Recent developments in intraday liquidity in payment and settlement systems

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Alongside consolidation and globalisation of the financial markets, the increase in values exchanged in payment and settlement systems has been remarkable. The size of intraday liquidity requested to expedite settlement of such values is accordingly very significant, especially compared to overnight or longer term liquidity.

*The increasing use of risk control arrangements in payment and settlement systems (*e.g. *real-time gross settlement) is typically associated with higher liquidity needs, which have been balanced by the parallel development of several forms of liquidity saving features in systems.*

The most remarkable developments have affected the qualitative management of intraday liquidity. A clear trend illustrated by continuous linked settlement (CLS) is the shortening of the time horizon in intraday liquidity management.

On the "supply" side, intraday liquidity can be provided by central banks or commercial banks, depending on the settlement asset used by systems. Since most central banks extend credit only against collateral, the type of assets that participants can use is an important factor in determining the opportunity costs of intra-day liquidity. In the past decade, most central banks have substantially broadened the range of collateral they accept in their provision of liquidity. Furthermore, an interbank intraday liquidity market seems to start emerging in relation with concentration of correspondent banking activities and funding costs related to critical time windows.

Developments affecting intraday liquidity management need to be adequately considered from a financial stability perspective.

Liquidity risk profile has changed alongside a variety of factors including consolidation which has led to a concentration of intraday liquidity risk and the development of interdependencies in payment and settlement systems.

One lesson to be drawn from the recent period is the usefulness for central banks, to have a list of eligible assets that is diversified enough to address an unexpected increase in collateral demand, in order to mitigate the consequences of a financial turmoil.

*Over the past decade, the relevant actors, including the banking sector, central banks and the banking supervisors have taken various initiatives to better approach the diverse challenges raised by developments in intraday liquidity. Central bank policy responses encompass the provision of new settlement services which allow to optimize intraday liquidity management of banks (*e.g. *the new TARGET2 platform), the adaptation of their collateral policy to the new landscape of interdependent payment systems and oversight initiatives to better monitor and address changing risks.*

Liquidity is usually defined as the ability for a financial institution to fund increases in assets and meet obligations as they come due. Liquidity has to be considered within different time horizons, depending on the respective maturity of obligations and assets used to fulfil these obligations. Intraday liquidity is the shortest time horizon of the overall liquidity of a said institution. It can be referred to as the funds which are available or can be borrowed during the business day in order to enable financial institutions to effect payments/settlements. Intra-day liquidity has different sources: incoming funds and intraday credit, *i.e.* the credit extended by the settlement agent of the system and reimbursed within a single business day (also called "daylight credit"). The provision of intraday credit is aimed at ensuring a smooth settlement process and avoiding gridlocks situations in the system. It allows to mitigate the effects of any hazard in sequencing payment flows in the system. Repayment of the borrowed funds should take place before the end of the business day, otherwise there is spillover to overnight credit.

Structural developments in the financial industry have led in the past years to a clear trend in shortening time horizon of liquidity risk and liquidity management. One practitioner recently summarised the situation as follows: "my short-term is intraday, my medium-term is overnight and my long-term is one week".

This evolution has notably been driven by changes in the use and in the patterns of payment and settlement systems. Actually, alongside consolidation and globalisation of the financial markets, the increase in values exchanged in payment and settlement systems has been very dynamic in the recent years. For instance, every day in France, EUR 500 billion are exchanged through large-value payment systems, which represent 30% of the country's annual GDP. Furthermore, the widespread use of real-time settlement as a way to expedite settlement in payment and securities systems has been an important change in the last decade in most countries.

Liquidity risk is usually defined as the risk of not being able to meet payment obligations when due. However, the increasing use of payment and settlement systems and the evolution of these systems towards real-time settlement practices have created a new situation, with payment obligations falling due much quicker than in the past.

Another important trend is the growing importance of collateralisation as a risk mitigation technique, especially in payment and settlement systems. Addressing intraday liquidity related issues requires considering at the same time issues related to collateral management.

The objective of this article is to address changes which have affected intraday liquidity management and the implications of these changes for financial stability, including an overview of preliminary lessons drawn from the recent period of market turbulences.

1| CHANGES IN INTRADAY LIQUIDITY MANAGEMENT

Recent changes in intraday liquidity management have affected both the demand and the supply sides.

1|1 Evolution of intraday liquidity needs

Some developments can be categorised as constraining the amount of intraday liquidity necessary to ensure smooth functioning of settlement systems while other factors are rather influencing the way intra-day liquidity is managed in qualitative terms by participants in systems.

WIDESPREAD USE OF RISK CONTROL MEASURES HAS INCREASED THE QUANTITATIVE INTRADAY LIQUIDITY NEEDS

Over the past decade, the features of payment and settlement systems have significantly evolved.

The first crucial evolution which has influenced intraday liquidity needs is the progress in the implementation of some standard practices of risk control measures in payment and settlement systems. The stronger emphasis on risk management in the design of market infrastructure has been reflected in the shift towards real-time gross settlement (RTGS) in large-value payments and delivery versus payment (DVP) in securities settlement, which are typically associated with higher liquidity pressures.

The first example is the implementation in most countries of RTGS systems, which have become the standard model of large value payment system (LVPS), progressively replacing deferred net settlement (DNS) systems (see paragraph 2|1, *Changing forms of liquidity risk*).

DNS systems were the predominant form of payment systems in the 1980s. They are usually defined as providing settlement on a net basis at the end of a predefined settlement cycle, typically at the end of the business day.

By reducing the number and overall value of payments between financial institutions, netting minimises the usage of settlement asset. However, a drawback of DNS systems is the higher settlement risks involved, in particular since the finality is not reached immediately but late in the day.

In contrast with DNS systems, RTGS systems settle each payment individually (*i.e.* on a gross basis). Provided the payer has sufficient balances (or credit availability), each payment order is settled as soon as it enters the system (*i.e.* on a real-time basis). When the payer's funds are insufficient, the order is typically queued. RTGS systems provide the advantage that payments become final in the course of the day. The adoption of such safer systems was strongly supported and often initiated by central banks. A common side affect of settlement in RTGS mode is that the associated intraday liquidity needs required to settle an equivalent of underlying payment obligations are higher than in a DNS environment. The number of RTGS systems has increased dramatically in the 1990s.[1]

Comparable evolution has taken place in the securities settlement environment where DVP model 1 has also expanded significantly in the past ten years. In contrast with model 2 and model 3 DVP, model 1 DVP implies that the delivery of the securities leg of a transaction is processed on a gross basis as well as the settlement of the related cash obligation.[2] This evolution has taken place as a way to improve final settlement and to accelerate both re-delivery of securities and re-use of the cash settlement proceeds.

One significant illustration of this trend in expanding the use of DVP model 1 is the implementation under course of the Euroclear group's business model aimed at further integrating securities settlement. The so-called Euroclear settlement of Euronext-zone securities (ESES) project will lead to the creation of a single platform allowing for multi-central bank settlement in real time of securities deposited in Euroclear Belgium, Euroclear France and Euroclear Nederland. The ESES project has been implemented at Euroclear France in November 2007 and is due to be rolled out at Euroclear Belgium and Euroclear Nederland in 2008. It will entail in the three central securities depositories (CSDs) the decommissioning of the model 2 DVP systems currently used to expedite a large part of the volume of settlement of securities transactions. All transactions will accordingly be processed under a DVP model 1 basis. This change reflects the market demand for intraday finality.

Key implications of all these developments are the more complex liquidity management requirements faced by banks accessing the infrastructure, and the growing importance of collateralisation to support liquidity demand.

Development of innovative liquidity saving features in payment and settlement systems

Opposite offsetting factors have recently developed in order to save liquidity and collateral associated with the widespread design of risk control measures in payment and settlement systems.

In order to respond to concerns expressed regarding the costs associated with RTGS and DVP model 1 in securities settlement, mechanisms have been introduced to allow participants to economise on liquidity needs. Concerns relate primarily to the added opportunity costs for payment system participants due to the higher amount of intraday liquidity needed to expedite settlement on a gross basis compared to net settlement. In extreme circumstances, the possibility for shortages of liquidity may emerge with the potential to generate significant disruption in payment systems.

These concerns have led the market to push LVPSs to introduce liquidity-saving features, including offsetting algorithms and the combination of

1 *See BIS (1997):* "Real-time gross settlement systems", *March.*
2 *See the three different models of DVP identified in the report entitled* Delivery versus payment in securities settlement systems, *published by the Bank for International Settlements in 1992 (*http://www.bis.org*).*

bilateral or multilateral netting with real-time settlement functionality (for instance, CHIPS in the United States, TARGET2 in the EU). Technological advance and legal changes have facilitated the introduction of these liquidity-saving features without reintroducing the kind of uncertainties and risks which characterised the DNS systems.

Associated to these developments, most LVPSs now provide their users with a broader range of real-time information and more flexibility to manage liquidity. Such controls include, for instance, the possibility to change the order of a payment in the queue, the intended settlement time or bilateral and multilateral credit limits to control the outflow of funds.

Actually, progress in the design of LVPSs now allows the banks to obtain earlier finality with a fewer amount of settlement asset needed at a lower cost. With a lower consumption of settlement asset, banks can make the same amount of payments with fewer settlement balances. Thus, the costs of making payments are lower. Where applied, liquidity saving features have significantly alleviated the liquidity burden on system participants, thereby relaxing potential collateral constraints.

Another example is the automated self-collateralisation procedures in securities settlement systems. Several CSDs of the Euroclear group (Euroclear France and Euroclear UK and Ireland) have liquidity-saving mechanisms that facilitate real-time DVP. Securities in the course of being purchased can be used as collateral for intra-day credit in order to fund the purchase. Monte Titoli in Italy and Iberclear in Spain use comparable arrangements.

In designing payment and settlement systems, a certain trade-off exists between on the one hand achieving early finality and thus lower risks and on the other hand economising on settlement asset and thus lower costs. While this trade-off remains, a better risk-cost equilibrium has been made possible by the development of these advanced liquidity saving features. In quantitative terms, the parallel development of liquidity saving features in systems has allowed to limit to a large extent the higher liquidity needs due to the implementation of risk control measures relying on gross settlement.

FACTORS INFLUENCING THE QUALITATIVE MANAGEMENT OF INTRADAY LIQUIDITY

One of the main remarkable developments of the recent years has been the increasing time criticality of the functioning profile of payment and settlement systems.

The liquidity demand is becoming concentrated at critical times during the day, such as when a key system requires payments to settle, in particular in the RTGS system which is the backbone of the payment organisation. Peak liquidity demands can come from the need to fund payments at specific times on different systems.

The first example can be drawn from the funding needs relating to the continuous linked settlement (CLS) system for foreign exchange transactions. At the end of 2007, CLS Bank is connected to 15 RTGS systems to allow its members to fund their positions, which has to be done within stringent schedules, in order to address the time zone differences between the different currency areas involved.

A second example is the growing implementation by central counterparties (CCPs) for securities and/or derivatives of the internationally recognised best practices, recommending to have the authority and the operational capacity to make intraday margin calls. The objective is to better capture price volatility or exceptional increases of exposures of trading positions during the day. One example of such recent development is the Intraday margin call project, implemented by LCH.Clearnet SA in Spring 2007. The arrangement focuses on intraday margin solution in derivatives markets as these are considered the most volatile in risk profile intraday. The recourse to intraday margin calls by CCPs requires participants to be able to transfer enough liquidity or collateral to the CCP within a very short notice intraday.

A third example is the increasing recourse to arrangements aimed at preventing consequences of settlement risk in DNS. Pursuant to internationally agreed standards applicable to both payment systems and securities settlement systems (SSSs), DNS systems should implement a mechanism that ensures timely settlement, even in the event of a participant's default.[3]

3 *See Core Principle V for Systemically important payment systems (BIS, February 2001) and recommendation No 9 of the CPSS/IOSCO report on securities settlement systems (BIS, November 2001).*

Among the different practices to implement such an arrangement to protect DNS systems against settlement risks, a possibility is to combine a permanent mutual fund, which amount is based upon average debit balances in the system, with complementary individual and temporary collateral for participants whose transactions would exceed the total amount of the permanent common fund. Combination of a mutual fund and individual additional collateral minimises opportunity costs in the level of the mutual fund, since exceptional peaks are covered by individual collateral. At the same time, it requires a more dynamic intraday liquidity management of participants and a close real time monitoring of the intraday evolution of their position in the related DNS system, in order to avoid that individual transactions are queued because of insufficient collateral.

One relevant example of such financial protection arrangement combining a mutual fund supplemented by individual collateral could be found in the previous revocable channel of the Euroclear France RGV2 SSS, which was decommissioned in November 2007, to be replaced by the ESES France SSS operating on a DVP model 1 basis for all types of transactions. This SSS used to process non-urgent transactions and operated on the basis of a multilateral netting of the cash leg of transactions. In order to bring the revocable channel of RGV2 into compliance with CPSS/IOSCO Recommendation 9, an arrangement was set in February 2005, consisting of caps on participants' buying positions, secured by a permanent mutual fund of over EUR 400 million, supplemented when necessary by individual collateral (*i.e.* collateral allocated strictly to cover the short cash position of the participant concerned). The arrangement was aimed at ensuring timely settlement of transactions, including in the event of an inability to settle by the participant with the largest single settlement obligation.[4]

Beyond the evolutions that have increased liquidity peaks at specific parts of the day, another trend is the extension of the operating times of systems, in order to take into account the interdependencies between them. For instance to achieve DVP settlement of securities transactions, market participants need to access both the securities and payments infrastructure. Accordingly, synchronisation of the opening hours and cut-off times for settlement has often been achieved in order to ensure the smooth functioning of the market. One relevant example is for SSSs processing Eurosystem eligible collateral to have operating hours in compliance with NCBs requirements for TARGET.[5]

However, synchronisation of operational processes across systems in different countries and currency areas is a more recent phenomenon. At the time of implementation of CLS, the synchronisation of payment system processes was addressed, and some payment systems adapted their operating hours to meet the requirements of the CLS pay-in schedule. One of the major challenges in this context is overcoming the time-zone frictions that exist between, the Asian, the European and the American time-zones.

Extension of operating hours and synchronisation with other domestic or cross-border systems has strongly constrained intraday liquidity and collateral management, since it requires an efficient management so that timely transfer of liquidity resulting from settlement proceeds in one system is able to meet liquidity needs in another system.

1|2 Evolution of financing sources

Financing sources available to feed intraday liquidity needs have also evolved during the past years. An important distinction can be made depending on the settlement asset used, *i.e.* central bank money and commercial bank money. Developments in collateral policies have also significantly affected intraday liquidity management.

Relation between central bank money and commercial bank money

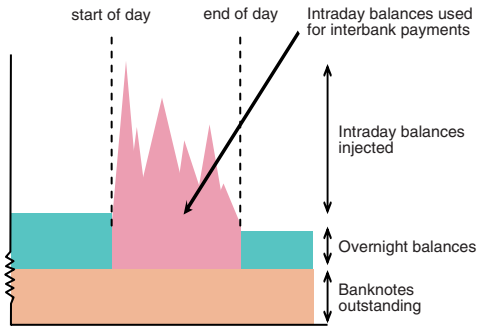
Payment and settlement systems can settle either in central bank money or in commercial bank money.

When central bank money is used as the settlement asset, the first component of intraday liquidity takes the form of deposits with the central bank that can be used to make payments during the day.

4 *See Sampic (C.) and Hervo (F.) (2003):* "Protection of deferred net payment and securities settlement systems: the examples of SIT and Relit", *Banque de France,* Financial Stability Review, *No 3, November.*

5 *See* "Standards for the use of EU Securities Settlement Systems" *in ESCB Credit Operations –EMI, January 1998.*

Figure 1
Stylized diagram of central bank money
(y-axis: value; x-axis: time)



Source: BIS (2003): The role of central bank money in payment systems, August.

The intraday balance is also impacted by proceeds of settlement of payments with other participants all along the operating day.

If the intraday balance available for payments is too small relative to the value of payments to be made in a given time, it could result in gridlock, preventing payments from being executed. Thus in many cases central banks provide intraday credit to banks and other eligible account holders. Indeed, particularly with the decline in importance of reserve requirements in many economies, balances held by banks during the day are often substantially larger than those held overnight.

The smooth and safe functioning of a payment system is dependent not just on the quantity of the settlement asset. It also depends crucially on the quality of the asset and thus on the identity of the settlement agent. Therefore, international best practices recommend payment and settlement systems to use the central bank of issue as the settlement agent, providing the safest settlement asset.

However, in an era of financial globalisation, global players, active in multiple currencies, are confronted with the fact that each central bank provides as settlement asset only the currency it issues. This is one reason why systems providing multi-currency settlement services usually use commercial bank money as settlement asset. For example, the International Central Securities Depositories, Euroclear Bank and Clearstream Banking Luxembourg which service international markets and participants, provide settlement in multiple currencies in commercial bank money.

The use of commercial bank money raises specific liquidity risks in relation with the transferability of the private settlement asset in claims denominated in central bank money.

Central banks can address some of the consequences of globalisation through mutual co-operation. For example, in the mid-nineties, central banks expressed their preference for a market solution to address the need to reduce principal risk in foreign exchange settlement. CLS was launched in 2002, with support of the international central banking community. In 2007, the system provides payment versus payment (PVP) settlement in 15 major currencies which are eligible in the system. CLS Bank is the settlement institution for CLS, *i.e.* settlement is not in central bank money. However, all payments to and from CLS are made through the issuing central bank, so central bank money retains a pivotal role in the settlement of foreign exchange transactions in CLS.

CLS illustrates the clear trend towards the development of commercial money settlement backed by funding in central bank money (CHIPS in the US is another relevant example, with initial and final funding done in central bank money) or other innovative arrangements aimed at limiting the use of central bank money to a net funding (*e.g.* Clearstream settlement model or Euroclear future alternative payment model). The consequences of this type of settlement models in terms of intraday liquidity management are complex. On the one hand, the level of funding in central bank money appears very limited in quantitative terms, compared to the underlying value of payment obligations settled in commercial bank money. On the other hand, a strong settlement interdependency is introduced between the settlement system in commercial bank money and the payment system(s) used to fund the net obligations in central bank money. This requires from the banks a very close monitoring of the completion of their funding obligations, typically within tight intraday deadlines.

CENTRAL BANK INTRADAY CREDIT AND COLLATERAL POLICIES

Intraday credit policies

There is some variation in central bank policies as regards which institutions are eligible to be provided

with intraday credit in RTGS systems.[6] Besides resident banks, which are commonly eligible to intra-day and overnight credit, there is less uniformity about providing credit to non-bank financial institutions (*e.g.* clearing houses or other settlement systems operators, investment firms and brokers…). Intra-day credit is generally provided only to a limited set of account holders, where necessary to ensure the orderly flow of payments. This automatically introduces a level of tiering in systems since for many institutions, direct access to a payment system may be of little or no use without access to credit. This has in turn consequences on liquidity management with direct participants having a broad access to intraday credit facility with the central bank providing clearing settlement services to other parties willing to use the system to expedite payments.

Where central banks provide credit they are potentially exposed to credit risk and consequently they require collateral, set limits and/or charge fees. Most central banks extend credit only against collateral.[7] This is the case with the Eurosystem which grants unlimited, interest rate free but fully collateralised intraday credit to eligible counterparties participating in TARGET.

Actually, monetary policy considerations are also important when designing a central bank policy with regards to intraday credit. The failure to repay intraday credit by close of business may lead to "spillover" into overnight credit. This might threaten the implementation of monetary policy, either in case intraday credit has been granted to institutions that are not monetary policy counterparties[8] or in a crisis situation. Actually, the amount of intraday credit may average several times the whole amount of liquidity provided overnight or longer through regular monetary policy. A massive spillover of intra-day credit into overnight credit may accordingly create short term disturbances in the conduct of monetary policy operations. However, central banks which provide fully collateralised intraday credit would become the owner of the collateral, in case one or some participants ultimately failed to reimburse credit or became insolvent. The possibility to liquidate the collateral would not only protect central banks against credit risk but also limit the impact of the spillover to the time needed to sell/realize the assets.

Diversification of eligible collateral

The collateral policy of the central banks influences the costs of the liquidity. Since most central banks extend credit only against collateral, the type of collateral that the participants of the payment systems can use is an important factor in determining the opportunity costs of holding collateral. In general, in the past decade most central banks have broadened the range of collateral they accept in their provision of intraday liquidity.

The collateral framework of the Eurosystem is one relevant example of a responsive policy to market innovations and developments. ESCB statutes state that any provision of liquidity (monetary policy or intraday) should be fully collateralised by adequate assets. At the beginning of Stage III of the Economic and Monetary Union in 1999, a two tier approach was followed. Tier 1 assets were based upon criteria common to the whole euro area whereas Tier 2 assets complied with national eligibility criteria. Irrespective of the difference in eligibility criteria, both Tier 1 and Tier 2 assets were eligible to collateralise any provision of liquidity (monetary policy or intraday) and were usable both on a domestic or cross-border basis within the euro area.

The financial industry expressed, in a public consultation made in 2003 a request to improve the collateral framework, including a desire to expand further the range of eligible assets. The Eurosystem took these views into account when it was decided to implement a phased approach towards a single list of eligible assets (implemented between Mid 2005 and 1st January 2007). The single list of Eurosystem eligible assets comprises a wide range of collateral, including marketable assets (*e.g.* public bonds) as well as non marketable assets, especially credit claims complying with an eligibility credit assessment framework.

TRENDS IN COMMERCIAL BANK MONEY FINANCING

Recent developments in commercial bank money intraday financing comprise the design of diverse intra-group organisations in order to better address liquidity and collateral management in a more global financial environment as well as the starting emergence of some intraday interbank market.

6 *See BIS (2003):* "The role of central bank money in payment systems", *August.*
7 *The intraday credit policy of the US Federal Reserve Bank System is based upon a different framework, allowing eligible institutions to obtain a maximum amount of uncollateralised daylight overdraft (*"single day net debit cap"*) charged with a daily fee and above this limit an additional amount of collateralised credit (*"Collateralised capacity"*).*
8 *Which is not a widespread practice of central banks.*

Internationally active institutions with a significant presence in a large number of countries manage their intraday liquidity and the related collateral in a variety of ways.[9] It seems that a large number of internationally active banks operate primarily through correspondent banking relationships, accessing only a select group of markets directly and often managing their network of nostro agents on a partially centralised basis.

Of the small group of banks with a high level of direct participation in international payment systems, few operate with a fully centralised liquidity and collateral management function. Several others are partially centralised, managing liquidity on a regional basis.

The degree of centralisation of the liquidity and collateral management function tends to be driven by one or more of several factors: cost-efficiency, local regulatory and access factors, technological capacity and the degree of integration of IT systems across the banking group as well as the bank's particular contingency arrangements. In particular, banks with sizeable operations in multiple markets perceive the greatest scale economies from centralisation, with technological capacity and group-level contingency planning providing an additional level of comfort.

Other banks seem to consider that a decentralised liquidity and collateral management approach also supports business continuity planning, ensuring diversification of collateral and liquidity sources in the event of an emergency.

There is also some evidence of banks' implementation of in-house liquidity –and collateral– saving payment management techniques to mitigate intraday liquidity risk pressures. Examples involve queue release algorithms or internal schedulers to manage the flow of payments and prioritise obligations.

Surveys conducted at regional or international levels regarding provision of credit in the context of correspondent banking services seem to indicate that intraday overdraft limits are generally uncollateralised and can be quite large, while overnight overdrafts are comparatively small. In case of default of participants in correspondent banking arrangements, such overdrafts could accordingly become a vector for domino effects. However, to the extent that credit lines offered also tend to be uncommitted, correspondent banks would quickly cut or suspend credit lines, in case of need. This would allow the correspondent banks to keep control of their credit risk but might also precipitate or amplify the consequences of a crisis (*e.g.* suspension of credit lines due to a misperception of an operational incident affecting a major bank using correspondent agents to expedite its settlement activities in away systems).

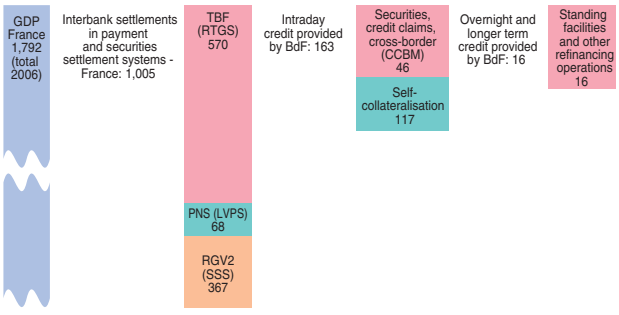
Traditionally, intraday credit provided in correspondent bank services has been free of interest. However, there is some anecdotal evidence that an interbank intraday liquidity market seems to start emerging in relation with concentration of correspondent banking activities and funding costs related to critical time windows. The introduction of CLS in particular has triggered a move towards greater concentration of correspondent activity into those banks that are direct participants in, or act as nostro agents for CLS. In relation with the time criticality of funding obligations related to CLS, those banks have started to charge intraday liquidity.

Overview of intraday credit in Paris market place settlement systems

The following diagram provides an illustration of the respective importance of payment flows compared to the real economy (the ratio between the daily turnover in payment and settlement systems averages 56% of the annual GDP; in other words, two days turnover in payment and settlement systems is equivalent to the annual GDP in value).

The amount of intraday credit required to settle the payment and settlement obligations averages 16% of the daily turnover in value.

Figure 2
Intraday credit and settlement flows – Paris financial centre
(January – September 2007, daily average, EUR billions)



9 *See* Cross-border collateral arrangements report – *CPSS BIS, January 2006.*

Intraday credit granted by Banque de France is ten times higher than the overnight and longer term credit provided to the banks.

In this context, the smooth functioning of payment and settlement systems appears all the more important that a major problem preventing reimbursement of intraday credit at the end of the day would lead to a spillover to overnight credit.

2| FINANCIAL STABILITY IMPLICATIONS

The developments affecting intraday liquidity management with shortening of the time horizon in a more complex settlement landscape need to be adequately considered from a financial stability perspective. It is necessary to understand the evolution of risks, which differ depending on the settlement model used but also on the evolution of the global financial environment, charaterized by a concentration of actors and growth of settlement interdependencies. Over the past decade, the relevant actors, including the banking sector, the banking supervisors and central banks have taken various initiatives to better approach changes in intraday liquidity risk.

2|1 Risks associated to intraday liquidity management

CHANGING FORMS OF LIQUIDITY RISK

Liquidity risk in payment systems differs depending on the settlement model used.

In DNS systems, finality of settlement is only achieved at the end of the day (or end of settlement cycle) and thus there is no certainty that the payments will be settled timely. If one participant fails to meet its payment obligation when due, the whole processed payment orders could be unwound and new balances excluding the defaulter would have to be presented for a new attempt for settlement. Liquidity risk would therefore arise from an unforeseen change in the liquidity position of the different participants, particularly those that expect to be creditors in the system. This situation would force them to seek other funding resources, which could give rise to strains on the interbank market, with potential repercussions on the conduct of the monetary policy.

This situation generates the consequent risk of other participants defaulting in turn because of unexpected debit position to be covered late in the day. The liquidity risk would become systemic if, by a spillover effect, the inability of an institution to settle its net balance in one system generates a failure in other systems. Thus, in DNS systems, the liquidity risk rather materialises end-of-day than intraday, when it appears implicit.

The earlier finality occurs (*i.e.* a payment becomes unconditional and irrevocable) the lower is the risk of unexpected credit exposures arising in the settlement process. This has been a main driver to develop real-time gross settlement (RTGS payment systems and DVP model 1 for securities transactions). However, in systems operating on the basis of gross settlement, there is a risk that insufficient liquidity creates queued payments. Should they accumulate, this may generate gridlocks and eventually failed payments (and/or deliveries) at the end of the day. To a certain extent, risk mitigation measures aimed at preventing credit risk through the development of gross settlement has translated in higher liquidity risk (which can be in turn mitigated through innovative liquidity saving features described in section 1|1 *Development of innovative liquidity saving features in payment and settlement systems*).

CONCENTRATION OF INTRADAY LIQUIDITY RISKS

The continuing consolidation of the financial sector has led to a significant concentration of payments activities and associated exposures within individual banks. There is anecdotal evidence that a few banks process on their own books very high payment values –in some cases similar to those of LVPSs. Such concentrations may arise for various reasons such as consolidation between banks, specialisation by certain banks in correspondent banking, or changes in cost structures that encourage indirect rather than direct participation in payment systems. In Europe, payment flows passing through the leading correspondent banks attain values comparable to those observed in certain national payment systems.

The process of adapting correspondent banking and custody services to the context of financial

globalisation has sometimes resulted in similarities between these arrangements and payment and settlement systems, giving birth to quasi-systems. Some banks provide services for a substantial number of other banks and financial intermediaries for which the use of a correspondent or custodian bank is an alternative to direct access to a system.

Lastly, corresponding and custodian banks which have a critical mass of customers and flows can settle transactions internally; in other words, they can make payments and deliver securities from account to account between their customers without going through payment and settlement systems. Recent regulatory developments, *e.g.* the implementation of the EU Directive 2004/39/EC on market in financial instruments ("MiFID") in the European Union is probably putting new emphasis on this trend with large banks that develop internal systems competing with infrastructures.

These developments influence the form of intra-day liquidity risk, leading to a concentration and internalisation of flows in commercial bank money outside the payment and settlement systems.

IMPACT OF SETTLEMENT INTERDEPENDENCIES ON LIQUIDITY RISK

During the past decade, the forms of interdependencies between payment and settlement systems have significantly increased and changed, primarily within the settlement infrastructure of a said country or currency area but also on a cross-border basis.

The consolidation and globalisation of the financial sector has resulted in the emergence of a few global financial institutions acting as common and significant participants in multiple systems operating in several countries. They may also play different roles, as settlement banks, liquidity providers, and collateral custodians to the same systems in which they are typically among largest participants. This creates institution-based interdependencies between payment and settlement systems.

Other forms of interdependencies that may influence liquidity management are related to the direct settlement relations between systems (*e.g.* between SSSs and payment systems to achieve DVP in securities settlements and to collateralise extensions of intra-day credit in payment systems). Interdependencies can facilitate significant improvements in the safety and efficiency of payment and settlement processes. DVP and PVP processes, for example, have led to a significant reduction in the principal risk otherwise associated with the settlement of securities and foreign exchange transactions.

Interdependencies, however, have also substantial consequences regarding the form of liquidity risk and accordingly on the liquidity and collateral management of participants in payment and settlement systems.

In particular, as systems and system participants become more dependent on the smooth functioning of one system to meet liquidity or collateral demands in another system, the risk that a financial or operational disruption in one system may have an impact on another system and its participants also increases.

The increasing interdependence of liquidity flows among systems has lead to a more complex liquidity management for systems' participants, in order to avoid the creation of unbalance between liquidity traps in some systems and liquidity shortages in other systems.

2|2 Lessons drawn from recent turmoil on financial markets

In the context of the recent turmoil that affected financial markets in the summer 2007, many payment and settlement systems and their participants faced a variety of challenges in the conduct of their settlement operations. These challenges comprised increased trading volumes and asset price volatility, as well as the consequences on systems of institutions' precautions against liquidity and credit risk. These challenges were generally well met and consequently payment and settlement systems functioned smoothly.

Regarding more specifically intraday liquidity and collateral management, several lessons can be drawn from this period of strains.

Counterparty credit concerns that became manifest in money markets did not significantly affect institutions' willingness to meet their payment and settlement obligations on a timely basis. In particular timely settlement was preserved for systems operating in the Paris financial centre.

Neither spillover from intraday to overnight credit, nor any increase in end-of-day failed/unsettled payments were ascertained. Figures do not even show any intraday gridlock or delay in the interval between the submission of payment orders and their actual settlement, compared to the normal time lags observed.

However, one important behaviour that was observed in most systems, including in the ones operating in the Paris financial centre were related to the precautionary demands for central bank liquidity.

Actually, financial institutions' increased aversion to credit and liquidity risk also affected payment and settlement systems. The difficulties in money markets led financial institutions to increase significantly the amount of collateral pledged to central banks for potential intraday and overnight credit.

The level of intraday credit provided by central banks also increased somewhat. This primarily reflects the precautionary actions of financial institutions, rather than an increase in actual intraday liquidity needs. At the same time, central banks' provision of overnight and longer term funds alleviated some of this increased demand for intraday credit.

As with the other challenges, the precautionary steps taken by institutions, ascertained by the additional central bank liquidity required did not result in visible negative implications for the functioning of systems. Central banks were able to process these additional collateral deliveries, and institutions apparently found sufficient collateral to pledge to the central bank.

Chart 3
Average and maximum settlement delay in the French RTGS during August 2007

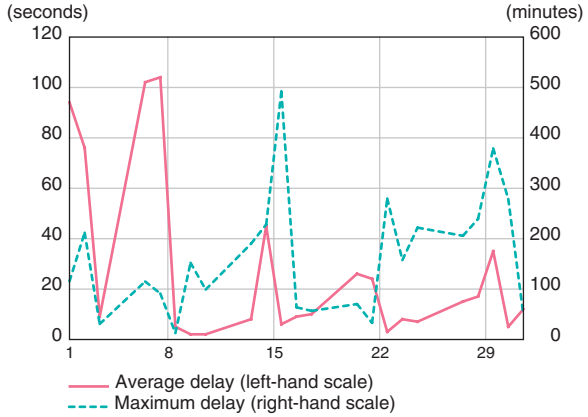
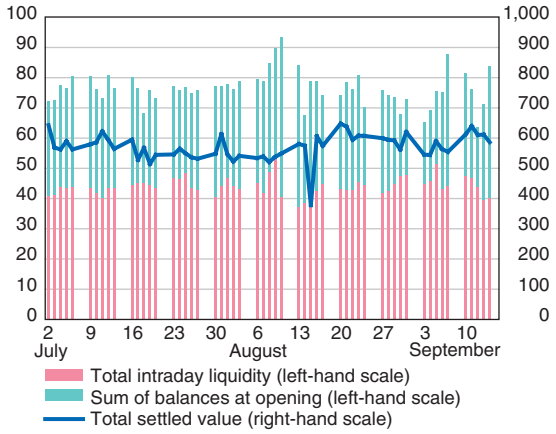


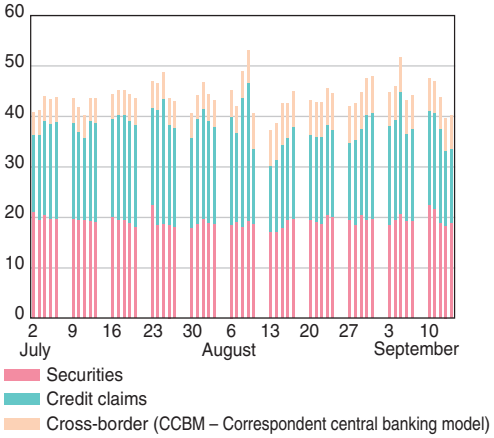
Chart 4
Total settled value and total liquidity usage (balances at the opening and intraday liquidity borrowed) in the French RTGS, from 1 July to 15 September 2007
(EUR billions)



As far as central bank policies are concerned, an important lesson relates to the need of having a list of eligible assets that is diversified enough to address an unexpected increase in collateral demand.

This requirement was achieved in several ways. In the euro area, the existing collateral policy of the Eurosystem results in many institutions having high levels of diverse types of collateral already posted, or ready to be posted to one or more central banks to face increased demand for liquidity. In that context, the provision of extra collateral was processed without much difficulty. Several other central banks met this demand allowing some flexibility in expanding their collateral lists in light of the turmoil.

Chart 5
Total intraday liquidity borrowed in the French RTGS and breakdown by type of collateral
1 July to 15 September 2007
(EUR billions)



Another lesson is related to the strong relation between operational risk and liquidity risk. The question raised is whether the system design allows the mitigation of liquidity strains in preventing for instance the development of liquidity sinks in case of an operational problem at one of a major participant.

2|3 Initiatives to better mitigate intraday liquidity risks

In order to better address the intraday liquidity risks in a moving environment characterized by increased constraints in terms of systems interdependencies and shortening of the time horizon, policies and practices have been developed both by the banking sector and by the central banks and other public authorities.

INITIATIVES DEVELOPED BY THE BANKING SECTOR

In the past decade, the banking sector has taken several initiatives to address effectively liquidity risk while minimising the costs of managing payment liquidity in a global environment.

One example is the Guidelines on liquidity management released by the European Banking Federation in 1999, to take into account the new environment resulting from the implementation of TARGET in the EU.

Other relevant examples are the reports released in 2003 and 2005 by the Payments Risk Committee (PRC),[10] a private sector group sponsored by the Federal Reserve Bank of New York on which many of the largest global banks are represented.

The PRC recommended central banks to further harmonise their collateral policy. It also recommended individual institutions to develop well-constructed intraday liquidity collateralised services, (such as intraday real-time repos, cross-border collateral pool facilities and intraday currency and collateral swaps). The PRC advocated that obstacles to moving collateral across borders in support of such liquidity services should be eliminated. In a second report, the PRC detailed the different market solutions, as well as the role that some market infrastructures (*e.g.* CLS and ICSDs – International central securities depository) could play for their implementation.

THE ROLE OF CENTRAL BANKS AND SUPERVISORS

Central banks influence payment and settlement systems by providing a variety of services to commercial banks. In doing so, central banks provide a safe settlement asset: the central bank money. In most cases, they also operate systems which allow for the transfer of that settlement asset. Central banks have also developed oversight responsibility over payment and settlement systems.

Therefore, central bank responses to the new challenges regarding intraday liquidity comprise the provision of systems offering liquidity saving features, the adaptation of their policy in the area of access to central bank money and collateral eligibility, as well as oversight initiatives to better capture the moving liquidity risk.

Most RTGS systems recently developed by the central banks encompass liquidity saving features. The new TARGET2 platform which has been launched on 19 November 2007 is one relevant example of the new RTGS generation offering state-of-the-art liquidity saving features.

Improvements in the collateral policy and in the tools to mobilise more easily eligible assets also facilitate banks to better manage their collateral and to get more easily the central bank money they need. Recent turmoil demonstrated a preference for central bank money. Actors that do not have access to central bank's refinancing are in a more difficult situation as they are dependant on banks for refinancing.

Cross-border use of collateral either on a routine or on an emergency-only basis may be an effective policy response to alleviate collateral pressure. In the Eurosystem, there is extensive use of cross-border collateral among the euro area countries, although this is limited to euro-denominated collateral assets issued in the European economic area (EEA) and settled/held in the euro area.

A few central banks accept collateral denominated in foreign currency. Several central banks (in Sweden, Switzerland, the United Kingdom, and the United States) have already introduced such facilities and have adopted a range of approaches to accepting these assets. The existing arrangements vary from emergency-only facilities through infrequently used routine cross-border collateral arrangements to arrangements used extensively on a routine basis.

10 Managing payment liquidity in global markets: risk issues and solutions, *Payments Risk Committee, March 2003 and* Global payment liquidity – private sector solutions – *October 2005*

Box 1

Liquidity saving features in advanced payment systems: TARGET2's example

TARGET2 is a relevant example of a system providing its users with the most up-to-date liquidity management tools currently offered in RTGS systems. TARGET2 combines the following liquidity-saving patterns:

• ***consolidated monitoring of the liquidity position in all RTGS accounts*** *of a credit institution across Europe, thanks to TARGET2's architecture, consisting of a single shared platform. Multi-country banks are able to manage the activity of their branches from a single point and to centralise their cash management, which will include the liquidity involved in the settlement of ancillary systems – as settlement of these systems will be performed over RTGS accounts after a transition period (maximum 4 years after TARGET2 go-live);*

• ***liquidity pooling functionality*** *based on the concept of the virtual account, which purpose is the intraday aggregation of the liquidity available on all the single accounts belonging to a group of accounts of a said banking group. Its liquidity can be managed in a consolidated way. Each transaction involving an account belonging to a group of account will be immediately booked on the relevant single account using the global liquidity available at the group of accounts level; this global liquidity available is defined as the sum of balances of all the*

• *RTGS accounts belonging to the group of accounts (plus the sum of all the credits lines, if any, of all the RTGS accounts belonging to the group of accounts);*

• ***different priority levels*** *that can be assigned to each payment depending on its criticality;*

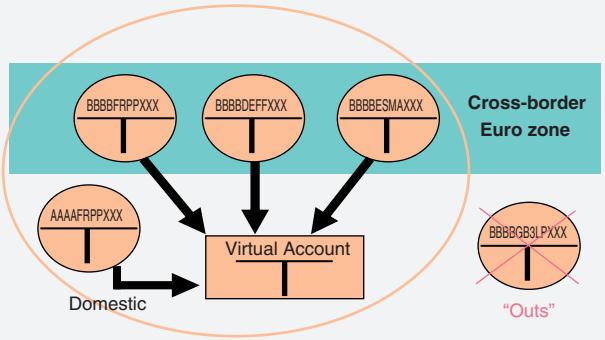
• ***possibility to use a liquidity reservation feature*** *in order to facilitate the settlement of participants' operations, including the ability to set aside liquidity on specific sub-accounts especially in order to dedicate it to the settlement of transactions stemming from ancillary systems;*

• ***bilateral and multilateral sending limit features*** *offered in order to avoid that some participants are inclined to wait for receiving payments from their counterparties before issuing their own payments. Setting a bilateral limit* vis-à-vis *a participant prevents the settlement of payments that would cause the bilateral balance with this participant to breach this limit. Setting a multilateral limit prevents the settlement of payments that would cause the balance* vis-à-vis *all the participants towards whom no bilateral limit was set to breach this multilateral limit. Thanks to the multilateral limit feature, there is no need for participants to manage bilateral limits towards each other (TARGET2 should have around 1,000 direct participants);*

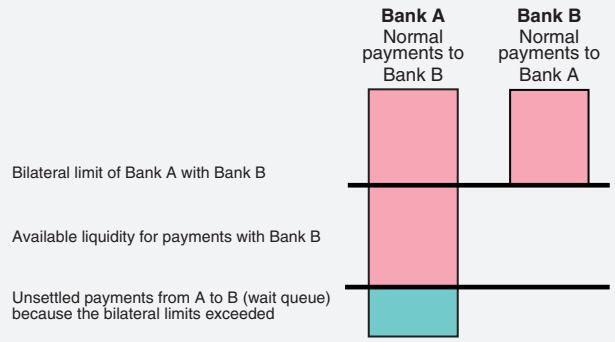
• ***optimisation mechanisms*** *which aim at reducing participants' liquidity needs while improving the fluidity of settlements.*

– *Offsetting processes that are triggered by the arrival of a transaction in the system. They attempt to immediately settle this transaction, in combination with already queued transactions;*

– *five optimisation processes. The first three of them are applied to payments placed in the queue (normal priority) and are sequentially triggered throughout the day. The other two correspond to specific settlement methods for ancillary systems.*



Effect of bilateral limits on normal priority payments



Given the different needs and arrangements among the central banks, a full harmonization of the policies regarding collateral eligibility and mobilization practices does not seem feasible. However, further cooperation between central banks may be desirable to address possible common needs (*e.g.* responding to emergency liquidity situations), ensure readiness to respond to future challenges and facilitate individual projects of some central banks to further develop cross-border collateral facilities that may be used for routine or emergency credit, or both.[11]

From an oversight perspective, it seems important that central banks in cooperation with other relevant public authorities are in a position to adequately address the changing nature of the liquidity risk.

A first area relates to the ability to monitor developments and risks affecting liquidity in payment and settlement systems. Several tools are used to analyse and forecast developments, including simulation models.

A second area is to develop oversight analysis and eventually specific requirements with respect to intra-day liquidity risk.

Intraday liquidity risk issues are of a common interest between banking supervisors, who are in charge of the prudential safety of the financial institutions, participating in payment and settlement systems and central banks, entitled to ensure the smooth functioning of these systems. In this respect, coordinated actions between central banks and banking supervisors have helped strengthening the resilience of both banks and payment systems.

Supervisory requirements and recommendations have increasingly recognised that developments affecting payment and settlement systems have lead to a situation where the relevant time-frame for active liquidity management is generally quite short, including intraday liquidity.[12]

For instance, the Principle 9 set by the Basel Committee regarding Contingency Planning states that a bank should have contingency plans in place that address the strategy for handling liquidity crises and include procedures for making up cash flow shortfalls in emergency situations. It could be interesting to investigate further whether banks' contingency funding plans and stress tests adequately reflect intraday liquidity risks, including the potential for sudden and unexpected changes in liquidity or collateral needs.

Another issue is related to the regulatory approach with respect to developments in correspondent banking and custody business. A number of central banks have been working to better understand the risks issues, in relation with internalisation and concentration of flows. But large correspondents and custodians are also commercial banks that are subject to banking supervision. Thus, it is useful that central bank overseers and banking supervisors monitor and assess in cooperation the management of potential risks related to the evolution of correspondent and custody activities for the smooth functioning of the payment and settlement process.

11 *See BIS (2006):* "Report on cross-border collateral arrangements".
12 *See Basel Committee on Banking Supervision (BCBS) (2000):* "Report of the Sound Practices for managing liquidity in banking organisations", *February*

Box 2

Attempt to simulate and modelizing intraday liquidity risks

Recently, several central banks have developed simulation tools able to reproduce the operation of payment systems using real payment data.

These new tools allow the different central banks to conduct several stress-testing exercises, as a part of their oversight mission. In particular, payment system simulators are especially helpful to investigate the issue of liquidity risk in RTGS systems. In such systems, an operational problem affecting the IT infrastructure of a large participant could prevent the considered participant from emitting any payment, while it would still receive payments from its counterparties. The affected participant would thus turn into a «liquidity sink» for the system, depriving the RTGS of its liquidity and consequently, threatening the smooth functioning of the system. Possible consequences include the rejection of payments at the end of the day, or a substantial increase in the average settlement delay.

Simulation tools allow central banks to quantify those consequences, and help them to define the most appropriate oversight policies to face this issue.1 In particular, which participants should be requested to have a secondary processing site and how many contingency payments per hour should the system operator be able to make on behalf of an affected participant, are important questions, to which a payment system simulator can help provide an answer.

1 *Mazars (E.) and Woelfel (G.) (2005):* "Analysis, by simulation, of the impact of a technical default of a payment system participant", *Banque de France,* Financial Stability Review, *No 6, June.*