlement, etc.

⁴ After 1 June 2003 Kronos' opening hours were extended to 7.00 a.m. – 3.30 p.m.

CLEAN is purely an RTGS system with no liquidity-saving functionality at all. This means that a payment is rejected if there is insufficient cover at the moment that it is sent to the system. In other words, there is no queue facility.

FIFO is an RTGS system with a liquidity queue based on the FIFO (First In First Out) principle. Each time a participant's liquidity position changes (on receipt of a payment or increase in collateral), the system seeks to settle payments placed in the participant's liquidity queue due to insufficient cover, in the sequence that is entered to the system

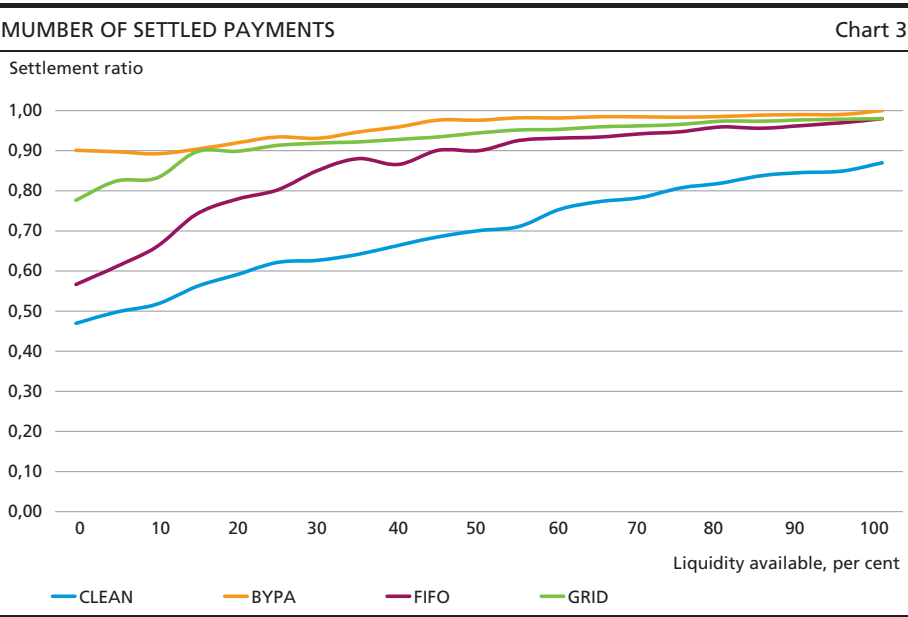
The BYPA system has a liquidity queue that applies the bypass principle. Like the FIFO system it will seek to settle payments in the liquidity queue whenever the payment remitter receives liquidity, although the sequence of the payments will not be respected.

GRID includes a gridlock algorithm that respects the sequence of the payments in the liquidity queue and seeks a solution every 30 minutes, cf. Appendix A.

Results

Chart 3 shows the average percentage of the payments that will be executed in the four systems, given the liquidity available.

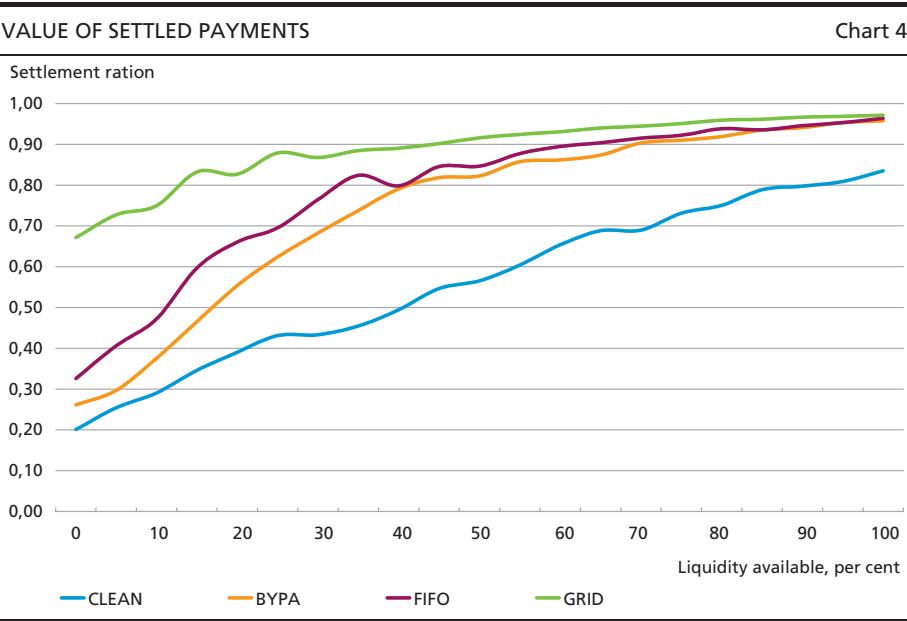
CLEAN settles fewest payments since the system cannot postpone payments and use liquidity received later to settle the large payments. It is noteworthy that even if 100 per cent liquidity is available there is insufficient liquidity to settle all payments in CLEAN. BYPA is the system

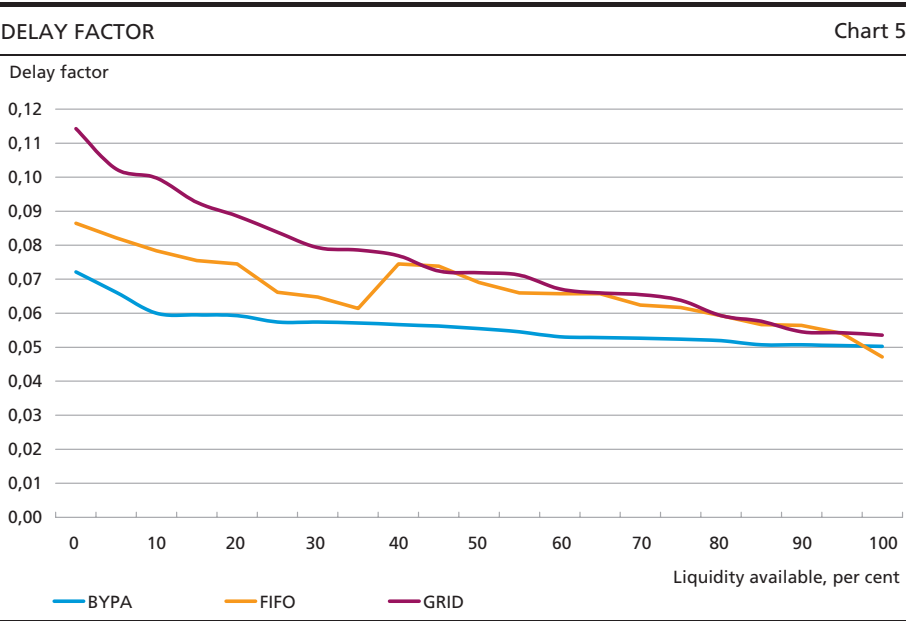


that settles most payments irrespective of liquidity amount. This is because the system does not respect the sequence of the payments and can therefore settle many small payments.

Chart 4 shows the value of the settled payments. It is seen that the BYPA and FIFO systems have changed positions relative to Chart 3, so that FIFO settles a larger overall value than BYPA. However, the GRID system proves to be most effective. Even with only 5 per cent liquidity available the GRID system settles more than 70 per cent of the value of the payments, while CLEAN settles approximately 25 per cent.

The delay factor is shown in Chart 5. The CLEAN system is not included in the Chart since CLEAN does not feature queuing and thus cannot delay its payments. The GRID system has a relatively large delay in the system, which can be attributed to the gridlock resolution mechanism searching for a solution every 30 minutes. BYPA also has a high delay factor since it continuously uses liquidity for small payments, so that large payments are queued for a relatively long time. The convexity of the curves shows the falling marginal utility of extra liquidity in relation to payment delays. However, FIFO is slightly concave at 30-40 per cent. This is because FIFO respects the sequence of the payments so that bottlenecks occur in the course of the day. These bottlenecks could be eliminated with extra liquidity.





The simulations show that a gridlock resolution mechanism is highly effective since it can settle many payments for a high value with relatively little liquidity. The opportunity cost of saving liquidity is that the payments are delayed. The simulations also show that a liquidity queue with either BYPA or FIFO principles can to a certain degree help the participants to use and reuse their liquidity efficiently.

The analysis shows that the Kronos participants have relatively ample liquidity available. The amount of liquidity thus has to be reduced considerably before the number and value of settled payments is affected in any significant way. It should be noted that Kronos contains all the liquidity-saving functions described in this analysis. This means that the participants can utilise their liquidity even more efficiently than shown by the results of this analysis.

LITERATURE

Koponen, Risto and Kimmo Soramäki, 1998. Intraday Liquidity Needs in a Modern Interbank Payment System, Bank of Finland, *Bank of Finland Studies*, E:14-1998.

Olsen, Kasper Sylvest, 2004. *Liquidity management in payment systems*, (in Danish only), Institute of Economics, University of Copenhagen.

Appendix D: Simulation of Systemic Risk in the Sumclearing

If a netting system participant defaults on its settlement obligations, there is a risk that one or more of the other participants will also default on their settlement obligations. These contagion effects can cause disruptions to the financial system. It is therefore sought to minimise the risk of such systemic events occurring.

This Appendix¹ defines the systemic risk and the risk that one participant's difficulties affect other participants. Hereafter data from the Danish retail payment system, the Sumclearing, cf. Chapter 6, is used to investigate the consequences of the participant with the largest net settlement obligation defaulting on its obligations. This is investigated by eliminating those participants' retail payments from the settlement and hereafter recalculating the other participants' net positions and comparing them with their available liquidity prior to settlement.

The result of the analysis shows that the participants in the Sumclearing reserve considerable extra liquidity so there is very little risk that default by one participant will affect the settlement of the other participants, and thereby lead to systemic effects.

SYSTEMIC RISK

Although there is no unambiguous definition of systemic risk, it is defined by De Bandt and Hartmann (ECB 2000) as the risk of a systemic event occurring. The same authors define a systemic event as a shock to either a market or a participant that has a contagion effect on other markets and/or participants.

The focus of this Appendix is on a participant-specific event, i.e. an event in which the participant with the largest multilateral net debit position (k) is unable to settle due to e.g. compulsory winding-up. The result can be used to investigate whether the Sumclearing lives up to Core Principle V, cf. Chapter 10, that considers the contagion effect. This principle requires the participants to be able to settle their multilateral positions even if the participant with the largest single settlement obligation is unable to settle due to e.g. compulsory winding-up.

¹ This Appendix is based on Bech, Madsen and Natorp (2002) and Danmarks Nationalbank (2002).

Definition of systemic risk

In order to define the event that the participant with the largest net obligation is unable to settle, the participants' settlement obligations in the financial system are defined as

$$Z = \begin{bmatrix} 0 & z_{12} & \cdots \\ z_{21} & 0 & \\ \vdots & & \ddots \end{bmatrix}_{n \times n}$$

where z_{ij} is the gross settlement obligation from participant i to participant j .

The total gross settlement obligation (TGS) is $TGS = \sum_i \sum_j |z_{ij}|$

The bilateral net positions can be defined as

$$B = Z - Z' = \begin{bmatrix} 0 & z_{12} - z_{21} & \cdots \\ z_{21} - z_{12} & 0 & \\ \vdots & & \ddots \end{bmatrix} = \begin{bmatrix} 0 & b_{12} & \cdots \\ b_{21} & 0 & \\ \vdots & & \ddots \end{bmatrix}_{n \times n}$$

So the total bilateral net settlement obligation is

$$TB = \sum_i \sum_{j \geq i} |b_{ij}|$$

Since the lower half of matrix B under the diagonal corresponds to the inverse of the upper half, the multilateral net positions are given as

$$d = B \bullet 1_{n \times 1}$$

where 1 is a unit vector. If $d_i > 0$, participant i is a net contributor in the net settlement system, and if $d_i < 0$, participant i is a net recipient in the system.

If participant k is wound up, $z_{kj} = 0 \forall j$, and the other participants' settlement obligation to participant k is $z_{ik} = 0 \forall i$

The other participants' mutual settlement obligations after elimination of participant k from the netting are

$$Z^{k,1}_{n \times n} = \begin{bmatrix} 0 & z_{12} & \cdots & z_{1k-1} & 0 & z_{1k+1} & \cdots \\ z_{21} & 0 & & & 0 & & \\ \vdots & & \ddots & & \vdots & & \\ z_{k-11} & & & \ddots & \vdots & & \\ 0 & 0 & \cdots & \cdots & 0 & \cdots & 0 \\ z_{k+11} & & & & \vdots & \ddots & \\ \vdots & & & & 0 & & 0 \end{bmatrix}$$

The new bilateral positions are:

$$B^{k,1}_{n \times n} = Z^{k,1}_{n \times n} - Z^{k,1}_{n \times n} = \begin{bmatrix} 0 & z_{12} - z_{21} & \cdots & z_{1k-1} - z_{k-11} & 0 & z_{1k+1} - z_{k+11} & \cdots \\ z_{21} - z_{12} & 0 & & & 0 & & \\ \vdots & & \ddots & & \vdots & & \\ z_{k-11} - z_{1k-1} & & & \ddots & \vdots & & \\ 0 & 0 & \cdots & \cdots & 0 & \cdots & 0 \\ z_{k+11} - z_{1k+1} & & & & \vdots & \ddots & \\ \vdots & & & & 0 & & 0 \end{bmatrix}$$

And the new multilateral net positions are $d^{k,1} = B^{k,1} \bullet 1$

CONTAGION AND DOMINO EFFECT

When a participant is unable to settle, the other participants' net multilateral positions and their liquidity requirements will normally change. Let $t = [t_1 \ t_2 \ \cdots \ t_n]$ be the liquidity each participant has reserved prior to the net settlement. The total liquidity (L) dedicated to settlement in the system can be written as

$$L = \sum_i t_i$$

If a participant's new multilateral net position ($d_i^{k,1}$) is greater than t_i , this means that the participant in question cannot meet its obligations after the largest participant has been removed. A new re-calculation is now made where the participants that cannot meet their new obligations are omitted. The process continues until $d_i^{k,1} < t_i$. The final positions are described as \hat{Z}^k, \hat{B}^k og \hat{d}^k .

The number of re-calculations describes the duration of the systemic event while the number of insolvent participants and the value of non-settled payments indicate the effect of the systemic event. The effect of the event is twofold: there is an initial effect and a subsequent effect, also called the domino effect.

The effects are measured in relation to the total gross settlement obligation,

$$T\hat{G}S = \sum_i \sum_j |\hat{z}_{ij}|$$

The total effect (TE) of the systemic event is

$$TE = \frac{TGS - T\hat{G}S}{TGS}$$

TE is a relative measure of how much will be settled on re-calculation in relation to the original settlement with all participants.

The initial effect (IE) can be stated as

$$IE = \frac{\sum_j |z_{kj}| + \sum_i |z_{ik}|}{TGS}$$

while the domino effect is

$$DE = TE - IE$$

The effect of systemic events depends on the amount of liquidity reserved in the system. Measurement points in this analysis are:

The minimum liquidity required to settle all payments:

$t_i^{LB} = \max(0, d_i) \forall i$; this corresponds to the sum of the non-positive multilateral net positions.

t_i^{UB} , is the liquidity reserved by the participants for the settlement. It is assumed that the participants cannot procure further liquidity.

Finally, some measurement points are needed. Simple interpolation between the minimum liquidity and the liquidity reserved by the participants gives

$$t_i(\alpha) = t_i^{LB} + \alpha(t_i^{UB} - t_i^{LB}) \forall i, \alpha \in [0, 1]$$

THE SIMULATIONS IN THE SUMCLEARING

The simulations took place over 22 banking days in the period 21 December 2001 to 25 January 2002. On each run the participant¹ with the largest net inpayment was excluded from the settlement and the other participants' net positions were re-calculated.

During the period eight different participants had the largest debit position. On average the inability to settle by the largest participant

¹ Danmarks Nationalbank also participates in the Sumclearing on behalf of the central government. In the cases where Danmarks Nationalbank has the largest debit position the second-largest position has been chosen instead.

meant that 26 per cent of the total gross settlement obligations (TGS) were removed from the settlement before re-calculation.

There was only an actual domino effect on one day when a single participant had not reserved sufficient liquidity. However, the effect stopped at this participant since the other participants still had sufficient liquidity at the subsequent re-calculation. The domino effect meant that 7 per cent of the settlement (TGS) was not settled, while the total effect (TE) was 14 per cent, cf. Table 1.

In the cases where the participants do not have their full reserved amounts available there is still considerable liquidity left. Once the largest participant has been removed, no other participant will be unable to settle until the actual amount is reduced to 25 per cent.

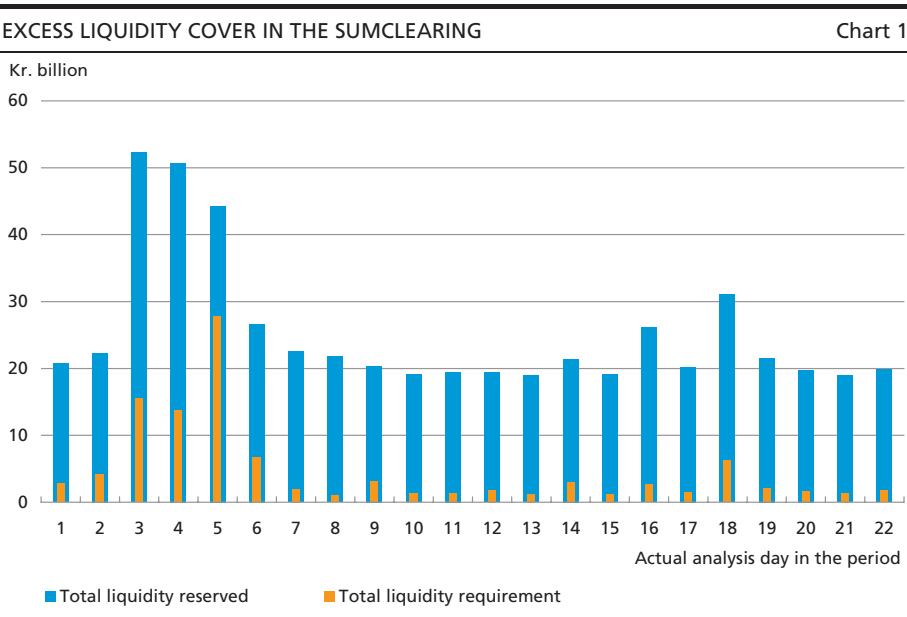
It must generally be stated that the participants take considerable excess cover. The excess cover is necessary for several reasons. The participants do not know their exact positions in advance as they do in VP settlement. This is because the participants have to reserve liquidity when Kronos closes, while retail payments, etc. can still be made by bank customers, which can thus affect the positions in the Sumclearing. Finally, the Danish Bankers Association can fine those participants that do not reserve sufficient liquidity in the Sumclearing.

SIMULATION RESULTS

Table 1

	t^{LB}	$t(.25)$	$t(.5)$	$t(.75)$	t^{UB}
Days with systemic effects.....	22	3	1	1	1
<i>Duration</i>	Number of re-calculations				
Average	2.5	1	1	1	1
Minimum	1	1	•	•	•
Maximum	4	1	•	•	•
<i>Domino effect (DE)</i>	Number of participants				
Average	25	27	1	1	1
Minimum	3	24	•	•	•
Maximum	48	31	•	•	•
<i>Domino effect (DE)</i>	Percentage of TGS				
Average	26.0	4.4	7.4	7.4	7.4
Minimum	1.0	0.1	•	•	•
Maximum	68.7	7.4	•	•	•
<i>Total effect (TE)</i>	Percentage of TGS				
Average	51.8	24.7	12.9	12.9	12.9
Minimum	8.0	12.9	•	•	•
Maximum	93.1	35.1	•	•	•

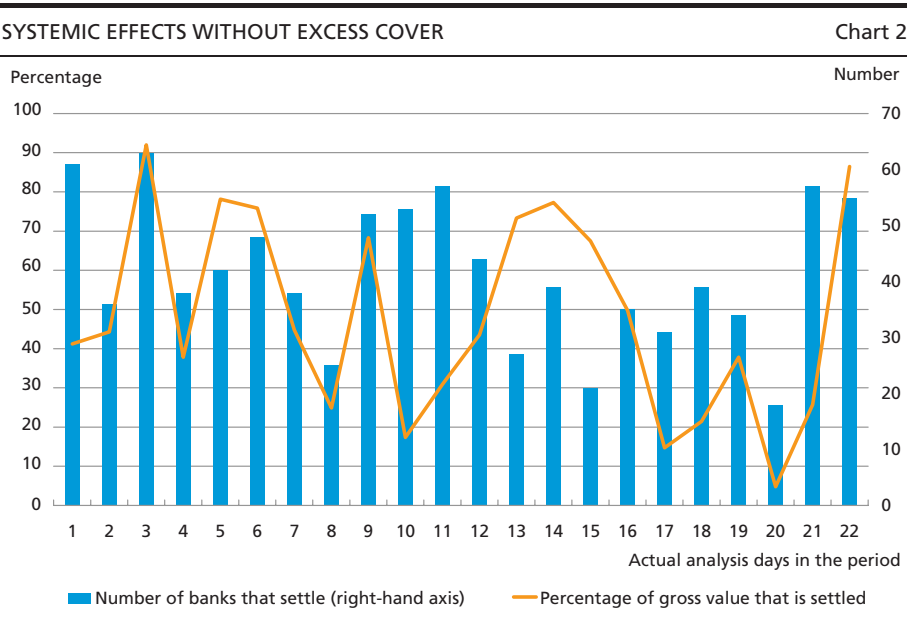
Source: Bech, Madsen and Natorp (2002).



Source: Danmarks Nationalbank, *Financial stability 2002*.

Chart 1 shows the excess liquidity cover for the 22 days analysed.

The simulations also showed that if there was no excess cover in the Sumclearing, participants would be affected by systemic effects every single day. On average 52 per cent of the gross positions would not be settled, and on one day 93 per cent of the positions could not be settled.



Source: Danmarks Nationalbank, *Financial stability 2002*.

CONCLUSION

There is a very low risk of systemic effects in the Sumclearing due to the relatively high excess cover. It is noteworthy that when the participant with the largest obligation was removed from the settlement this entailed a systemic effect on only one out of 22 days, and moreover this was limited to a single bank.

LITTERATURE

Bech, Morten Linnemann and Bo Madsen and Lone Natorp, 2002. Systemic Risk in the Danish Interbank Netting System. Danmarks Nationalbank, *Working papers*, 8/2002.

Danmarks Nationalbank, 2002. Payment System Risks, *Financial stability*.

Glossary

Central bank

In most countries, the main tasks of the central bank are to conduct monetary and foreign-exchange policies; to issue banknotes and coins; and to contribute to financial stability by acting as lender of last resort, providing liquidity to banks as required. A number of financial institutions hold accounts with the central bank. These accounts are used to settle payments between the institutions, either on their own behalf or on behalf of their customers. Central banks also typically act as *settlement bank* to important *payment and settlement systems*. Danmarks Nationalbank is the Danish central bank.

Central counterparty

A central counterparty acts as intermediary in securities transactions, i.e. is the seller to every buyer and the buyer to every seller. A central counterparty usually offers *netting* of securities transactions, which limits the requirements in terms of *liquidity* and securities portfolios. *Settlement* via a central counterparty allows the buyer and seller to remain anonymous.

Central securities depository

An enterprise in charge of the issuance, safekeeping and administration of securities, as well as settlement of securities transactions. A central securities depository may also undertake *clearing* of securities transactions, though some countries leave this task to a *central counterparty*. VP Securities Services is the central securities depository in Denmark.

Central-bank money

Banknotes and coins and deposits by financial institutions in accounts held with the *central bank*. *Settlement* of payments in central-bank money involves the exchange of *liquidity* between the institutions holding accounts with the central bank. Settlement of payments in important *payment and settlement systems* is usually effected in central-bank money.

Clearing

The process of compiling, reconciling and, in some cases, confirming payment or securities trading instructions prior to *settlement*. In *net settlement systems* clearing includes calculation of system *participants'* bilateral or multilateral net positions.

Collateralisation

Assets delivered to secure an obligation, e.g. securities as collateral for a loan. Most *central banks* require collateral in order to extend loans, including *intraday credit*.

Commercial bank money

Account deposits by citizens and business enterprises in private banks. Commercial bank money can be exchanged for *central-bank money* in the form of banknotes and coins. When private banks act as *settlement banks*, payments are settled in commercial bank money.

Correspondent bank

A bank holding accounts for other financial institutions and executing payments on their behalf. *Settlement* of payments via correspondent banks represents an alternative to settlement via the *payments infrastructure*.

Credit card

Payment card that enables the holder to make purchases of goods and services and withdraw cash up to a prearranged limit. The credit granted is settled in full or in part by the end of a given period.

Credit transfer

A payment order initiated by the remitter (debtor) to transfer funds from his bank account to the bank account of the recipient (creditor). Credit transfers are known also as account-to-account transfers.

Current account

Account holders' main account with Danmarks Nationalbank. Current-account deposits may be used immediately at the account holders' initiative. Banks and mortgage-credit institutes are monetary-policy counterparties and their current-account deposits accrue interest at the current-account interest rate. The current-account deposits of other account holders are non-interest bearing.

Custodian

Financial institution, typically a bank, that safekeeps and administers securities and, in some cases, carries out *clearing* and *settlement*.

Debit card

Payment card enabling cash withdrawals and purchases of goods and services to be charged directly to the card holder's account with a bank. The Dankort is a Danish example of a debit card.

Delivery versus Payment (DvP)

Mechanism of a *securities settlement system* that ensures that delivery of securities occurs if, and only if, payment occurs.

Electronic money

Monetary value stored in an electronic medium and accepted as a *means of payment* by third parties. The electronic medium may be a *prepaid card* or a central server. Electronic money stored on a central server is referred to as network money. See also *e-payment*.

e-payment

Payment for online purchases of goods and services. Most consumers use *debit* or *credit cards* to pay for online purchases. An alternative mode of payment is by e-account, set up on a central server. Funds transferred to e-accounts are known as *electronic money* or network money. Transfers between e-accounts are made in a closed system outside the existing *payments infrastructure*.

Finality

Term applied to a transaction that is irrevocably and unconditionally settled.

Foreign-exchange (FX) settlement system

System used to settle foreign-exchange transactions. CLS (Continuous Linked Settlement) is an example of an international foreign-exchange system. CLS currently settles foreign-exchange transactions in 15 currencies, including Danish kroner, according to the *Payment versus Payment (PvP)* principle.

Gridlock

A situation that can arise in a *real-time gross settlement (RTGS)* system if payments are prevented from being executed as a result of inefficient allocation of *liquidity* between *participants*. If payments fail due to a general lack of *liquidity* in the system, it is known as deadlock.

Hybrid system

A *payment system* that combines characteristics of *real-time gross settlement (RTGS)* systems and *net settlement systems*.

Interbank payment

A payment between two financial institutions in the interbank market, known also as the money market. If both institutions are *participants* in

the *payments infrastructure*, the payment can be settled via their accounts with the *central bank* through a *payment system*. Alternatively, an inter-bank payment can be settled outside the payments infrastructure via *correspondent banks*.

Intraday credit

Credit extended by the *central bank* for a period of less than one banking day within the same *monetary-policy day*. Credit extended for more than one monetary-policy day is known as interday credit or monetary-policy loans.

Liquidity

The key liquidity concept of *payment systems* is the sum of account holders' *current-account balances* and maximum overdraft access within the day (*intraday credit*). The key liquidity concept of monetary policy is the current-account deposits of the monetary-policy counterparties, i.e. banks and mortgage-credit institutes. The balances of the monetary-policy counterparties must not be negative at the end of the *monetary-policy day*.

Liquidity queue

Function in an *RTGS system* that queues payments if a *participant* has insufficient *liquidity* to settle his payments. Most liquidity queues settle payments in accordance with the FIFO principle (First-In-First-Out), i.e. payments are settled in the order in which they were entered in the system as liquidity becomes available.

Means of payment

Assets used to pay for goods and services. Examples are banknotes and coins transferred directly between two parties, and *commercial bank money* requiring a *payment instrument*.

Monetary-policy day

Period of time within which all payments between accounts held with the *central bank* have the same value date. The monetary-policy day in Danish kroner runs from 4.00 p.m. on day T-1 to 3.30 p.m. on the following banking day, T. All payments booked during this period have the value date T. See also *intraday credit*.

Moral suasion

Where the authority of *central banks* to influence financial-sector development, e.g. their work to provide secure and efficient *payment and settlement systems*, is not granted by statute, the central banks rely on

moral suasion. To be efficient, moral suasion presupposes mutual respect and a willingness to take into consideration the wishes and interests of counterparties. For purposes of legal clarity, central banks increasingly base their *oversight* of payment and settlement systems on formal legal authority.

m-payment

Payment for purchases of goods and services made by mobile phone. Mobile phone companies offer their customers various m-payment solutions for *non-physical trading* purchases. Customers may pre-register their payment card and subsequently need only to authorise payments via their mobile phone; alternatively, they may have the purchases charged to their next phone bill.

Net settlement system

Payment system in which payments are settled on a net basis at one or more specific times during the settlement day. Net settlement systems are typically used in the settlement of *retail payments*. A distinction is made between bilateral and multilateral net settlement systems. The Danish retail payment system, the Sumclearing, is a multilateral net settlement system. See also *netting (bilateral/multilateral)*.

Netting (bilateral/multilateral)

An arrangement between two (bilateral netting) or more (multilateral netting) parties to offset their obligations. After bilateral netting has been performed in a *payment* or *settlement system*, a *participant* has a net position towards each of the other participants in the system. After multilateral netting has been performed, the participant has an overall net position towards each of the other participants in the system.

Non-physical trading

Trading in which the parties involved are not physically present, e.g. online trading.

Oversight

Central-bank task involving assessments to determine whether systemically important *payment and settlement systems* are secure and efficient. Oversight is performed by comparing the systems with international and possibly national standards. The international standards are described in two reports, Core Principles for Systemically Important Payment Systems and Recommendations for Securities Settlement Systems, published by BIS (Bank for International Settlements) in

2001. In addition to system recommendations, these reports contain recommendations for central banks' oversight of payment and settlement systems.

Participant

Financial institution that participates in a *payment* or *settlement system*. An institution participating in a system via another participant is known as an indirect participant.

Payment instrument

Instrument that has no value in itself, but gives the holder access to draw on e.g. a bank account. Payment instruments can be used to pay for goods and services. Payments made using a payment instrument are cleared and settled via the *payments infrastructure*. A debit card such as the Danish Dankort is an example of a payment instrument.

Payment system

Overall set of *payment instruments*, procedures and IT systems for exchanging *interbank payments*. In most modern payment systems, the settlement procedure is electronic. Payment systems are usually classified as either *real-time gross settlement (RTGS) systems* or *net settlement systems*.

Payment versus Payment (PvP)

A mechanism in a *foreign-exchange (FX) settlement system* which ensures that a final transfer of one currency occurs if, and only if, a final transfer of the other currency takes place.

Payments infrastructure

Joint term for accounts, IT systems and networks used in *payment systems*. For the purposes of this book, the term refers to the infrastructure of the *payment* and *settlement systems* in which *settlement* is effected via accounts held with the *central bank*. In Denmark, the term covers the infrastructure of the payment systems Kronos, the Sumclearing, the VP securities settlement system, FUTOP and CLS.

Prepaid card

A card on which value is stored, and for which the holder has paid the issuer in advance. Some prepaid cards can be used again if the holder transfers money to the card. Telephone cards are examples of prepaid cards. Stored value on a prepaid card which is accepted by third parties is known also as *electronic money*.

Real-time gross settlement (RTGS) system

Payment system in which payments are settled individually and immediately. RTGS systems are typically used for *settlement* of large-value, time-critical payments. Danmarks Nationalbank's payment system, Kronos, is a real-time gross settlement (RTGS) system.

Retail payment

Payment between consumers and businesses. A retail payment is usually of relatively low value and does not require immediate *settlement*.

Securities settlement system

System for *settlement* of securities transactions, securities lending and periodic payments, i.e. interest, repayments and dividend. The exchange of securities is usually effected via accounts held with a *central securities depository*, while the settlement of cash is effected via accounts held with the *central bank*, i.e. in *central-bank money*. Most securities settlement systems settle payments in accordance with the *Delivery versus Payment (DvP)* principle. The VP securities settlement system is the Danish securities settlement system.

Settlement

The sequence of events from a payment is debited to the remitter's account until it is credited to the recipient's account. Settlement of a securities transaction involves the exchange of cash and securities. If settlement is effected immediately after the completion of the transaction, it is known as real-time settlement. When settlement has taken place, a transaction is usually final. See also *Finality*.

Settlement bank

Bank in which payments are exchanged via the *participants'* accounts in connection with *settlement* in a *payment* or *settlement system*. The settlement bank is either a central bank or a commercial bank. See also *central-bank money* and *commercial bank money*.

Settlement system

See *securities settlement system*, *foreign-exchange (FX) settlement system*, *net settlement system* and *real-time gross settlement (RTGS) system*.

Straight-Through Processing (STP)

Completion of all stages of a payment or trading transaction on the basis of instructions that are entered only once. Straight-Through Processing is based on national or international standards.

Systemic risk

The risk that problems experienced by one financial institution or in one payment or settlement system spread to other financial institutions, in a worst-case scenario causing a systemic crisis that may threaten financial stability.

Unwinding

Procedure used in certain *net settlement systems*. Unwinding entails that all transfers are provisional until all *participants* have discharged their settlement obligations. If a participant is unable to settle, the transfers involving that participant are removed from the *settlement* and the net positions of the remaining participants are recalculated.

Value date queue

Functionality in a *real-time gross settlement (RTGS)* system, whereby payments are queued if they are not to be settled immediately, but at a specified future value date.

Index

- Account holders 74
- Acquirer **133**, 184
- Act on Certain Means of Payment (Payment Cards Act) **140**, 184
- Assesment methodology 193, 201
- ATMs 130
- Automatic Collateralisation **83f.**, 183

- Bank for International Settlements (BIS) 164
- Banknote holdings 74
- Banknotes **29**, 34ff., 74
- BIC 159, 161
- Bills of exchange **24**, 34ff.
- BIS Core Principles 191, **196**, 212f.
- BIS/IOSCO recommendations **199**, 214f.
- Bypass 46

- Card holder **132**, 184
- Card issuer 132, 184
- Cash account manager 113
- Central bank **9ff.**, 28f., **73ff.**, 189f., 197
- Central counterparty **53**, 71
- Central securities depository 55, 70
- Central-bank money **15**, 55, 168
- Central-government payments 75
- Certificates of deposit 76f., 83
- Cheques 127
- Clearing banks 27f.
- Clearing participant 111
- CLS Bank (CLS) 91, **164f.**
- Coins **21ff.**, 74
- Collateral basis 80
- Collateral directive 179f.
- Collateral value 80
- Collateralisation **79f.**, 183f.
- Commercial bank money 16, 30
- Contingency plan 206
- Correspondent bank 39, **43f.**

Correspondent central bank model (CCBM) 85

Credeuro 163

Credit cap 156

Credit card 131

Credit risk 15, 25, **63**, 65, 69

Credit transfers 129

Cross-border payments 149ff.

Current account **75**, 76

Current-account limits 77

Current-account rate 75, 77

Custodian risk 70

Danish Bankers Association 104

Danish Financial Supervisory Authority 217f.

Dankort 135f.

Dankort A/S 136

Dankort agreement (2003) 140

Dankort model (2005) 139

Danmønt 127, 184

Deadlock 47f.

Debit cap 156

Debit card 130

Delivery versus Payment (DvP) **53**, 69, 111, 200

Direct debit, Betalingsservice 129

Discount rate 76

Disposable amount 83, 86

DK-Kontanten 136

e-account 141

EBA Clearing 154

eDankort 136

Electronic cheque truncation 127

Electronic clearing and truncation 105

Electronic money (e-money) 146, 184, **185**

Eligible securities 80

Elimination rules 115

EMV security standards 133

e-payments 139

ESCB-CESR recommendations 199

EU legislation **185f.**, 162

Euro Banking Association (EBA) 154

Euro payment system 149

EURO1 153f.

Euroclear Bank **59**, 116f.

European Central Bank (ECB) 81

European Payments Council (EPC) 162

Externalities 13

Fedwire 10, **31**

FIFO principle **46**, 240

Finality directive 67, **176f.**

Financial Sector Assessment Programme (FSAP) 16, 192

Financial stability 63, 190, 195

Foreign-exchange (FX) settlement system 164

FUTOP 119

G30 (Group of Thirty) 198

Giro inpayment form 128

Gresham's law **22**, 32

Gridlock **47f.**, 101, 221f., 240

Hague convention 180

Haircuts 80

Herstatt risk **11**, 164

Hybrid systems 50f.

IBAN 159, 161

ICP 163

IMF 192

In/out swap 170

International standards 16, **195f.**

Intraday credit, euro **78f.**, 86f.

Intraday credit, kroner 46, 78, **81f.**

Joint inpayment form 128

Kronos **96f.**, 202f., 221f., 235f.

Kronos terminal 97

Lamfalussy standards 176, **196f.**

Legal risk **63**, 66, 70, 175f., 179

Lender of Last Resort 9

LeverandørService (Supplier Service) 129

Line **88**, 115

Liquidity management 46f, 100f, 227ff.

Liquidity queue 46, 66, **101**

Liquidity risk 15, 24, **63**, 66, 70,

Loss sharing agreement 65

Loss sharing pool 156

Maximum for intraday credit 83

Means of payment 20, **125f.**

Membership risk 65

Minimum Common Features for Domestic Payment Systems 197

Monetary-policy counterparty 76

Monetary-policy day **76**, 88

Monetary-policy instruments 77

Moral suasion 191

m-payments 143

MTS 114

Multi-purpose card 146

Net settlement system **48f.**, 67f., 154

Netting (legal) 177ff.

Netting effect 51

Network externalities 13

New Legal Framework 186f.

Norex Alliance 59, 114

Nostro agent 167

Omnibus account 116

Operational risk **63**, 67, 70, 207

Oversight 16f, **189ff.**

Pan-European Automated Clearing Houses (PEACH) 163

Payment card **133**, 144

Payment instrument 125f.

Payment Systems 197

Payment versus payment 90, 119, 164

PBS (Payment Business Services) 104, 136

PBS clearing 105, 106

Pengeinstitutternes Betalingsformidlingscenter (PBC) 135

Pengeinstitutternes Købe- og Kreditkortaktieselskab (PKK) 135

Periodic payments **56**, 116

Pledge 183

Poseidon module 100

Postal giro system 128
 Prefund participant 160
 Prepaid card 126
 Pricing 47, 103, 137
 Primary cash provider 112
 Principal risk 54, **69**, 164

Queue facilities **46**, 235f.

Real-time gross settlement system (RTGS-system) **44f.**, 67f., 149, 151, 166
 Real-time settlement **117**
 Recipient **132**, 184
 Relayed links 85
 Replacement risk 69
 Retail payments 48, 105, **125ff.**
 Risk management 197, 199

Safekeeping account 79
 Saxess 114
 Scandinavian Cash Pool (SCP) 84f.
 SECUR 120
 Securities lending 70
 Securities settlement system **52f.**, 69f.
 Securities Trading Act 181
 Seignorage 21
 Settlement account 55, 75, 87
 Settlement bank 14f, 45, 65, **74f.**
 Settlement cycle 51, 52f., **87**
 Settlement risk 63ff.
 Single Euro Payment Area (SEPA) 161f.
 Single investor account 56
 STEP1 157f.
 STEP2 159f.
 Straight Through Processing (STP) **59**, 99
 Sumclearing 86f., **104f.**, 203f., 245f.
 SWIFT 99
 Systemic risk **63**, 68, 190, 245f.
 Systemically important payment systems 9, 192

Target 149f.
 Target2 151f.
 Traditional pledging of collateral 79, 183

Unwinding **67**, 177

Value date queue 66, **102**

VP Securities Services 112

VP settlement 86f., **111f.**, 204f.

VP settlement, periodic payments 116