

The BIS statistics on payments and settlements¹

The methodology and presentation of the BIS payment and settlement statistics have been modified to enhance the comparability of data provided by different countries. The statistics show the impact of technological innovations on the use of payment instruments and on the processing of payments and securities settlements over the years. The addition of central bank intraday credit to the statistical collection allows for an analysis of liquidity needs in payment systems.

JEL classification: E51, E58, G2.

Among the least well known of the BIS statistics are the statistics on payments and settlements. They include data on the use of payment instruments, payment systems, and securities trading, clearing and settlement systems. They have been collected yearly since 1988 for the G10 countries, being expanded over time to include all the members of the Committee on Payment and Settlement Systems (CPSS).² They are published in the so-called “Red Book” on *Statistics on payment and settlement systems in selected countries*.³ A methodology and a glossary were added to the publication in 1998. The methodology and representation of the data have changed as from the 2004 data for payment instruments and payment systems, and will be revised as from the 2006 data for securities. The revisions have been coordinated with the ECB, which publishes a similar report for the European Union (the Blue Book).

This special feature provides an overview of the payment and settlement statistics collected by the BIS, focusing on recent and planned enhancements.

¹ The views expressed in this article are those of the author and do not necessarily reflect those of the BIS. I would like to thank Stephan Arthur for excellent research assistance.

² The CPSS is responsible for the collection of these statistics. The CPSS serves as a forum for central banks to monitor and analyse developments in domestic payment, clearing and settlement systems as well as in cross-border and multicurrency settlement schemes. For more information, see www.bis.org/cpss/index.htm.

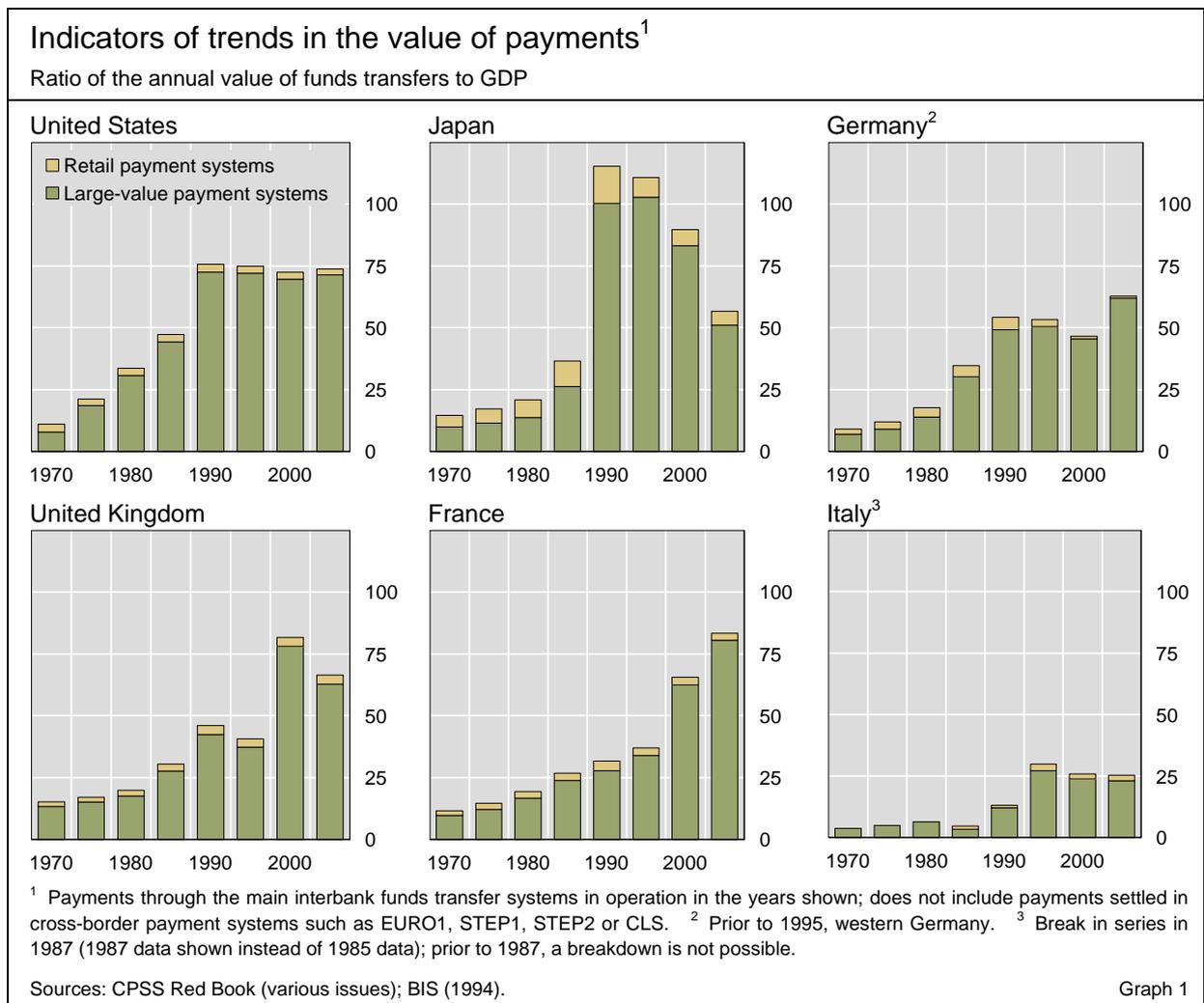
³ The first two publications were dated 1980 (with data for 1978) and 1985, and also included a detailed description of payment and settlement arrangements in the reporting countries. Such qualitative information was further published in 1989, 1993 and 2003. The statistical addendum of the Red Book has been published yearly since the edition containing the 1988 data. Other countries, in cooperation with the CPSS, have also published Red Books on their payment and settlement systems. These publications can be found at www.bis.org/statistics/payment_stats.htm.

It also shows some of the possible uses of the data for the analysis of the use of payment instruments, payment systems and securities infrastructures.

Evolution of the payment and settlement statistics

The collection of payment and settlement statistics by the CPSS, which was motivated by an interest in money as a means of payment,⁴ started directly ahead of a period of continuous technological progress and on the eve of a major increase in transactions. Over the last 25 years, the automation of processing has greatly reduced transaction costs in payment systems,⁵ as well as in securities trading and settlement systems, and has allowed for spectacular growth in the volumes and values settled. Between 1978, the first year for which the BIS collected statistics on cashless payments, and 2005, the

Strong growth in domestic payment systems ...



⁴ The first Red Book stated that "it was felt that the material collected for the purpose of this study may be of interest to students of the subject of money, and in particular its use as a means of payment".

⁵ Payment systems are generally used for transfers between individuals banking with different institutions. When the payer and the payee are customers of the same bank, the transfer is processed "in-house" and is not reflected in the statistics on interbank payment systems.

value of such payments in the G10 countries increased nearly thirteenfold, driven mainly by surges in financial activity, while the number of transactions increased more than threefold. Securities settlement systems in these countries in 2005 settled about 3.5 times the volume and 5.5 times the value processed in 1992, when the BIS started collecting the data.

... slows down in
the 1990s

The spectacular growth recorded in the 1980s has since slowed in most countries (Graph 1). This may be due to the introduction and increased use of cross-border payment and settlement systems (eg EURO1 or CLS), the figures for which are not included in the payment system statistics in Graph 1. In addition, European monetary union has reduced the total number and value of domestic payments related to cross-border transactions. Japanese payment systems exhibited the strongest relative drop, matching the overall stagnation of the country's financial markets since 1990.

Issues evolve over
time ...

Although the important role of technological advances and the increase in transaction volumes and values applies to all segments of the market, the issues at stake are different at the retail customer level and at the wholesale or interbank level. In retail payments, the main issues for central banks relate to the efficiency provided by the use of various payment instruments, some of which reduce the costs of commercial transactions compared to cash, as well as the safety of these instruments. In contrast, the crucial issue for large-value payment systems is the potential for systemic risk. This arises because of the volumes and values involved and the often critical nature of the interbank payments – money market, foreign exchange and other large and often urgent transactions – settled. Systemic risk issues are also important in securities settlements, as weaknesses in the supporting infrastructure might transmit disturbances to securities markets and to other payment or settlement systems.⁶

... as do the
statistics

The BIS payment and settlement statistics reflect the evolution of such central bank interests and concerns. The statistics include background information related to the holding of monetary assets by banks and non-banks, deposits (at banks and at the central banks) and currency (Table 1). The value on electronic money (e-money) storages and intraday credit provided by the central bank were added in 2000 and 2004, respectively. The statistics also include information about the use of retail payment instruments, such as credit transfers, direct debits, cards, cheques and e-money.⁷ They provide transaction volumes and values for large-value and retail payment systems, as well as for securities trading platforms, clearing houses and settlement systems. The Red Book also contains qualitative information about, among other things, the organisation and risk management of payment and securities

⁶ Central banks have made major efforts in the last decade to reduce the risks in large-value payment systems by introducing intraday finality, and the settlement risks associated with foreign exchange transactions by encouraging the use of payment versus payment (PVP). The introduction of delivery versus payment (DVP) and the use of central counterparties (CCPs) in securities transactions have achieved similar risk-reducing benefits. See CPSS (1997), Borio and van den Bergh (1993) and BIS (1994).

⁷ The transaction values and volumes were introduced in 1997, while the outstanding e-money value (the difference between values loaded and values spent) was added in 2000.

Payment and settlement statistics published by the BIS			
	First year available	Type of data	Breakdown
Basic information: banknotes and coin, institutions, transferable deposits			
Settlement media used by non-banks	1978	stock	Notes and coin, transferable deposits, value on e-money storages (added in 2000)
Settlement media used by banks	1992	stock	Reserves at central bank and at other banks, central bank credit, of which intraday (added in 2004)
Banknotes and coin	1992	stock	Notes and coin by denomination, notes and coin held / not held by banks
Institutions offering payment services	1978	stock	Central bank, banks, post office, electronic money institutions. Number and value on accounts
Retail payment instruments			
Payment cards	1978	stock	Cards and terminals according to function
E-money	1997	flow	Transactions
Use of payment instruments and terminals	1978	flow	Type of payment instrument and terminal, domestic vs cross-border transactions (added in 2004)
Interbank funds transfers			
Interbank funds transfer systems	1978	stock/flow	Participants. Volume and value of transactions. Concentration ratio
Securities trading, clearing and settlement			
Trading platforms	2000	stock/flow	Participants. Securities listed. Trading volumes and values. Instruments
Clearing houses / central counterparties	1992	stock/flow	Participants. Clearing volumes and values. Instruments
Central securities depositories	1992	stock/flow	Participants. Securities issued/registered. Settlement volumes and values

Table 1

settlement systems. Furthermore, the full descriptive Red Book provides useful background information for interpreting the statistics.

Although new retail payment methods are regularly brought to market (eg proprietary online accounts, virtual credit cards), it has been decided not to collect specific information on them. They tend to be difficult to classify, being often mere variations on traditional payment instruments, and their adoption by the public is generally marginal. Recent innovations are presented in targeted surveys by the CPSS on e-money, internet and mobile payments.

Several enhancements have been introduced for 2004 data. First, the methodology for payment instrument and payment system statistics has been clarified, so as to increase the comparability of statistics reported by the CPSS countries. Second, new series have been introduced, such as intraday credit, as well as domestic and international transactions for payment cards and for payment systems operating across national borders. Similar enhancements are

planned for the securities trading, clearing and settlement data, with implementation scheduled with the release of 2006 data.

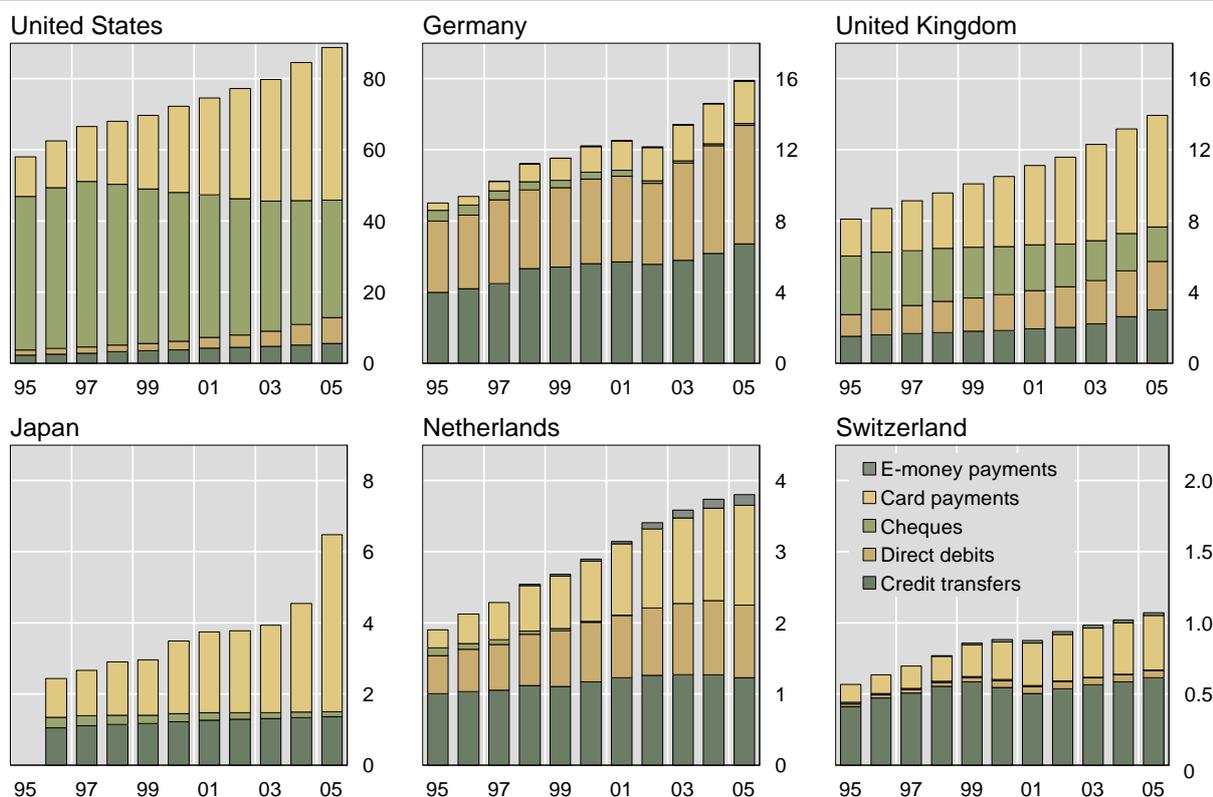
Increased consumer choice and efficiency in retail payments

Statistics document a shift from currency to bank accounts ...

At the retail payments level, the automation of transaction processing noted above has led to a gradual relative shift from central bank money (currency) to commercial bank money (money deposited on bank accounts). For example, the computerised management of accounts has allowed for the payment of salaries directly on workers' bank accounts; in some countries, this procedure has now become compulsory. Furthermore, the reliance on commercial bank money for customer transactions has been facilitated by the introduction by banks of payment instruments allowing customers to make payments and retrieve money from their accounts. The BIS statistics document the relative shift from currency to deposits. The values of transferable deposit accounts held by non-banks increased from about 30% of GDP in 1990 to nearly 50% in 2005 for all reporting countries, while the share of currency remained broadly stable, at around 7.5%.⁸

Use of payment instruments by non-banks, selected countries

Annual number of transactions, in billions



In order to present a coherent historical perspective, breaks in some series have been removed through statistical estimation. As a consequence, prior to 2000 some series differ from those previously published by the CPSS.

Sources: CPSS Red Book (various issues); author's estimates.

Graph 2

⁸ G10 countries for 1990, CPSS countries for 2005, excluding Hong Kong SAR for deposit accounts.

The BIS statistics can be employed to analyse the evolution over time and across countries of the use of different payment instruments (Graph 2). Humphrey et al (1996) rely on the Red Book data to analyse the determinants of payment instrument use in the 14 CPSS countries. Based on the available statistics, the authors also deduce the substitution relationships between these instruments and their significance for the further evolution of the use of paper-based versus electronic carriers.

Since the BIS started collecting these statistics, traditional paper-based instruments used to make face-to-face payments, such as the cheque, have tended to be replaced by electronic instruments, mainly debit and credit cards. For remote payments, direct debits and credit transfers have gained in importance, again at the expense of cheques. While cheques accounted for nearly 60% of all retail transactions in the CPSS countries in 1996, compared to about 20% for cards and 8% for direct debits, these instruments now account for some 26%, 45% and 14%, respectively. All countries have seen a similar evolution in the use of payment instruments, although the relative shares of these instruments differ substantially. In the United States and France, for example, cheques are still widely used, despite a notable decline; in contrast, in the Netherlands and Germany, direct debits account for a substantial share of retail payments.

... and the replacement of paper-based by electronic instruments

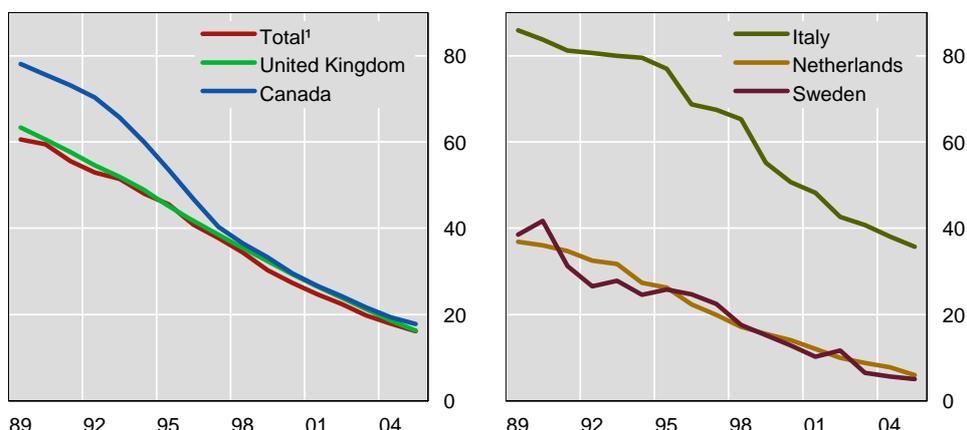
Another measure which can be derived from the BIS statistics and documents the electronification of payment instruments is the so-called paper ratio. This ratio indicates the proportion of payments initiated by the submission of a paper order (predominantly cheques and paper-based credit transfers), compared to payments submitted electronically. In recent years, paper-based orders have tended to be driven out by the increasing use of electronic banking and the initiation of credit transfers from the customer's computer. In the countries for which these data are available, between 1989 and 2005 the paper ratio declined from an average of nearly 60% to less than 20% of all retail transactions with payment instruments (Graph 3). At the same time, the paper ratio does not provide information on the modernisation of the processing of paper-based instruments through the elimination of paper in the early stages of the processing. For instance, in countries where cheques are still widely used, the processing has been largely automated, with the introduction of cheque truncation or the exchange of images instead of paper cheques.

Technological advances have also allowed the creation of so-called electronic money. In some respects, this is akin to currency, as the value is stored on a device in the consumer's possession that can be used as a general, multipurpose means of payment. In others, it resembles deposits on accounts, as it is prefunded at issuing institutions and mirrored (though not in real time) in their books. Central banks have been very attentive to developments in this field, because the replacement of currency by bank-issued electronic money could potentially threaten their seigniorage revenues. Central banks and academics have also discussed how electronic money might affect the implementation of monetary policy, but have concluded that any such effects would be minor. E-money has nonetheless generally been included in

Limited success for electronic money

Cheque payments and paper-based credit transfers

Number of transactions as a percentage of total transactions



In order to present a coherent historical perspective, breaks in some series have been removed through statistical estimation. As a consequence, prior to 2000 some series differ from those previously published by the CPSS.

¹ Unweighted average of the country ratios shown.

Sources: CPSS Red Book (various issues); author's calculations and estimates.

Graph 3

central banks' definition of narrow money, as reflected in Red Book data on settlement media used by non-banks.

In practice, since its introduction, electronic money has only been a mixed success, and in most countries is still only marginally used. The BIS statistics show that, in most reporting countries, e-money accounts for only 0.1 to 5.4% (data for 2005) of all retail transactions and that its values are negligible. However, one country does stand out – Singapore: there, more than 80% of all retail transactions involve e-money. A general political drive to improve the country's information infrastructure was a key factor behind the success of the instrument. Although the collection of statistics on electronic money allows for the distinction between card-based and computer-based storage, no single country reports the latter, due to difficulties in obtaining data from the non-bank service providers that are usually involved.

Intraday finality and liquidity needs in large-value payment systems

In large-value payment systems, computerisation has been accompanied by a rapid increase in payment activity both within and between countries and by two waves of changes in system design. The Red Book documents the evolution of system design from predominantly deferred net settlement (DNS) systems to real-time gross settlement (RTGS) systems.⁹ DNS systems calculated interbank obligations during the day and only settled the resulting net positions at the end of the day. Consequently, growing transaction values

⁹ See Table PS1, p 210, CPSS Red Book, March 2007, and similar tables in previous issues. Netting refers to the offsetting of positions or obligations between participants.

exposed payment system participants to increased settlement risks.¹⁰ In contrast, RTGS systems settle individual interbank transactions immediately and irrevocably, so that market participants can fully rely on the obtained funds. Today, there are some 90 RTGS systems worldwide (Bech and Hobijn (2006)).

Reserves and intraday credit in RTGS systems

The BIS statistics provide information on the liquidity available to banks for use in each reporting country's main large-value payment system. This liquidity consists of banks' reserves at the central bank and intraday credit provided by the central bank; both items appear in the Red Book table on settlement media used by banks. There, central bank intraday credit is defined as the maximum daily volume of credit granted by the central bank, averaged over the last reserve maintenance period¹¹ (or, when not applicable, the last month) of the year (CPSS Red Book, March 2005).

Data on intraday credit in payment systems ...

Intraday credit has become important since the replacement of end-of-day by real-time settlement. During the day, banks tend to have payment flows that can be netted against each other, resulting in much smaller end-of-day positions in DNS systems. In RTGS systems, payments are settled gross continuously and therefore need to be funded individually. The cost of such funding provides incentives for banks to delay their outgoing payments. In addition, insufficient funds might increase the risk of payment system gridlock. In order to reduce liquidity strains in their payment systems, central banks generally offer intraday credit, which needs to be repaid at the end of the day.¹² Furthermore, some central banks have introduced new system designs with liquidity-saving mechanisms (CPSS (2005)).

How much intraday credit is used varies between payment systems. It ranges from 4.3% of the value of all payments settled in Switzerland to over 18% in Japan. In most countries, however, it lies between about 6 and 9% (Table 2). The low figure for Switzerland seems to be a legacy of the relatively late introduction of such credit, in 1999. Prior to this, Swiss banks needed to synchronise their payments in order to efficiently manage their liquidity in the system. While the Bank of Japan has also introduced intraday liquidity quite recently (January 2001), the low opportunity cost of collateral for banks seems to have contributed to the widespread use of such credit.

... show differences between countries ...

¹⁰ During the day, banks remained exposed to the risk that some would not be able to fulfil their payment obligations as a consequence of credit difficulties or liquidity strains. The design of DNS systems allowed for the unwinding of unsettled payments at the end of the day in case of a participant failure and a recalculation of the multilateral exposures of the remaining banks, introducing systemic risk. Faced by unexpected new end-of-day positions, these other banks might also have been forced to default on their payments. See CPSS (1997).

¹¹ The period of time (usually a month) over which banks are expected to keep, on average, a predetermined amount of reserves (the required reserves) on their central bank accounts.

¹² Such credit is generally offered against collateral deposited at the central bank, or repo'ed to the central bank. The US payment system Fedwire offers intraday credit against a fee per minute.

Intraday credit in CPSS countries, 2005			
	Total value of transactions (USD billions) ¹	Maximum intraday credit (USD billions) ²	Maximum intraday credit as a percentage of total transactions ³
Belgium	21,448	5.2	6.4
Canada	30,321	.	.
France	151,425	44.0	7.6
Germany	172,023
Hong Kong SAR	14,936	5.0	8.8
Italy	40,840	10.5	6.7
Japan	196,452	136.3	18.2
Netherlands	38,126	25.5	17.5
Singapore	7,564
Sweden	14,867
Switzerland	32,956	5.4	4.3
United Kingdom	94,293	24.6	6.8
United States	518,547	116.5	5.9
CPSS	1,333,807	373.0	8.8

¹ Payments processed by the main domestic interbank funds transfer systems during 2005. ² Extended by the central bank; daily averages of the last reserve maintenance period in 2005; for Japan, calculated from the December value. ³ Maximum intraday credit as a percentage of the average daily value of transactions.

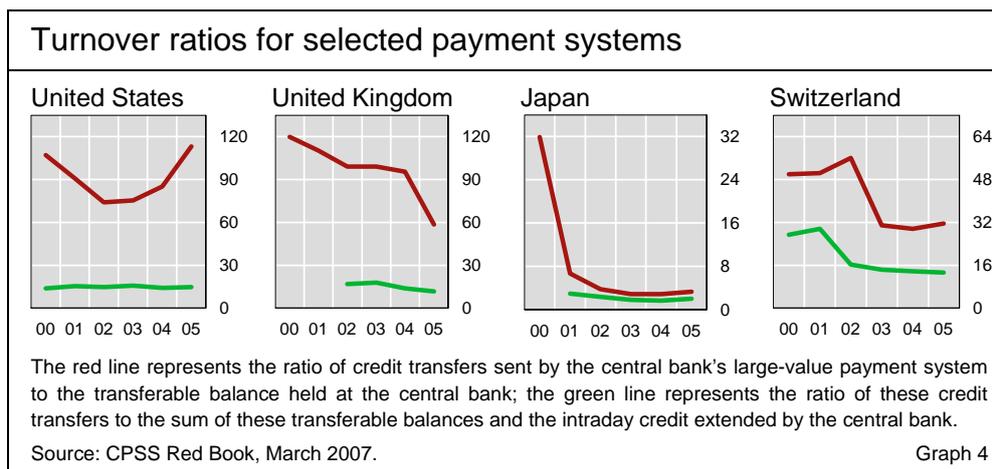
Sources: CPSS Red Book (various issues); BIS calculations. Table 2

The turnover ratio

... reflected in different turnover ratios

Reserves and intraday credit give an indication of the maximum liquidity needed to settle all payments in the system on a given day. This can be expressed as a turnover ratio, which is the ratio of the value of total payments made to either total overnight reserves (Heller and Lengwiler (2003)) or the sum of overnight reserves and intraday credit (Imakubo and Chida (2006)).¹³ To a certain extent, the turnover ratio reflects the efficiency of a payment system's design. But it is also influenced by factors affecting the level of reserves held by its participants. First, reserve requirements impose an upper bound on the turnover ratio (Heller and Lengwiler (2003)). Second, banks' intraday liquidity management, among other things, determines the level of free reserves that they are willing to hold. Therefore, a system with a low turnover ratio might be inefficient; it might also be safer, if banks hold relatively high reserves to cushion liquidity shocks. From that perspective, turnover ratios tend to decline when payment system participants are faced with uncertainty about incoming payments, as was the case following the events of 11 September 2001 in the United States (McAndrews and Potter (2002)). Due to the number of factors that might affect the turnover ratio, payment systems cannot be easily compared across countries on the basis of this measure. The

¹³ The inverse of the turnover ratio, with utilises reserves in the numerator and total payments in the denominator, gives an indication of the likelihood of payment delays. The lower the level of reserves, the less likely payments are to be settled rapidly.



turnover ratio can nevertheless be used to illustrate developments over time in a given payment system.

Using the BIS statistics for calculating turnover ratios has an element of imprecision, due to different reporting periods for reserves and intraday credit (the last reserve maintenance period, if appropriate) and the values settled in the payment system (the total for the year). These ratios nevertheless show some interesting developments in CPSS countries (Graph 4). As a general rule, an increase in liquidity needs first seems to push intraday credit upwards, before leading to an increase in banks' free reserves, as can be inferred from the earlier drop of the lower line in Graph 4 for Switzerland in 2002 and the United Kingdom in 2004.¹⁴ More specifically, the United States saw a decrease in Fedwire's turnover ratio as represented by the upper line after 2001, due to higher required and free reserves, followed by a return of both required reserves and the turnover ratio to pre-2001 levels. In Japan, the quantitative monetary easing policy, which targeted banks' overnight accounts at the Bank of Japan, negatively affected the turnover ratio. Imakubo and Chida (2006) show that the end of that policy in March 2006 immediately led to an increase in the turnover ratio. The Red Book figures for 2006 (not yet collected) can thus be expected to exhibit such a move upwards, all other things being equal.

Continuous Linked Settlement

The BIS statistics also provide, as from 2004 data, the values and volumes of the foreign exchange transactions settled by the Continuous Linked Settlement (CLS) Bank together with some more qualitative information. CLS Bank is an institution set up in 2002 by the private sector, which had been strongly encouraged in that direction by the central banking community, in order to reduce the settlement risks associated with foreign exchange transactions.¹⁵ With settlement through CLS Bank, the two sides of the

CLS data are included in the statistics

¹⁴ In the United Kingdom, banks' reserves surged by more than 60% in 2005 compared to 2004, which is double the increase in intraday credit used in the previous year. Other factors have certainly also played a role.

¹⁵ In these transactions, settlement risks were compounded by the fact that the settlement of the two legs of the transaction took place in different domestic payment systems, at different times of the day. For example, in a USD-JPY transaction between a US and a Japanese bank,

transaction are simultaneous (PVP). In December 2006, CLS Bank settled slightly less than 300,000 payment transactions (counting each side), in 15 currencies, with a value in excess of \$3.3 trillion per day.

Securities trading, clearing and settlement systems

The evolution of securities trading, clearing and settlement systems has also been affected by the automation of processing and the subsequent decline in transaction costs. For example, paper certificates representing the ownership of securities have been replaced by electronic records kept in central securities depositories (CSDs). This has increased both the tradability of assets, and the substitutability between securities and cash. Self-collateralisation is a perfect example of such substitutability: through it, securities can be used as collateral in order to raise the funds needed for their own purchase. More generally, the use of securities (and also cash) collateral has gained ground in all financial transactions.

Harmonisation of
the securities
statistics ...

To date, however, the BIS statistics have been utilised only rarely for the analysis of developments in the use of the securities trading, clearing and settlement infrastructure. To a large degree, this is due to the inadequate harmonisation of the figures reported by the CPSS countries. Only securities settlement statistics and qualitative information on securities settlement systems are available for all countries. Red Book Table SSS1 shows how the use of DVP,¹⁶ whereby the securities and the cash are delivered simultaneously, has gained ground, and which DVP models are used in the reporting countries.

... is enhanced in
2006

As from 2006 data, the Red Book statistical tables will be organised along functional lines, distinguishing between securities trading, CCP¹⁷ and non-CCP clearing, and settlement. This will permit the compilation of comparative tables for securities trading and CCP clearing that are similar to the ones now drawn up for securities settlement. Furthermore, the new structure of the tables will increase the visibility of the various breakdowns that countries are currently reporting. The hope is that this transparency will lead towards greater harmonisation in reporting. In addition, a few new breakdowns will offer the opportunity to distinguish between different instruments (eg equities, bonds and short-term paper). They will also distinguish between the clearing and

the JPY value would first have to be delivered, Tokyo time, to the Japanese correspondent of the US bank. Later in the day, the USD payment to the American correspondent of the Japanese bank would be settled in the US payment system. See Galati (2002) and CPSS (1996, 1998).

¹⁶ In the settlement of securities transactions, the time elapsing between trading and settlement (the settlement lag) represented a window of uncertainty similar to that in foreign exchange transactions. During that window, the counterparties were exposed to each other's potential failure to pay or to deliver. The potential loss was, here as well, the full value of the transaction. DVP was introduced in order to eliminate such principal risk.

¹⁷ The use of CCPs, which interpose themselves between the counterparties to financial contracts, has generally been seen as an effective way to mitigate the risks involved in these transactions, provided the CCP adopts stringent risk management procedures. See CPSS (2004).

settlement of exchange-traded and over-the-counter (OTC) derivatives, depending on the availability of these figures for the reporting central banks.¹⁸ OTC derivatives clearing and settlement have recently come under the central banks' focus, as the development of the settlement infrastructure has lagged behind that of derivatives markets more generally.¹⁹

Concluding remarks

The BIS payment and settlement statistics are a unique centralised source of information. Until now, these statistics, although regularly referred to, have not often been used for analytical work, due partly to issues of data comparability and partly to the low number of available observations. However, recent enhancements to the methodology and presentation of the reported data, together with the centralised storage of all statistical information, can be expected to increase the usefulness of the BIS statistics for research purposes. Issues that might be addressed by the enhanced statistics include the use of CCP clearing and its relation to market structure, the relative use of free-of-payment securities settlements, and developments in cross-border retail payment transactions, for countries for which such data are or will be available. Both the BIS and the CPSS strongly encourage the use of their data to improve understanding of the financial system.

References

Bank for International Settlements (1994): "Payment and settlement systems: trends and risk management", *64th Annual Report*, Chapter VIII.

Bech, M and B Hobijn (2006): "Technology diffusion within central banking: the case of real-time gross settlement", *Federal Reserve Bank of New York Staff Reports*, September.

Committee on Payment and Settlement Systems (1996): *Settlement risk in foreign exchange transactions*, March.

——— (1997): *Real-time gross settlement systems*, February.

——— (1998): *Reducing foreign exchange settlement risk: a progress report*, March.

——— (2004): *Recommendations for central counterparties*, November.

——— (2005): *New developments in large-value payment systems*, May.

——— (2007): *New developments in clearing and settlement arrangements for OTC derivatives*, March.

¹⁸ Figures on OTC derivatives trading are published semiannually by the BIS, while data on exchange-traded instruments are published quarterly.

¹⁹ It became increasingly apparent that these infrastructure deficiencies, which were endemic to the contract documentation, processing and settlement phases of all sorts of OTC derivatives, could create substantial risks. See CPSS (2007).

——— : *Statistics on payment and settlement systems in selected countries* (Red Book), yearly publication.

Borio, C and P van den Bergh (1993): “The nature and management of payment system risks: an international perspective”, *BIS Economic Papers*, no 36, February.

Galati, G (2002): “Settlement risk in foreign exchange markets and CLS Bank”, *BIS Quarterly Review*, December, pp 55–65.

Heller, D and Y Lengwiler (2003): “Payment obligations, reserve requirements and the demand for central bank balances”, *Journal of Monetary Economics*, 15 January.

Humphrey, D, L Pulley and J Vesala (1996): “Cash, paper and electronic payments: a cross-country analysis”, *Journal of Money, Credit and Banking*, vol 28, no 4, November.

Imakubo, K and H Chida (2006): “BOJ-NET funds transfers after the end of the quantitative monetary easing policy”, *Bank of Japan Review*, November.

McAndrews, J and S Potter (2002): “Liquidity effects of the events of September 11, 2001”, *Federal Reserve Bank of New York Policy Review*, November.