



EUROPEAN CENTRAL BANK

EUROSYSTEM



BANK OF ENGLAND

# PAYMENTS AND MONETARY AND FINANCIAL STABILITY

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**ECB-BANK OF ENGLAND  
CONFERENCE**

**12-13 NOVEMBER 2007**





## PAYMENTS AND MONETARY AND FINANCIAL STABILITY

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CONFERENCE  
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**Address**

Kaiserstrasse 29  
60311 Frankfurt am Main  
Germany

**Postal address**

Postfach 16 03 19  
60066 Frankfurt am Main  
Germany

**Telephone**

+49 69 1344 0

**Internet**

<http://www.ecb.int>

**Fax**

+49 69 1344 6000

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Behind the scenes, a number of people contributed to both the organisation of the conference and the preparation of these conference proceedings. Many thanks to Marco Galbiati, Susan Germain de Urday, Matt Hart, Cornelia Holthausen, Johannes Lindner, Mark Manning, Stephen Millard, Erlend Nier, Charlotte Riddle, Simonetta Rosati, Daniela Russo, Jochen Schanz, Heiko Schmiedel, Andreas Schönenberger, Frank Smets and Alex Spivack.



## I KEY MESSAGES AND PROGRAMME

### I.1 CENTRAL BANKS, STABILITY AND THE FINANCIAL INFRASTRUCTURE

By Mark Manning<sup>1</sup> and Daniela Russo<sup>2</sup>

#### I.1.1 INTRODUCTION

The typical objectives of central banks – monetary and financial stability – have grown from their early roles in the field of payment systems. Today, central banks around the world continue to provide the ultimate settlement asset and strengthen their influence via a role in ownership, operation or oversight of key components of the financial infrastructure. But, as the payments and settlement landscape evolves, it is essential that policy-makers and practitioners continue to adapt and update their thinking and, through a deeper understanding of the links between payments and monetary and financial stability, work together to make the right policy choices.

It is with this objective in mind that the Bank of England and the European Central Bank came together to organise a two-day conference on “Payments and Monetary and Financial Stability”, providing an opportunity for the academic, policy and practitioner communities to debate some of the key infrastructural issues of the day.

This introductory article aims to put the conference programme in context, setting out the motivation for central bank interest in these issues, exploring where papers presented at the conference fit into the associated literature, and drawing out the key policy issues included within the conference themes.

In the event, the conference fell at a time when many participants were preoccupied with the ongoing implications of market turmoil for either their businesses or their policy choices. The programme provided ample opportunity to examine the role of infrastructure in facilitating the efficient redistribution of liquidity and collateral, both between market participants and central banks, and between market participants

themselves. The related papers and slides are available on the ECB<sup>3</sup> and Bank of England websites<sup>4</sup>.

#### I.1.2 CENTRAL BANKS IN THE PAYMENTS LANDSCAPE

Borio et al. (1992) define the payment system as “that set of arrangements for the discharge of the obligations assumed by economic agents whenever they acquire control over real or financial resources”.

In the historical evolution of banking and payments, such arrangements typically emerged with a single institution offering a settlement asset that all banks were willing to accept. This institution often later became the central bank, with central bank liabilities – “outside” or “central bank” money – emerging as the ultimate settlement asset. In practice a hierarchy then tended to develop below the central bank, with a top tier of banks settling directly across the books of the central bank and offering settlement in their own liabilities – “inside” or “commercial bank” money – to banks in the tier below. Hence, central bank and commercial bank money settlement typically co-exist, a theme explored by the Bank for International Settlements (2003). The end-customer also typically settles in commercial bank money at his/her own bank, but relies on one-for-one convertibility of his/her deposits into central bank money: cash.

#### I.1.3 PAYMENT SYSTEMS AND MONETARY STABILITY

##### CENTRAL BANK MONEY AND PRICE STABILITY

To safeguard the demand for its liabilities in settling interbank claims, the central bank will

- 1 Senior Manager, Financial Resilience Division, Bank of England.
- 2 Deputy Director General, Payments and Market Infrastructure, European Central Bank.
- 3 Available at <http://www.ecb.europa.eu/events/conferences/html/pmfs.en.html>.
- 4 Available at <http://www.bankofengland.co.uk/publications/events/fsconfnov07/index.htm>.



seek to control the terms on which they are offered to the banking system: the quantity provided and the price. This *stability* objective with respect to the ultimate settlement asset explicitly addresses its functions as a *unit of account* and a *store of value*.

In practice, this objective is usually cast in terms of price stability, and often executed with reference to an inflation target. For instance, the Bank of England seeks to maintain “stable prices and confidence in the currency”. Similarly, the ECB has an explicit objective to “maintain the euro’s purchasing power and thus price stability in the euro area”.

#### **PAYMENT SYSTEMS FACILITATE TRADE**

But in an advanced monetary economy, most money is held in the form of bank deposits: inside money. Agents in the economy rely on the payment systems that enable these to function as a “medium of exchange”. It is agents’ recourse to inside money to effect payments that ultimately underpins the banking system’s demand for outside money, so the central bank needs to take an interest in the functioning of the payment systems that determine this ultimate demand.

In particular, in a monetary economy without payment systems, economic agents would have to hold, or at least be able to access readily, sufficient cash to fund all (potential) market transactions in which they might wish to participate during a given period. Hence, it would be necessary for agents’ cash holdings to be much greater than in the presence of well-functioning interbank payment systems.<sup>5</sup> Given the disadvantages of holding cash – such as the risk of theft, the risk of receiving counterfeits, and the opportunity cost of forgone interest – this can be costly for the agent and will serve to reduce the quantity of transactions in the economy.

He, Huang and Wright (2005) set out a theoretical model of the transition from an early monetary economy to one with financial institutions and payment systems. They establish conditions for the introduction of payment systems, noting that it will more likely be the case that the cheaper

it is to use such a system, the greater the risk of theft in a cash-only world, and the higher the gains from trade. Lester (2005) and Millard and Willison (2006) have built on this model, incorporating settlement and operational risks in the use of payment systems, and investigating welfare implications.

Analogously, in wholesale financial markets, it is the presence of effective interbank settlement systems – and, in particular, confidence in the finality of settlement – that facilitates trade between market participants.

So, above and beyond the narrow objective of price stability, the central bank, as issuer of the ultimate settlement asset, will seek to ensure the smooth-functioning of payment systems and will take an interest in the incentive effects of system design. The nature of the public interest here is similar to that in respect of the transport network or the legal system. In the most basic terms, the central bank seeks to ensure the ongoing ability of payment systems to support the monetary economy and, by extension, the desired path of economic growth.

#### **DEPENDENCE ON EFFICIENT AND WELL-FUNCTIONING PAYMENT SYSTEMS**

Once established, agents depend heavily on such systems to support their transactions, taking for granted the fact that their transfers will be settled as expected. As is clear from the annex to this article, the flows passing through key infrastructures each day are immense, giving some sense of the high level of dependence on their smooth functioning.

The prolonged absence of, or loss of confidence in, the systems on which agents rely for the transfer of bank deposits could therefore have a severe impact, resulting in a retreat from inside money and a costly return to cash – in extremis, a return to barter – with potentially stark implications for the level of activity in the real economy. As Kahn and Roberds (2007)

<sup>5</sup> That is, payment systems relax the “cash-in-advance” constraint within an economy.

point out, payment systems are typically seen as “essential, pervasive, and boring until there’s a malfunction.”

Thankfully, such malfunctions are rare events. Nevertheless, it is instructive to examine some case studies and consider some empirical evidence on the role played by payment systems in support of trade, financial intermediation and overall economic activity.

In this conference, **Gerali and Passacantando** provided some insight, drawing on anecdotal evidence from the Great Depression. Between 1929 and 1933, the value of payments processed by the major US dollar settlement systems fell by more than 60% as confidence in the banking system disappeared. The contraction in settlement activity was more than proportional to the overall reduction in economic activity during the Depression. As agents retreated from the worst affected banks in the system, deposits in the safer banks increased, as did holdings of currency. In localised communities, forms of barter emerged, as well as new locally accepted alternative forms of money: “scrip” money or trade credits. These workarounds substituted only imperfectly for inside money, as they were only accepted in defined communities where informational frictions were sufficiently low.

Similarly, Murphy (1978) and the Central Bank of Ireland (1971) examine agents’ workaround measures during the Irish banking strike of 1970. Most importantly, agents continued to draw and accept cheques throughout the strike period: the banks were fully expected to re-open again in due course and hence cheques drawn on pre-closure bank accounts circulated as “money”. But, in this way, agents were accepting credit risk on each other for a prolonged, and indeed, unknown, period: between the date of issuance of the cheque and ultimate settlement once the banks reopened. In this case, the real economic effects were more limited than might have been expected.

It seems that this workaround system was able to function purely by virtue of low

informational frictions: that is, for the majority of transactions, information was available on the creditworthiness of the issuer of the cheque, facilitated by the spatial proximity of those issuing and accepting cheques. One might imagine that, in a world with a larger number of transacting agents, unknown to one another and perhaps highly dispersed, the impact on the real economy would have been far more severe.

Indeed, Kahn and Roberds (2007) argue that the record-keeping embedded within interbank payment arrangements can facilitate a higher quantity of transactions within the economy. In a world with imperfect information and limited enforcement, inside money transfers reveal potentially valuable information about the identity of the transacting parties and provide evidence that a trade has taken place.

In a similar vein, Koepl, Monnet and Temzelides (2006) draw out the importance of periodic settlement in the presence of informational frictions. The authors show that with sufficiently frequent settlement the first-best quantity of trade can be achieved. Importantly, it is not settlement per se that improves welfare in their model; rather it is the influence of settlement on agents’ intertemporal incentives.

## PAYMENTS AND MONETARY POLICY

In order to be able to effectively exercise control over the quantity and price at which its liabilities are made available, and to facilitate the smooth-functioning of payment systems within the economy, the central bank will need to establish appropriate arrangements for liquidity provision to the banking system. It will also pay attention to the mechanisms by which it carries out such operations, ensuring the safety, resilience and efficiency of the payment and settlement systems used to mobilise collateral assets and distribute funds. And, by extension, it will take an interest in the payment systems employed by the banking system to carry out its own credit intermediation and thereby transmit policy more widely throughout the economy.



In the past decade, there has been a marked shift away from deferred net settlement to real-time gross settlement (RTGS) in large-value payment systems. This implies heightened intraday liquidity demands on payment system participants, which are typically met via the provision of credit by the central bank. Intraday credit is often extended against collateral, but typically with a very low, or zero, nominal interest rate. Central banks' generous policy in respect of intraday liquidity provision has all but crowded out a private market for intraday funds, spawning a series of theoretical studies as to whether it is appropriate for a central bank to adopt different approaches to intraday versus overnight monetary policy.

Millard, Speight and Willison (2007) argue that the difference reflects a tension between different aspects of the central bank's monetary stability objective: on the one hand, a central bank sets overnight rates to meet its price stability objective; on the other, it may be prepared to inject intraday liquidity into an RTGS payment system at a very low cost to ensure that banks do not have an incentive to delay payments and risk settlement failure (as in Furfine and Stehm (1998)).

A variety of regimes exist around the world for central bank operations and monetary policy implementation. Channel systems, for instance, are becoming increasingly popular, whereby a central bank offers standing lending and deposit facilities at a spread around a central policy rate. **Berentsen and Monnet**, in this conference, provided a framework for thinking about the implications of adopting a channel system.

Different regimes have potentially different implications for banks' intraday and overnight liquidity management and hence banks' payment behaviour. **Martin and McAndrews**, in the first session of the conference, wondered whether an appropriately constructed regime could meet both monetary policy and payment system objectives simultaneously. And **Williamson**, also in the first session, argued that

the distinction between intraday and overnight policy action had become blurred.

#### 1.1.4 PAYMENTS AND FINANCIAL STABILITY

##### LENDER OF LAST RESORT

Millard and Saporta (2007) capture the dual objectives of price stability and smooth functioning of interbank payment systems in a broad definition of the pursuit of monetary stability: "ensuring that money can perform its functions of unit of account, store of value, medium of exchange and means of deferred payment in all states of the world."

A financial stability objective nests within such a broadly interpreted monetary stability objective. Financial instability, manifested, say, in contagious losses among banks or disruptions to payment systems and other components of the financial infrastructure, would directly undermine the ability of money to perform its functions. In times of stress, the provider of the ultimate settlement asset would have the capacity to increase the supply of its liabilities to ensure that payments continued to be settled. In certain circumstances, it might also expand its balance sheet so as to prevent the failure of a solvent but illiquid institution: that is, it might take on the role of lender of last resort.

Historically, the lender of last resort role was not always assumed naturally by the established settlement agent, reflecting tensions arising where a private institution had evolved to perform ultimate settlement but was then called upon to provide emergency lending to competitors. One way of resolving such conflicts was to make the central bank a public sector institution.

In seeking to minimise the frequency with which it is called upon to conduct emergency lending, and in the spirit of controlling its balance sheet and maintaining price stability, the central bank will wish to reduce systemic<sup>6</sup> threats to the

<sup>6</sup> Systemic risk can be defined in terms of the risk of losses in the wider economy which are not considered by individual system members when they make their decisions.

financial system: that is, it will seek to maintain financial stability.

Some of these threats may derive from the design and operation of payment systems themselves, particularly when the dependence on such systems is high. Jenkinson and Manning (2007) and Millard and Saporta (2007) identify two principal sources of systemic risk arising from payment and settlement activity: single point of failure risk; and risk arising from strategic interaction between payment system participants.

#### **SINGLE POINT OF FAILURE AND OPERATIONAL RISK**

The provision of payment and settlement services is characterised by high fixed costs and low marginal costs – and hence increasing returns to scale – and network externalities. The traditional definition of a network externality is that the consumption of a good by one agent indirectly benefits others already consuming the good. In this context, the greater the volume of trade settling through a particular system, the greater the opportunities for netting and liquidity recycling.

Together, these characteristics imply a tendency towards concentrated, perhaps monopoly, provision of payment and settlement services, which can lead to “single point of failure” risks. In other words, faced with a prolonged disruption (or frequent disruptions) to the operation of a single provider of payment and settlement services in a particular market, users will be unable to re-route volume readily to an alternative provider. Trades may then remain unsettled for a period, either implying direct losses (for instance where the intended recipient of funds was relying on settlement, perhaps to meet a contingent obligation) or creating unintended credit or market exposures. Alternatively, users may seek workarounds, reverting to alternative, perhaps bilateral, settlement arrangements, with attendant costs and risks.

More generally, disruption to a non-substitutable system reintroduces trading frictions, with implications for conditions in the underlying

markets supported by the stricken system. The costs might be expected to be most significant in the case of large-value systems supporting activity in financial markets. For instance, **Klee**, in an empirical paper presented at the conference, shows that operational incidents at the member level in Fedwire can affect trading conditions in the Fed Funds market.

While perhaps low for short periods of disruption in stable conditions, costs could be sizeable if a disruption were to occur during stressed circumstances when it might exacerbate nervousness in already uncertain markets. And with growing interdependencies between systems, both domestically and across borders, channels for cross-system spillover in the event of a disruption have increased. Such costs might not be fully internalised by a monopoly supplier in its investment in system resilience, which may imply a role for public intervention to impose system design and resilience standards commensurate with a system’s critical role.

#### **STRATEGIC INTERACTION BETWEEN MEMBERS OF PAYMENT AND SETTLEMENT SYSTEMS**

Another source of systemic risk is strategic interaction between members of payment and settlement systems. This may arise when agents operating within a system make strategic decisions in an environment of uncertainty. For instance, faced with concerns over the solvency of another participant, a bank may withhold payments to that participant. This may, in turn, affect the stricken bank’s capacity to settle its own obligations and disrupt the overall flow of liquidity within the system, imposing settlement delays and liquidity costs on other participants.

Unlike the “single point of failure” risk described above, this source of risk is not characteristic of the payment system itself. Rather, its source is the interconnections between the participants and their pre-existing exposures and obligations to each other. Features of system design can, however, serve to either exacerbate or mitigate such risks.

In the final academic session of the conference, **Galbiati and Soramäki** explored the strategic choices made by payment system participants in the context of an agent-based model of payment behaviour. They considered circumstances in which participants might choose to delay payments rather than hold up-front liquidity, a trade-off examined in a series of game-theoretic studies in the spirit of Angelini (1998) and Bech and Garratt (2003). More work is required to explore agents' incentives and behaviour in stressed circumstances, such as when the solvency of a payment system participant is called into question.

#### THE GROWING ROLE OF NON-BANKS IN PAYMENT SYSTEMS

Retail payment networks have traditionally been closed, with access permitted only to banking institutions. However, modern retail payment networks increasingly exhibit real-time interactions among different categories of participant parties and open access technologies (e.g., the internet), even at the earliest stages in the processing chain. The growing role of non-banks may increase efficiency, but its implications for (traditionally bank-focused) risk mitigation policies are less clear-cut. In this conference, **Weiner et al.** discussed some of these implications, drawing out underlying similarities and differences between the European Union and the United States.

#### 1.1.5 PAYMENT SYSTEMS OVERSIGHT IN A CHANGING WORLD

Today, central banks around the world still typically provide the ultimate settlement asset, at least for large-value and wholesale market payments. Recognising the 'broad' monetary stability objective described above, central banks often strengthen their control by also operating key components of the payment and settlement infrastructure, or by taking on a role in payment systems oversight. The Bank for International Settlements (BIS) defines oversight of payment and settlement systems as "a central bank function whereby the objectives of safety and efficiency are promoted by monitoring existing and planned

systems, assessing them against these objectives and, where necessary, inducing change."<sup>7</sup> Many central banks also continue to own a large-value payment system, and sometimes a securities settlement system as well.

Over time the financial infrastructural landscape has become much deeper, expanding well beyond the traditional domain of central banks. Specialist payment systems and other clearing and settlement infrastructures have emerged to serve particular markets or certain categories of payments. Where the central bank does not have a direct engagement with a component of the infrastructure (as owner, operator or provider of the settlement asset), oversight is typically the only feasible tool available to exercise control. This is sometimes carried out in cooperation with the financial regulator.

Oversight is increasingly conducted with reference to established international standards, as laid out in the Committee on Payment and Settlement Systems (CPSS) publication, Core Principles for Systemically Important Payment Systems (BIS, 2001a), and Recommendations for Securities Settlement Systems (BIS, 2001b) and Recommendations for Central Counterparties (BIS, 2004), compiled by the CPSS in collaboration with the International Organisation for Securities Commissions (IOSCO). The BIS (2005) also establishes principles for cooperative oversight, which are becoming increasingly relevant in a globalising world.

The scope, focus and conduct of oversight must, however, continue to adapt with the changing environment for infrastructure. Significant drivers for change in this regard include financial innovation, the globalisation of banking and the integration of financial markets. Panel sessions included within the conference programme were designed to draw out some of the issues associated with new developments in the market infrastructure and implications for central bank policy. Issues considered in these sessions included:

7 BIS (2005).

**System interdependencies:**

System interdependencies have recently been the subject of detailed analysis by the CPSS and are beginning to be explored by central bank researchers. **Schanz and Bech et al.**, for example, in papers presented alongside a panel session on this theme, examine interdependencies arising from internationally active banks' centralisation of liquidity management and their recourse to foreign exchange swap markets to redistribute surplus liquidity in one currency to meet a shortfall in another.

**Globalisation of the wholesale infrastructure:**

Globalisation poses significant challenges for financial infrastructure providers and the central banking community. Notwithstanding the globalisation of banking, the financial infrastructure remains largely domestically orientated. Only relatively recently have cross-border alliances been formed between infrastructure providers, by way of clearing and settlement links or outright mergers. But banks operating in multiple markets seek infrastructure solutions offering multicurrency settlement and seamless cross-border mobilisation of collateral. A potentially more prominent role for firms operating as infrastructure is another key sub-theme here, with internationally active banks in a strong position to offer multicurrency services.

**Innovation:**

Central banks around the world face the challenge of setting the appropriate scope for oversight as niche infrastructural services emerge to support new and growing markets, such as the Over-the-Counter (OTC) derivatives market. A panel of practitioners, representing the dealer and buy-side communities and key infrastructure providers in the OTC markets, were brought together to discuss a recent report on developments in this area published by the CPSS.

A final panel of central bankers and practitioners was asked to consider the financial stability issues arising from such developments, as well as potential public policy responses. Panellists

were also invited to consider infrastructure performance during the market turbulence and lessons learned. Specific aspects addressed here included the respective roles of central banks and supervisors as member-level issues loom larger and the distinction between intermediaries and infrastructure providers becomes more blurred; and steps that might be taken by infrastructure providers and central banks to facilitate banks' cross-border liquidity and collateral management in a world with stronger interdependencies and the swift transmission of shocks.

**1.1.6 CONCLUSION**

The goal of this introductory paper has been to articulate the nature and scope of central banks' roles and interests in payment systems, while putting the conference programme into the context of some of the broader literature in this area. In so doing, we have demonstrated the critical importance of payment systems in facilitating both real and financial transactions in an advanced monetary economy, and in implementing and transmitting central banks' monetary policy decisions. We have also shown that, as agents' dependence on the financial infrastructure becomes near-absolute, central banks must be particularly alert and vigilant, establishing appropriate ex ante criteria for safety and resilience, and standing ready to respond appropriately ex post in the event of a shock.



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## ANNEXES

### CONFERENCE PROGRAMME

#### JOINT EUROPEAN CENTRAL BANK - BANK OF ENGLAND CONFERENCE ON 'PAYMENTS AND MONETARY AND FINANCIAL STABILITY'

#### MONDAY 12 NOVEMBER

##### OPENING REMARKS

Gertrude Tumpel-Gugerell (Member of the Executive Board, European Central Bank)

##### THEME 1

##### PAYMENT SYSTEMS AND MONETARY STABILITY

Chair: Charles Goodhart (London School of Economics)

Steve Williamson (Washington University, St Louis): 'Transactions, Credit and Central Banking in a Model of Segmented Markets'

*Discussant: Charles Kahn (University of Illinois and Urbana-Champaign)*

Antoine Martin and Jamie McAndrews (Federal Reserve Bank of New York): 'Why are there no intraday money markets?'

*Discussant: Paolo Angelini (Banca d'Italia)*

Aleksander Berentsen (University of Basel) and Cyril Monnet (European Central Bank/Federal Reserve Bank of Philadelphia): 'Monetary Policy in Channel Systems'

*Discussant: Erlend Nier (Bank of England)*

Elizabeth Klee (Board of Governors of the Federal Reserve System) 'Operational problems and aggregate uncertainty in the federal funds market', presented by Douglas Conover (Bank for International Settlements)

*Discussant: Nuno Cassola (European Central Bank)*

##### KEYNOTE SPEECH

Nigel Jenkinson (Executive Director, Financial Stability, Bank of England)

##### THEME 2

##### INTERDEPENDENCIES BETWEEN PAYMENT SYSTEMS AND SETTLEMENT SYSTEMS

Chair: Sean O'Connor (Bank of Canada)

Jochen Schanz (Bank of England): 'Models of foreign exchange settlement and informational efficiency in liquidity risk management'

*Discussant: James Chapman (Bank of Canada)*

Morten Bech (Federal Reserve Bank of New York), Walt Beyeler (Sandia National Laboratories), Robert Glass (Sandia National Laboratories), Fabien Renault (Banque de France), and Kimmo Soramäki (European Central Bank): 'Congestion and Cascades in Coupled Payment Systems'

*Discussant: Stephen Millard (Bank of England)*

## **PANEL SESSION**

Denis Beau (Bank for International Settlements) - Chair  
Colin Church (Citigroup)  
Sophie Gautié (BNP Paribas)  
Gerard Hartsink (ABN Amro)  
Marshall Millsap (JP Morgan Chase)

## **CLOSE OF DAY I**

## **CONFERENCE DINNER**

## **TUESDAY 13 NOVEMBER**

### **HIGH LEVEL REMARKS**

#### **GLOBALISATION OF THE WHOLESALE MARKET INFRASTRUCTURE AND CENTRAL BANK POLICY**

Jean-Claude Trichet (President, European Central Bank) – Chair  
Timothy Geithner (President, Federal Reserve Bank of New York)  
John Gieve (Deputy Governor, Bank of England)  
Christian Noyer (Governor, Banque de France)

### **THEME 3**

#### **OTC DERIVATIVES CLEARING ARRANGEMENTS**

## **PANEL SESSION**

Patrick Parkinson (Board of Governors of the Federal Reserve System) - Chair  
Peter Axilrod (DTCC)  
Ann Marie Davis (Citadel)  
Simon Grensted (LCH.Clearnet)  
Robert Pickel (ISDA)

### **THEME 4**

#### **THE ROLE OF NON-BANKS IN PAYMENT SYSTEMS**

Simonetta Rosati (European Central Bank) and Stuart E. Weiner, Terri Bradford, Fumiko Hayashi, Richard J. Sullivan, Zhu Wang (all Federal Reserve Bank of Kansas City): ‘The role of non-banks in payment systems’

*Discussant: Sujit Chakravorti (Federal Reserve Bank of Chicago)*

### **THEME 5**

#### **FINANCIAL STABILITY VULNERABILITIES AND PAYMENT SYSTEMS**

Chair: Nigel Wicks (Euroclear Group)

Marco Galbiati (Bank of England) and Kimmo Soramäki (European Central Bank): ‘An agent-based model of payment systems’

*Discussant: Cornelia Holthausen (European Central Bank)*



Andrea Gerali (Banca d'Italia) and Franco Passacantando (Banca d'Italia): 'The Loss of Confidence in Bank Money in the Great Depression'

*Discussant: James Moser (CFTC)*

#### **PANEL SESSION**

Alexandre Lamfalussy - Chair

Alberto Giovannini (Unifortune Asset Management)

Andrew Gracie (Crisis Management Analytics Ltd)

Peter Praet (Nationale Bank van België/Banque Nationale de Belgique)

Daniela Russo (European Central Bank)

John Trundle (Euroclear SA/NV)

#### **CONCLUDING REMARKS**

Daniela Russo (European Central Bank)

#### **CLOSE OF CONFERENCE**

Volumes and values in key (G10) infrastructures<sup>1</sup>

G10 Large-Value Payment Systems – average daily volumes and values, 2005				
Country	System	Value (US billions)	Value as % of GDP	Volume (thousands)
Belgium	ELLIPS	86	23	7
Canada	LVTs	121	11	18
France	TBF	606	29	17
	PNS	78	4	27
Germany	RTGS PLUS	688	25	143
Italy	BI-REL	163	9	42
Japan	BOJ-NET	786	17	21
Netherlands	TOP	153	24	19
Sweden	K-RIX	59	17	6
Switzerland	SIC	132	36	1,026
UK	CHAPS £	377	17	118
US	CHIPS	1,399	11	286
	Fedwire	2,074	17	530
Euro area	TARGET	2,454	31	305
	EURO 1	213	3	186

G10 Securities Settlement Systems – average daily volumes and values, 2005				
Country	System	Value (US billions)	Value as % of GDP	Volume (thousands)
Belgium	NBB SSS	26	7	1
Canada <sup>2</sup>	CDSX	116	13	264
France	Euroclear France	829	39	132
Germany	Clearstream Banking Frankfurt	194	7	189
Italy	Express II	261	15	101
Japan	BOJ-NET JGB	588	13	13
Netherlands	Euroclear Netherlands	5	1	12
Sweden	VPC	58	16	52
Switzerland	SECOM	34	9	90
UK	CREST	648	29	275
US	Fedwire Securities	1,476	12	90
	DTC	593	5	1,052
International	Euroclear Bank	767	207	108
	Clearstream Banking Luxembourg	N/A	N/A	N/A

<sup>1</sup> Figures obtained from the Statistics on payment and settlement systems in selected countries – the Red Book, Committee for Payment and Settlement Systems, March 2007. Available at <http://www.bis.org/publ/cpss78.htm>.

<sup>2</sup> Canada value figures are based on 2003 data.

## **1.2 THE ECB-BANK OF ENGLAND CONFERENCE ON PAYMENTS AND MONETARY AND FINANCIAL STABILITY – A SUMMARY OF THE MAIN MESSAGES AND CONCLUSIONS**

By Erlend Nier<sup>8</sup> and Andreas Schönenberger<sup>9</sup>

The conference brought together presentations of original research in the field of payments economics as well as – through panel sessions and general discussion – views from the practitioner, academic, and central banking communities. A wide range of different topics and issues were discussed and analysed from different angles. The main messages and conclusions to emerge over the course of the two days relate to the following five key themes:

- Globalisation and system interdependencies
- Operational risk and its effect on systems and markets
- Innovation
- Liquidity and collateral
- Regulatory change

The remainder of this article puts these into context, summarising the insights gained and conclusions reached on each. Potentially fruitful avenues for further research and analysis are suggested.

### **1.2.1 GLOBALISATION AND SYSTEM INTERDEPENDENCIES**

A recurring theme of the conference was that of financial globalisation and its implications for payment systems and market infrastructures. In the field of payments, financial globalisation has manifested itself in a number of different ways, such as: the emergence of cross-border payment systems and offshore systems; increasing demand for multicurrency services; the establishment of cross-system links, including liquidity bridges between systems; multiple system memberships among large internationally active firms; and a trend towards international consolidation of infrastructure. Particularly as a result of the

increased demand for multicurrency solutions, there is a greater role for banks operating as infrastructures, leveraging their ability to offer global reach in custody and correspondent payment services.

Financial globalisation has, of course, had a tremendously positive effect, lowering the cost of finance and thus increasing investment possibilities and creating new opportunities for economic development. However, financial globalisation has also increased the complexity of the financial system, creating a growing number of interdependencies between systems, i.e., increasingly, settlement flows, operational processes and risk management procedures of one system, institution or market are related to those of other systems, institutions or markets. Interdependencies can arise from direct connections between systems, indirect linkages arising from the activities of common participants, and “environmental” factors, such as the dependence on common third parties or common markets. A key example of the latter is a widespread reliance on SWIFT.<sup>10</sup>

While interdependencies can improve the safety and efficiency of payment and settlement processes, they can also serve as channels by which operational or financial disruptions are transmitted more easily or more rapidly. It is crucial, then, that central banks, system operators, and market participants improve their understanding of the various interdependencies among payment and settlement systems, ensuring that effective risk controls are established to contain the potential transmission of risk. Against this background, the work of the Committee on Payment and Settlement Systems (CPSS) on interdependencies among payment and settlement systems and their implications for risk management was welcomed by conference participants.

<sup>8</sup> Research Manager, Financial Resilience Division, Bank of England.

<sup>9</sup> Principal Expert, Payments and Market Infrastructure, European Central Bank.

<sup>10</sup> Society for Worldwide Interbank Financial Telecommunication.

Global integration and consolidation, as well as technological innovation, have had an impact on interdependencies. But the nature of interdependencies has also been affected by public policy. In the last decade, the safety of clearing and settlement processes has been significantly improved. The introduction of a range of risk-reducing measures – including real-time gross settlement (RTGS) for clean payments, payment-versus-payment (PvP) in the settlement of foreign exchange, and delivery-versus-payment (DvP) for securities settlement – has successfully mitigated settlement risks arising from unintended credit exposures. But, at the same time, these important changes have contributed to the development of tighter interdependencies among the components of the global financial system.

On a cross-border basis, interdependencies are especially acute in the context of the Continuous Linked Settlement (CLS) system for foreign exchange settlement and its links with large-value payment systems in all participating currencies. These are highlighted by simulation exercises undertaken by **Bech et al.** in support of the CPSS work on system interdependencies. The main finding of this work, presented at the conference, is that when liquidity is scarce, the introduction of PvP leads to correlated settlement cascades in the underlying RTGS systems. Discussion at the conference also highlighted how interdependencies might be linked to changes in the broader financial landscape. The paper by **Schanz**, for instance, shows how banks operating across borders have strong incentives to centralise liquidity management, relying on foreign exchange transactions to transfer liquidity from one location/currency area to another. The design of settlement arrangements for such transactions has implications for the transmission of risk within and between systems.

Further investigation of such issues should be given priority within the analytical agenda, perhaps building directly on these contributions. For instance, the channels identified by Schanz could usefully be explored within a

general equilibrium framework, so as to assess the welfare effects of centralised liquidity management; and the simulation approach in Bech et al. could be developed to incorporate endogenous liquidity choices.

Much of the discussion at the conference was devoted to the implications of growing system interdependencies for global risk management and the conduct of oversight. Several conference participants emphasised that, in a globalised world with growing interdependencies, the general “field of vision” must be broader than in the past. There is therefore a need to ensure effective international cooperation in risk assessment and to further improve arrangements for cooperative oversight. Equally, information sharing and effective coordination among regulators, supervisors and overseers are deemed crucial. While such international cooperation already exists and is encouraged within existing frameworks, further efforts may be needed to this end, perhaps also via revision of relevant oversight standards and risk management procedures. A deep dialogue with market infrastructure providers and major participants is essential. And, recognising that, in the presence of interdependencies, operational disruptions and liquidity problems can be channels for spillover, regular stress-testing exercises with broad participation may be more important than ever before (as discussed below).

Financial globalisation has accelerated the process of cross-border consolidation, as evidenced by a series of mergers and alliances between service providers worldwide. The consolidation process may eventually lead to the establishment of a small number of providers with a dominant position at a global level and able to offer seamless solutions across currencies. For central banks these developments pose a number of challenges. Central banks have traditionally supported a domestic financial infrastructure, located within the local currency area. Local arrangements not only help central banks to retain ultimate control over their currencies, but also facilitate the conduct of oversight and the provision of liquidity. This is



an important area for public policy and one in which further research, perhaps involving both the central banking and academic communities, would be very useful.

### 1.2.2 OPERATIONAL RISK AND ITS EFFECT ON SYSTEMS AND MARKETS

A number of developments have highlighted the need for an enhanced focus on system resilience against operational shocks. First, in the wake of 9/11 and subsequent terrorist attacks around the world, central banks, as well as participants and infrastructure providers, have become acutely aware of the potential implications of large-scale operational disruptions. As a result, there has been a redoubled effort to ensure business continuity, e.g., through back-up sites for systemically important infrastructures. There has also been an effort to test operational resilience against market-wide shocks of a different nature, such as last year's exercise in the UK on the potential impact of avian flu. Second, a continuing trend towards cross-border consolidation might call for increased resilience against operational shocks – in particular, if this establishes a “single point of failure”. Third, as noted above, increasing interoperability and interdependencies between systems might expand the channels of contagion arising from operational disruption at particular infrastructures, even in a world with “multiple points of failure”.

Some of these themes were also drawn out in research presented at the conference. For example, **Gerali and Passacantando's** assessment of the effects on the real economy of a market-wide decrease in the acceptability and use of inside money during the Great Depression illustrates the importance of a well-functioning payment system for the economy as a whole. Their analysis can therefore enrich an assessment of the likely impact of large-scale disruption to the payments infrastructure. Similarly, the paper by **Klee** documents the effect of outages (at member level) in a large-

value payment system on market outcomes in the interbank markets.

Observed market developments, combined with these research insights, deliver some clear policy messages. As noted for system interdependencies, they support the case for broad stress-testing exercises, perhaps involving multiple systems as well as globally active participants. Some would also suggest the involvement of small and medium-sized institutions in such exercises. However, a policy of ‘raising the bar’ in terms of operational resilience for systems subject to oversight might backfire, were the lack of a level playing-field to lead to the emergence of alternative infrastructure providers subject to less intensive official scrutiny. For instance, regulatory arbitrage might encourage the provision of services by systems located off-shore; or the provision of infrastructure services by firms falling outside the existing scope of oversight. This points to the need for consistent application of standards of resilience across countries and argues in favour of a dialogue beyond the Group of Ten (G10). It also highlights the need to ensure adequate resilience for firms operating as infrastructure, for example, through enhanced supervision that ensures adequate resilience against operational shocks.

The discussion around these issues also suggested a way forward for further research on these issues. For instance, extensions to the work by Klee might consider how other participants respond to one bank's outage and what this might imply for the flow of liquidity within and between systems. And it would be useful to consider the empirical question as to whether the effect of an operational shock (either at member- or system-level) would be amplified in times of stress.

### 1.2.3 INNOVATION

The last decade has witnessed financial innovation at an astonishing pace. Trading volumes across a number of derivatives products are growing rapidly and this growth is set to

continue. For example, none of the major Over-the-Counter (OTC) derivatives markets – including plain vanilla currency and interest rate swaps – is currently growing at a rate of less than 10% per annum. Growth in newer and more complex products (e.g., multi-name credit default swaps (CDS)) is approaching 200%. This pace of growth is likely to pose continuing challenges for back office resources and emerging post-trade infrastructure in these markets.

At the same time, there is an increased push for processing speed and low-cost execution in established asset markets. The latter is partly due to the rise in dynamic hedging strategies – used to arbitrage across derivatives and primary asset markets – but might also reflect a more general rise in automated and algorithmic trading. These demands have led to the arrival of electronic trading platforms which offer solutions that leapfrog to the technological frontier and fiercely compete with incumbent providers.

The OTC derivatives market is a good example of effective cooperation between the public and the private sector in tackling risks arising from inadequate post-trade infrastructure in a rapidly growing market. In 2005, the Federal Reserve Bank of New York launched an initiative to reduce backlogs in unconfirmed trades, initially in the CDS market, which has since led to a marked reduction in such backlogs. However, there has been some uncomfortable slippage during the recent period of market turmoil.

Further developments in this rapidly evolving area include: a move towards straight-through-processing for some derivatives products, e.g. as offered by SwapClear; improved documentation of trades and data integrity, e.g., through the Depository Trust and Clearing Corporation (DTCC) Trade Information Warehouse; and advances in close-out arrangements, as sponsored by the International Swaps Dealers Association (ISDA). However, the challenges in this area also remain formidable, due to both the complexity and the long life-cycle of existing OTC products, as well as the incentives on the part of front-office traders to create new

products and trading strategies to meet ever more sophisticated market demands.

Against this backdrop, the official sector needs to keep pace with new developments, by continuing to invest resources in better understanding the changing nature of financial markets and the evolution of the supporting infrastructure. Indeed, this is essential if the public authorities are to be able to identify emerging systemic threats and take appropriate action in response. Policy work in this area might usefully be supported by further research to better understand the economic forces driving the evolution of the landscape.

#### 1.2.4 LIQUIDITY AND COLLATERAL

There was agreement among panellists, and conference participants more broadly, that the financial market infrastructure had held up well in the face of the peak volumes witnessed during the recent period of turmoil in financial markets. This reflects, *inter alia*, the great strides taken in recent years to ensure the robustness of major infrastructures and their resilience to a range of shocks.

However, recent market turbulence has also highlighted the increased importance in times of stress of access to central bank liquidity (both for individual banks and for the system as a whole), raising questions around both policy on eligible collateral to support liquidity extensions and the mechanisms for delivery of such collateral. In particular, panellists drew out some of the potential issues arising from diversity in central banks' eligible collateral lists and stressed the need for further progress on the legal and infrastructural arrangements to facilitate cross-border use of collateral, such as is already in train at the CPSS.

Research presented at the conference also investigated the relationship between the provision of central bank liquidity intraday (to help the smooth functioning of large-value payment systems) and the provision of reserves overnight (traditionally seen in the context of the implementation of monetary policy). Papers by

**Williamson and Martin and McAndrews** argued that the two were in fact closely linked. A recent practical example of this is a new framework for monetary policy operations introduced by the Reserve Bank of New Zealand, which relies on the remuneration of (unlimited quantities of) overnight reserves at the policy rate. Sufficient overnight reserves are supplied under this regime to render redundant any additional provision of intraday liquidity. However, can an interbank market for reserves then continue to function well? If not, the usefulness of such a market, in either normal or stressed conditions, is called into question. The paper by **Berentsen and Monnet** offered a theoretical framework within which some of these issues, as they relate to ‘channel’ systems, might be considered. In this framework, rates paid in (secured) interbank markets will tend to be above the policy rate targeted by central banks, to the extent that collateral is costly.

Research by **Galbiati and Soramäki** explores further the interplay between the functioning of the payment system intraday and banks’ incentives to hold liquidity (collateral or reserves) overnight. Banks may have an incentive to economise on their provision of liquidity (collateral) to the payment system when collateral is costly and when this creates a positive externality for other system participants – who may come to rely on incoming liquidity to make their own outgoing payments.

But this trade-off gains force only when generating liquidity is costly. If there is a low opportunity cost to holding liquidity overnight or posting collateral intraday, a high level of recycling can be encouraged. For instance, during the recent period of turmoil in money markets, banks’ incentives were to hoard (overnight) liquidity. This will likely have helped to promote liquidity recycling in the major RTGS payment systems, perhaps further contributing to the resilience of major infrastructures during the recent stressed period. As data spanning the recent turbulence is gathered by central banks, these issues might usefully be further explored through empirical research. Similarly, issues around the boundary of intraday and overnight liquidity and mechanisms for providing each could be analysed further.

## 1.2.5 REGULATORY CHANGE

Payment, clearing and settlement services have traditionally been offered by banks and dedicated infrastructure providers, with banks acting as settlement agents for their customers. The paper presented by **Rosati and Weiner** in the conference highlighted that, across countries, non-banks are becoming increasingly important in the provision of retail payment services. However, also in the field of securities trading, clearing and settlement, the boundary between banks and infrastructures is changing, partly in response to a number of regulatory reforms. In the European Union, the Markets in Financial Instruments Directive (MiFID) dismantled existing obstacles to competition between trading venues, giving investors a choice between alternative trading functionalities, such as regulated markets, Multilateral Trading Facilities and internalising intermediaries.

The changing partition of roles between banks and non-banks is occurring against the backdrop of heightened innovation and competition; this may have implications for the risk profile of the services being offered. From a public policy perspective, the changing role of banks and non-banks implies a need to study possible trade-offs between efficiency and risk, to better understand the risk profiles of innovative solutions.

The conference also highlighted the significant impact that the Code of Conduct<sup>11</sup> for clearing and settlement and the removal of the existing Giovannini barriers<sup>12</sup> are likely to have in the field of post-trading in the European Union. As opposed to a Directive, the Code of Conduct is an industry-led approach aimed at fostering competition and integration in the field of securities clearing and settlement. Provided that the Code of Conduct is successfully implemented, there will be full freedom of choice at all levels along the value chain.

11 Available at [http://ec.europa.eu/internal\\_market/financial-markets/docs/code/code\\_eu.pdf](http://ec.europa.eu/internal_market/financial-markets/docs/code/code_eu.pdf).

12 Giovannini Group (2001).

Some conference participants expressed a sense of growing “regulatory fatigue”, especially in Europe after the wave of new regulatory measures in the context of the Commission’s Financial Services Action Plan. Similarly, some participants raised the question of how investment into new solutions and risk management capabilities could be sustained in the wake of a likely cyclical downturn in earnings. However, most were in agreement that new regulations could be a necessary response to a changing environment, but cautioned that public authorities needed to be careful that regulation did not impede the market finding its own solutions. In fact, the Code of Conduct may be a good example of a self-regulatory solution that gives headroom for the industry to develop.

The conference also highlighted the benefit of common regulatory standards and codes, such as the “The Core Principles for Systemically Important Payment Systems”, issued by the CPSS and the “Recommendations for Securities Settlement Systems” and “Central Counterparties” compiled by the CPSS in collaboration with the International Organisation for Securities Commissions (IOSCO).<sup>13</sup> Common regulatory standards serve three main purposes. First, they help authorities conduct comprehensive and systematic assessments of the safety and soundness of payment, clearing and settlement systems. Second, risk assessments produced at a national level can be compared across countries in a meaningful way. Third, common rules may help to avoid regulatory arbitrage.

Some participants took the view that the continued absence of a harmonised regulatory framework for securities clearing and settlement in the European Union was undesirable and underlined the need to finalise the ESCB-CESR (Committee of European Securities Regulators) standards for clearing and settlement (i.e., a EU/EEA version of the CPSS-IOSCO Recommendations) as soon as possible. The discussion here had raised the question as to whether the approach to regulation should be based on functions or institutions. Particularly

given increasing competition and greater prominence of firms operating as infrastructure, there was broad agreement on the need to maintain a regulatory level playing-field, via application of a risk-based functional approach. However, it was stressed that a functional approach should not be applied naïvely and should not stifle competition: in the end, the idea is not so much that an identical set of standards be applied to any entity carrying out a given function, but that equivalent standards be applied within the relevant regulatory framework. It was argued that establishing and enforcing an effective risk-based functional approach should be a high priority within the regulatory agenda, with a view to maintaining both financial stability and a level regulatory playing-field.

Furthermore, there was support for an active dialogue between central banks and regulators, including cooperation between the CPSS and the Basel Committee on Banking Supervision in relevant fields. For example, the effectiveness of system-level risk management measures increasingly depends on robust management of liquidity and collateral by system participants. Given these factors, institutions’ effective management of intraday liquidity risk is critical to preventing liquidity disruptions from spreading across multiple payment and settlement systems. These interests are common to both bank supervisors and payment system overseers, though in any cooperative work it will be important to be sensitive to and address differences in approach between overseers and supervisors.

## 1.2.6 CONCLUSION

The conference was characterised by a very open and constructive dialogue between the constituent international communities (system providers, commercial banks, central banks and academics) in the provision of payments and infrastructure services. Indeed, as one of the panellists remarked, such an event could not

<sup>13</sup> BIS (2001a); BIS (2001b); BIS (2004).



have been imagined ten years ago, at a time when dialogue had been largely confined to domestic and bilateral discussion between overseers and their respective domestic systems. Moreover, huge advances had since been made by both the central banking and academic communities in producing research into payments and infrastructure issues. The conference showed how this body of research could greatly enrich the discussion and illuminate the trade-offs involved in this important area.

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### 1.3 HIGH-LEVEL REMARKS: GLOBALISATION OF THE WHOLESALE MARKET INFRASTRUCTURE AND CENTRAL BANK POLICY

*Jean-Claude Trichet (Chair – President, European Central Bank); Timothy Geithner (President, Federal Reserve Bank of New York); John Gieve (Deputy Governor, Financial Stability, Bank of England); Christian Noyer (Governor, Banque de France)*

The discussion provided some insights on key structural developments in the wholesale infrastructure landscape and their potential implications, both for financial stability and for central bank policy and operations. Globalisation, innovation and regulation were identified as key drivers of change and, given the rapid pace of change, and uncertainty about the potential endgame, this was an historic time for payment and settlement systems.

In this regard, it was deemed vital that central banks keep up with the pace of change by establishing an appropriate framework for oversight, ensuring the existence of effective crisis management measures and, themselves, providing safe and efficient operational services. Remarking on the current market turbulence, there was broad consensus that, while infrastructures had performed well during a difficult period, central banks would need to reflect and investigate how they might further refine and coordinate their procedures and their terms for liquidity provision, particularly in the case of emergency situations.

#### KEY STRUCTURAL DEVELOPMENTS IN THE WHOLESALE PAYMENTS LANDSCAPE

Globalisation, technology and regulation have prompted sweeping changes in the wholesale infrastructure landscape. These are not necessarily *new* developments, but they are having profound effects, which can be expected to persist for the foreseeable future. Globalisation, in particular, is reinforcing the natural tendency towards concentrated provision

of infrastructural services. But, at the same time, other forces, such as regulatory change, especially in Europe, and both technological and financial innovation, are pushing in the opposite direction: lowering barriers to entry, building bridges between systems, and hence allowing a certain level of fragmentation in the infrastructure to persist.

At the extreme, there are two corner solutions: either a *utopian one* with a single integrated infrastructure covering the whole world; or an *autarkic one*, with nationally-based fragmented infrastructures that are, by and large, interoperable and are in competition with firms providing infrastructure services.

The panel agreed that the emergence of one of the two corner solutions might be neither probable nor desirable. The future may, in fact, turn out to be quite similar to the present, namely somewhere between these two extremes. While national monopolies are challenged at the moment and scale-effects have gained significance, complete concentration, and the creation of one global infrastructure, seems quite unlikely. At the very least, such an outcome might be limited to very specific services and providers, such as SWIFT<sup>14</sup> currently in global messaging. To the extent that a global system would not deliver the right balance between safety and efficiency, a balance might need to be struck between promoting the integration of national infrastructures and preserving – at least to some degree – national idiosyncrasies. In this respect, facilitating greater interoperability among infrastructures, and managing any associated risks, is likely to become more important.

It was also noted that the traditional boundaries between payment and securities settlement systems, on the one hand, and banking services such as correspondent banking and custody services, on the other hand, were becoming increasingly blurred. As the global economy has become more integrated and international

14 Society for Worldwide Interbank Financial Telecommunication.

financial flows have increased, the operations of many banks have expanded across borders. As a consequence, there has been an increase in the demand for multicurrency settlement services, met by a combination of traditional infrastructures – such as TARGET<sup>15</sup>, Continuous Linked Settlement (CLS) or the International Central Securities Depositories (ICSDs) – and correspondent and custodian banks. The very forces driving concentration in traditional infrastructures have been evident in the provision of correspondent banking and custody services: notably in Europe, where payment flows passing through the leading correspondent banks are comparable to those observed in some national payment systems. Recent regulatory developments, such as the implementation of the Market in Financial Instruments Directive (MiFID), are likely to reinforce this trend.

#### POTENTIAL IMPLICATIONS FOR FINANCIAL STABILITY

These general trends are likely to have implications for financial stability. First, the panel touched on the effects of concentration. Concentration can bring benefits, notably economies of scale (for example in fixed IT costs) and network effects in netting or liquidity recycling. At the same time, increased concentration creates “single point of failure risks”. Growing interdependencies among systems and the significant increase in speed and volumes create additional vulnerabilities, in particular in the face of potential terrorist threats. Therefore, operational resilience has assumed greater prominence. Stringent measures and regular trials are needed to ensure full resilience of infrastructures.

The second set of issues relates to the geographical and jurisdictional separation between the entity in charge of the oversight and supervision of the system and the entity providing liquidity to the system. Although this separation is unavoidable in the case of multicurrency systems, it may be more difficult to accommodate when the major system for a

central bank’s issued currency lies offshore. In such a scenario, a central bank’s ability to fulfil its responsibilities in the field of oversight and crisis management may be impaired. For instance:

- Concerning oversight, offshore systems would generally entail an unavoidable split between the central bank with the primary oversight responsibility of the system – usually the host central bank – and those central banks responsible for issuing the currencies served by the offshore system. To ensure that the strong interest of issuing central banks in the smooth functioning of the system is recognised, an effective cooperative oversight framework is essential.
- With regard to crisis management, offshore systems may pose greater challenges for the handling of crises by the central bank of issue. In such cases, the central bank would face greater difficulty in obtaining timely and relevant information, and in activating effective communication channels. This could impede the efficiency of decision-making, particularly around the provision of emergency liquidity. Such separation could also raise moral hazard issues – i.e., concerns regarding undue reliance on central bank lending by the system’s users – undermining the central bank’s control over reserve balances and, hence, over monetary policy and both monetary and financial stability.

Such concerns provide the background for the “Policy principles on the location and operation of infrastructures settling euro-denominated payment transactions”, in which the Eurosystem further clarified its stance on these issues in July 2007. The principles state that the Eurosystem would permit payment infrastructures for euro transactions to be located outside the euro area only in exceptional circumstances and subject to a set of clearly specified conditions.

<sup>15</sup> Trans-European Automated Real-time Gross settlement Express Transfer system.



A third and closely related set of issues concerns the “race to the bottom”, namely the possibility for the global infrastructure to be established in the least regulated jurisdiction. The panel agreed that differences in regulation should not set incentives for infrastructure to capitalise on regulatory arbitrage: in general, it was deemed important to take into account the incentives embedded in regulation, ensuring that they did not have unintended consequences. Indeed, the extensive use of off-balance sheet transactions at the heart of recent market turbulence might be seen as a consequence of the provisions of the original Basel Accord.<sup>16</sup>

The panel also considered the current workplan of the Committee on Payment and Settlement Systems (CPSS), agreeing that the current priorities did indeed address the key issues in the field of payment and settlement systems. Five workstreams were briefly outlined:

- *Foreign exchange settlement risk*: In the recently-conducted survey, it was revealed that a third of foreign exchange transactions are (still) settled via correspondent banking. A dialogue has begun between overseers and supervisors on this issue.
- *Evolution of infrastructures for the OTC market*: The move to an automated and standardised framework is of key importance. Some work within the field of credit derivatives has started, but a lot remains to be done. Central counterparties (CCPs) could gain greater prominence in this area.
- *Operational resilience and inter-dependencies*: It may be necessary to raise the existing set of common standards in these areas to reflect changes in the landscape. In support of the CPSS focus on operational risk, a conference participant questioned whether infrastructure providers had sufficient incentives to introduce innovations and ensure resilience. The panel concurred that overseers played a key role in ensuring that sufficient investment was channelled into both resilience and innovation.
- *Cooperative oversight framework*: This has so far been applied successfully and in a pragmatic manner. Valuable experience has been gained from the oversight arrangements for SWIFT and CLS, but the model is sure to develop, expand and evolve over time. The general framework of the Eurosystem for offshore systems seems to largely follow such a pragmatic approach, but needs to be tested.
- *Adequacy of liquidity provision arrangements*: In view of the ongoing difficulties in financial markets, it is important to identify flexible solutions that will allow counterparties to mobilise liquidity and collateral rapidly, ensuring that they can meet obligations in a timely manner in the relevant currency. The diversity in central banks’ eligible collateral lists, and other policies and processes around liquidity provision, can create uncertainties and moral hazard among market participants. Care needs to be taken to avoid regulatory arbitrage. There is a case for some sound reflection on the lessons learned from recent events, with issues arising around both around “policy” and “plumbing”. Importantly, with respect to the broader lessons learned from recent events, panellists stressed that regulators, supervisors and governments should not respond with a quick fix, but rather rely, as far as possible, on the market to develop its own solutions.<sup>17</sup>

## POTENTIAL IMPLICATIONS FOR CENTRAL BANK POLICY AND OPERATIONS

Panellists fully agreed on the need to have an effective cooperative framework among

<sup>16</sup> These incentive effects have been addressed in Basel II. Relatedly, members of the audience revealed that there was a certain “regulatory fatigue” within the industry. While this was appreciated by members of the panel, any unintended consequences of new regulations, such as Basel II or MiFID, that might become apparent only during implementation, should certainly be addressed.

<sup>17</sup> On a related point, most panellists concurred that the European Union would benefit from further harmonisation of existing financial regulation and greater convergence in supervisory practices. However, a departure from the current decentralised supervisory structure was not advocated.

overseers and regular exchanges between overseers and supervisors. There were differing views as to the optimal institutional set-up of such exchanges, but it was generally accepted that a functional approach to regulation and oversight would be desirable. More generally, central banks were seen to face three main challenges:

- First, the speed of international cooperation needs to be aligned more closely with the pace of economic and political change. While it is clear that reaching a consensus takes time, international negotiations tend to be too drawn out: the process towards implementation of Basel II, a prominent example of international cooperation, has simply taken too long.
- Second, given the formidable pace of change and increased complexity in financial markets, central banks face a tougher challenge in ensuring that they remain in step with the market. It is critical that the knowledge gap between central banks and markets does not widen too much, and in particular that central bankers understand not only the economics, but also the commercial drivers of financial market developments. More regular dialogue with the market will help here; indeed, the CPSS has recently established a forum for such dialogue at the global level.
- Finally, the locus of international cooperation in the field of payments has historically been within the G10: ties need to be strengthened with countries and regions outside of this group. In particular, China, India, the Gulf countries and Latin America should be integrated more closely into international discussions.

On the operational side, it was noted that recent market developments had again underlined the value of central bank money as the safest settlement asset. Market participants lacking ready access to refinancing in central bank money had apparently faced difficulties in times

of stress, as they were dependent on commercial banks for provision of liquidity. This provides central banks with a clear incentive to refine the tools and operational processes available to banks to better manage their collateral and gain access to central bank money. Against this background, it was noted that the Eurosystem was developing new systems, such as TARGET2 and, prospectively, TARGET2-Securities, which would promote the more efficient use of central bank money.



## 2 KEYNOTE SPEECHES

### 2.1 PAYMENTS AND MONETARY AND FINANCIAL STABILITY<sup>1</sup>

Opening remarks by Ms Gertrude Tumpel-Gugerell, Member of the Executive Board, European Central Bank.

Ladies and gentlemen,

It is a pleasure to welcome you to this conference and I am grateful that I can do so also in the name of the Bank of England. The idea of the joint conference was born at one of our regular bilateral meetings and it is wonderful to see the idea come to fruition.

You may wonder why we have put payments first, and monetary and financial stability second. This is not only because payments are at the root of a functioning (or not functioning) financial system; payments also require a thorough understanding of the economics of banking, money, financial markets, industrial organisation, and regulation. The diversity of theoretical and policy issues in this field is also reflected in the conference that I have the pleasure of opening this morning.

#### HISTORICAL OVERVIEW

Considering the historical evolution of interbank settlement arrangements and central banking functions may help to understand why central banks evolved as the natural candidates for taking the responsibility for financial and monetary stability.<sup>2</sup> Indeed, I would argue that the reason lies in the key role central banks played in payment systems. In a world with many banks, it is inefficient for every agent in the economy to have an account with each and every bank. One solution is for each bank in the economy to have an account with all the other banks and to net obligations bilaterally with them. In a world with many banks, this will tend to result in an inefficiently large number of interbank accounts. A more efficient solution is for a hierarchy of banks to develop, with banks at the bottom of the hierarchy having accounts with correspondent banks in its upper tier, which in turn have accounts with banks at the apex of the hierarchy. These banks at the top of the hierarchy

were naturally and literally “central” banks. Indeed, there is plenty of historical evidence that hierarchical structures evolved naturally in a free-banking environment without the need for the state to superimpose and/or guarantee a “settlement institution” at the apex of the hierarchy. One example is in fact the Bank of England.

The status of a central bank at the top of the hierarchy derived also from the fact that it was perceived to be “safe” – that is, an institution with a large capital base, holding high-quality assets. Such a central bank would also need to be concerned about its own soundness. This led the central bank to be careful about to whom it should provide settlement accounts and to monitor these banks. In addition, it also had to weigh carefully the advantages of providing lender-of-last-resort assistance to the banking system to avoid a drop in its revenue stream against the risk of lending to an insolvent institution and making a loss that could decrease its capital base and threaten its reputation as the supplier of the ultimate settlement asset. Similarly, central banks had a natural interest in ensuring the ability of the banking sector as a whole to meet the public’s demand for liquidity. The reason for this is that if it allowed a solvent commercial bank to fail as a result of a bank run, it would only aggravate the situation and this could ultimately result in a more general run on the banking system and ultimately on itself. As a result, financial stability became a concern for central banks. Moreover, for the central bank as the provider of the ultimate settlement asset, it was also important to maintain monetary stability. In particular, if the central bank printed more and more of its banknotes without a corresponding increase in the demand for them, the notes would fall in value relative to those of other banks. Eventually, central bank money would no longer be seen as “safe” and this would undermine the confidence in and acceptability of the settlement asset.

1 This speech may also be found on the ECB’s website at <http://www.ecb.europa.eu/press/key/date/2007/html/sp071112.en.html>.

2 See Millard and Saporta (2007). See also Norman, Shaw and Speight (2006).

This brief historical overview demonstrates that the development of the core functions of central banks – monetary and financial stability – has been closely linked to their role in the provision of the ultimate settlement asset in the payment system. It is therefore important for central banks to have a thorough understanding of how these links work. Let me share some thoughts with you in this regard.

#### **PAYMENT SYSTEMS, MONETARY POLICY AND CENTRAL BANK ACTIONS IN THE RECENT FINANCIAL MARKET DEVELOPMENTS**

Central banks provide liquidity for different purposes.<sup>3</sup> To achieve their primary objective of price stability, monetary authorities supply base money to the economy. By matching the demand for base money with the supply that they control, central banks steer short-term interbank interest rates, which, via the transmission mechanism of monetary policy, have an impact on the price level.

Another objective of central banks is to ensure the smooth functioning of the payment system. Central banks provide intraday liquidity to bridge the timing mismatch between banks' incoming and outgoing payments during the day. This not only facilitates intraday liquidity management of banks, but also makes payment gridlocks less likely and therefore contributes to financial stability.

Payment systems clearly matter for monetary policy. Monetary policy implementation today means steering short-term interest rates. If you are the treasurer of a bank and plan for the end-of-day settlement of your accounts, uncertainty about whether expected incoming payments will actually be received is obviously a major issue. It does not make an immediate difference if expected incoming payments are at risk for payment system reasons, or because the payments may not have been initiated. In both cases, the treasurer will need to look for alternative funding, and if there are no internal buffers, will turn to the interbank market for overnight funds. There, the treasurer will be ready to pay a premium and will

thus bid up rates. If uncertainty about incoming payments generally increases and affects all banks, be it for payment system or other reasons, banks will all tend to enter the interbank market on the buy side and will bid up the overnight rate accordingly. This is a monetary policy issue and will imply the need for the central bank to inject excess reserves into the system to bring interest rates down again. While payment system disruption may hence potentially have an impact on monetary policy, central banks have found ways of safeguarding price stability, while at the same time ensuring the smooth functioning of the payment system. This is achieved by drawing a clear line between providing intraday liquidity for payment system purposes and providing credit for monetary policy implementation.

Let me therefore turn briefly to these two types of liquidity provision by central banks. Central banks need to define the conditions under which they provide these two types of liquidity. In particular, they need to decide on the fee/interest they wish to charge and on the level and type of collateral they consider appropriate. Allow me to discuss briefly both features.

Central banks typically provide intraday liquidity on more generous terms than overnight credit. Why? To answer this question, consider the following alternatives: imagine that central banks would only ask for interest when credit spans a weekend, then we would have intra-week credit. Or, more extremely, imagine that interest would be charged only for credit spanning the year-end. Or why don't central banks require banks to settle every hour, such that every end of hour would be what today is an end of day, with credit bridging every end of hour being charged at the monetary policy interest rate.

I think that the reason why central banks choose a full day as the demarcation line reflects in particular three considerations.

First, economic projects have rarely, if ever, a lifetime of less than a day, so there is no need to

3 For further details see Kahn and Roberds (2007).

impose positive interest rates at the appropriate policy level intraday from a transmission mechanism perspective. However, there may be projects with a lifetime of days or certainly months and weeks, such that lowering the frequency of settlement points to, say, annually would clearly create an artificial and harmful annual economic cycle and affect price stability.

Second, increasing the frequency of points in time when banks need to settle, say to hourly, would increase liquidity management costs of banks considerably. Because this is not needed from a monetary policy perspective, this would mean a waste of economic resources.

Finally, central banks probably want to control the ability of banks over time to settle their accounts, and also banks are probably more comfortable to see that other banks settle their accounts with the central bank on a regular basis, as proof of their soundness.

To sum up, the daily cut-off separating free central bank credit and credit against a monetary policy-related interest rate is a reasonable convention, reflecting monetary policy transmission mechanism issues, convenience of banks' liquidity management, and credit risk management considerations. It allows central banks to safeguard price stability, while at the same time ensuring the smooth functioning of the payment system.

Turning to collateralisation, it is important to note that in the past, central banks often set ceilings for intraday and overnight credit to banks. In contrast, today, many central banks, including the Eurosystem, tend to provide *unlimited* access to both types of credit, *but with the need to provide eligible collateral*. This reflects first that unlimited liquidity facilities provide banks with a buffer against liquidity shocks and thereby contribute to financial stability. Second, it however also reflects the need for sound credit risk management by the central bank, which argues against unsecured lending, in particular at overnight and longer maturities.

This framework – of unlimited access to intraday and overnight central bank credit against eligible collateral – implies that collateral availability becomes the ultimate liquidity issue for banks. As long as banks have sufficient eligible collateral for overnight or intraday credit, they have a buffer against liquidity shocks. Once a liquidity shock exceeds the eligible collateral, a major liquidity issue arises, and the bank may fail to fulfil its payment obligations, with all the serious consequences that this has for the bank itself and, via knock-on effects, potentially for the entire financial system.

This is what makes collateral availability so important today as a contribution by central banks to financial stability – again, both intraday, i.e., for payment purposes, and for overnight credit.

Let me now turn briefly to the recent financial market developments, which involved, as you know, partially a shortage of credit, but eventually also a significant drying-up of liquidity. It was not a failure of the payment system, as all payment systems worked smoothly. Nevertheless, let me say a few words here.

The recent developments were triggered by a perception of higher credit risk originating from a perceived deterioration of the credit quality of assets held both by banks and by special investment vehicles, with which banks were associated either through liquidity commitments or reputation issues. The situation deteriorated when liquidity buffers of banks were put under stress by the need to meet their liquidity commitments and to take on their balance sheet assets which had become illiquid. Then, banks also became unwilling to provide unsecured lending to other banks, in particular at longer maturities, because of uncertainty whether they would themselves obtain liquidity if needed. Once this stage was reached, the deterioration of liquidity conditions became self-reinforcing, and turned out to be painfully durable, as can be seen for instance from the still exceptional



three-month EURIBOR spread relative to three-month repo rates.

What could central banks do about this? First, they provided extra liquidity through open market operations. This not only contributed to bringing down short-term interbank rates to target levels again, fulfilling monetary policy implementation purposes, but may also have contributed to supporting the willingness of banks to lend.

Second, accepting that availability of central bank eligible collateral is the ultimate line of defence against illiquidity for banks, many central banks widened the set of eligible collateral. For instance, the central banks of Canada and Australia took such actions, and also the US Fed clarified that it would accept certain instruments in its discount window.

The Eurosystem was not forced to take such measures, since its collateral framework already foresees the acceptance of a very wide set of collateral. The Eurosystem framework specifies that this very wide range of collateral is accepted for all types of Eurosystem credit operations: intraday operations and monetary policy-related operations, the latter including both access to standing facilities and open market operations. The wide and unified set of collateral supports both the smoothness and systemic stability of intraday and overnight liquidity management of banks.

## **PAYMENT SYSTEMS AND FINANCIAL STABILITY**

The global financial system has been going through a phase of major structural change, which may have several implications for payment systems and financial stability.<sup>4</sup>

First, we have witnessed the creation of new financial instruments and products to address market and credit risk, and in principle to enhance liquidity of financial assets. At the same time, the size of the financial sector in relation to the real economy has significantly grown.

This suggests that the stability of the financial system has become more important for the real economy. Moreover, there has been a growing symbiosis between markets and intermediaries. While intermediaries and markets have often been seen as alternative forms of arranging financial relationships, they are increasingly complementary. Indeed, intermediaries such as banks have become increasingly reliant on markets as a source of income and for their risk management, through their hedging operations. Markets in turn have become increasingly dependent on intermediaries for the provision of market-making services and of funding liquidity. This structural change may have some implications for payment systems and market infrastructures, especially in periods of financial distress. One important implication is that more than ever before, the smooth functioning of the financial system is dependent on the assumption that the option to trade can be exercised even under stressed market conditions. This is a natural consequence of the development of markets and instruments which are actively traded or that are held in the expectation that, should the need arise, they could be traded. Moreover, the new financial environment appears to be more reliant on the immediate availability of funding liquidity. Funding liquidity is critical for the orderly execution of trades and it can become scarce at times of distress, precisely when it is most needed, as market participants cut credit lines and/or raise margin requirements to protect themselves against counterparty risks. In conclusion, the stability of the financial system is also dependent on the assumption of ample market liquidity and, most critically, of the smooth functioning of the payment systems and market infrastructures.

Second, the complexity of the financial system has greatly increased. This complexity applies not only to individual financial instruments, but also to the financial system as a whole. Its various segments have become more closely interconnected and the linkages across them more opaque. A new configuration of players in the financial system has led to a blurring of distinctions between different types of

4 For further details see Borio (2007).

intermediaries, to greater consolidation, and to a rapid growth of new financial players and services. Payment, clearing and settlement systems naturally evolve in response to such financial market developments. As the number of new financial products is growing and existing markets are rapidly expanding, the infrastructure needs to be in the position to handle such developments. A good example is the evolution of clearing and settlement arrangements for OTC derivatives. It took a while for the infrastructure to adjust to the tremendous growth in OTC derivatives. Eventually, with support from central banks, the most pressing shortcomings began being addressed. Today, there is a far higher degree of automation, new technical processes have been introduced, and innovative services are available. The infrastructure for the OTC derivatives markets will undoubtedly continue to evolve. Whatever path the evolution takes, as the market infrastructure moves further in the direction of centralised processing of trades and post-trade events, several issues will assume greater importance. First, providers of essential post-trade services for OTC derivatives should provide open access to their services and should aim to achieve convenient and efficient connectivity with other systems. Moreover, central banks and supervisors will need to consider whether certain existing standards for securities settlement systems, central counterparties or systemically important payment systems should be applied to providers of clearing and settlement services for OTC derivatives.

Including new players in stress-testing the system is challenging and requires cooperation and timely transparency. Many of these new players are non-banks. It is therefore important to look at the role of non-banks in payment and settlement systems. Payment, clearing and settlement services have traditionally been offered by banks and non-banks alike. The co-existence of banks and non-banks raises some important regulatory questions. In fact, while there is a trend towards common regulatory standards, banks would typically argue that they are subject to prudential supervision and that there is no need for further regulation. In

contrast, non-banks would argue that common regulatory standards should apply to all relevant service providers in order to ensure a competitive level playing-field. In the end, the question is whether the approach to regulation should be based on functions or institutions.

Finally, the globalisation of finance has resulted in the expansion of cross-border financial linkages. An implication of globalisation is that financial distress is more likely to have far-reaching cross-border effects. This is a natural consequence of the tighter cross-border linkages that have formed. Such effects are almost guaranteed if distress were to involve one of the global players that operate across so many countries and underpin the smooth performance of so many markets. In fact, over 30 years ago, even the failure of a small bank active in FX transactions was sufficient to have significant cross-border ramifications – so significant as to act as a catalyst for the establishment of the Basel Committee on Banking Supervision. The knock-on effects of distress at one of the current large global players would presumably be much bigger.

## CONCLUSION

Let me briefly conclude, ladies and gentlemen. Central banking and payment systems are inextricably linked. Central banks all around the world are involved in payment systems and market infrastructures in many different ways owing to their roles and responsibilities in relation to monetary policy and financial stability. Indeed, payment systems disruptions would not only affect financial stability, but may potentially also have an impact on monetary policy implementation. Central banks have found ways of safeguarding price stability, while at the same time ensuring the smooth functioning of the payment system, by drawing a clear line between providing intraday liquidity for payment system purposes and providing credit for monetary policy implementation. Moreover, the sufficient availability of collateral is important today as a contribution of central banks to financial stability.

The roles of central banks in the field of payment systems are changing in a number of ways as a result of progressing globalisation, increasing complexity, and the emergence of new players and services:

- The approach of central banks to analysing financial stability is changing. A comprehensive view of the key sources of risk and vulnerabilities facing the payment systems and market infrastructures cannot be formed without taking due account of developments at the global level, such as the emergence of cross-border payment systems and offshore centres. Issues and questions relating to the location of payment systems and market infrastructures are also gaining in importance for central banks.
- Central banks have started interacting and cooperating with new interlocutors and partners outside the banking area. Many new players and providers in the field of payment, clearing and settlement services are indeed non-banks with which central banks traditionally had little – if any – direct interaction.
- Central banks are increasingly concerned with the division of responsibilities and the allocation of risks between infrastructure providers and their clients. The responsibility for the safety of a payment, clearing or settlement system rests largely with the system operator. However, to the extent that participants in the system can take action to reduce risks that may have a bearing on the system as a whole, they should be given incentives to do so. For example, the margining systems of central counterparties should give incentives to participants to trade prudently.
- Central banks are increasingly involved in cross-border cooperation and information exchange with other central banks and authorities contributing to financial stability in order to obtain a comprehensive picture of risks and vulnerabilities and to identify

appropriate and effective mitigating policy actions.

- Central banks have been intensifying their efforts to produce consistent regulatory and oversight standards on a cross-border basis. The Core Principles for Systemically Important Payment Systems and the CPSS-IOSCO Recommendations for Securities Settlement Systems and Central Counterparties have been important steps in this direction. Against this background, some further work needs to be done on the harmonisation of the oversight framework for securities clearing and settlement in the European Union. The continuous absence of such a harmonised oversight framework generates a number of undesirable effects. However, after the recent ECOFIN decision, I am very optimistic that we will soon see the finalisation and adoption of the ESCB-CESR recommendations for securities clearing and settlement.
- The relevance of collateral for liquidity issues has been clearly recognised by central banks. During the past ten years, central banks have – especially in the context of the Committee on Payment and Settlement Systems and other Basel committees – focused jointly their attention on the use of collateral in financial transactions, including the cross-border use of collateral.<sup>5</sup> Cooperation in this respect is very useful and, especially for emergency situations, I would think that central banks – by enabling the cross-border use of collateral – could make a positive contribution to financial stability.

Ladies and gentlemen, let me now close my introductory remarks by once again welcoming you all and by thanking all of those who have been involved in preparing this conference, in particular Daniela Russo and Mark Manning.

<sup>5</sup> CPSS report on “Cross-Border Collateral Arrangements”, Bank for International Settlements, Basel, January 2006.

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## 2.2 NEW MARKETS AND NEW DEMANDS: CHALLENGES FOR CENTRAL BANKS IN THE WHOLESALE MARKET INFRASTRUCTURE<sup>6</sup>

Keynote speech by Nigel Jenkinson, Executive Director, Financial Stability, Bank of England.<sup>7</sup>

### INTRODUCTION

Central banks sit at the heart of the monetary economy providing the ultimate settlement asset and typically operating the large-value payment systems that underpin financial activity. The modern central bank's twin objectives of monetary and financial stability emerged from their early role in settling claims between banks.

But this traditional payments function is subject to the same forces for change that are transforming the rest of the economy. In particular, developments in technology, the financial innovation they allow, and the globalisation of finance are reshaping the landscape, exposing new sources of risk and posing fresh challenges for regulators and central banks.

As markets become more interconnected and international, national authorities have to work more closely together, cooperating in their oversight and operational activities and coordinating their risk assessments. As new products and players emerge in the commercial sector, they may also need to adapt the scope of their oversight and regulatory response.

I would like to take some time this afternoon to explore some of these issues, many of which will resurface over the course of this two-day conference.

### EARLY DEMANDS: THE HISTORICAL CONTEXT

First some history. How did central banks come to assume their 'central' role in the financial infrastructure?

Internationally, Venice claims a key role in the story, but I will start later with the activities of

goldsmiths in 17<sup>th</sup> century London. Starting from their custody business, goldsmiths began to settle transactions between merchants, across their books or via the transfer of deposit receipts – the early bank notes. Merchants were thereby able to settle obligations with one another without having to carry, count out and value coins: a welcome development, considering that a £100 sterling bag of silver coins – a commonly used value for notes – weighed over 30 pounds (14kg for those in the audience baffled by imperial measures)!

Over time, so as to accommodate transfers between customers of different 'banks', the banks started accepting claims on each other and, once they found ways to settle these claims, established the first British interbank payment systems.

So what were these early settlement mechanisms? At first, banks started settling interbank claims using gold and silver coins. But these were in short supply and, again, costly to transport and exchange.

Banks thus eventually innovated by switching to settlement in assets convertible into gold and silver. For example, by the 1770s, London bankers had begun to settle in notes issued by the Bank of England, a highly-regarded, but at that time, private bank.

A low-risk settlement asset was particularly important in the unregulated world of the goldsmiths, in which credit risk was acute and liquidity shocks – like the one we have experienced of late – were common and dangerous. In a sorry letter to an associate<sup>8</sup>, one goldsmith wrote to another in the 1660s: *"I have beene by many accidents much postpon'd...ye*

<sup>6</sup> This speech may also be found on the Bank of England's website at [www.bankofengland.co.uk/publications/speeches/2007/speech328.pdf](http://www.bankofengland.co.uk/publications/speeches/2007/speech328.pdf) and in the Bank of England's Quarterly Bulletin 2007 Q4, available at [www.bankofengland.co.uk/publications/quarterlybulletin/qb070412.pdf](http://www.bankofengland.co.uk/publications/quarterlybulletin/qb070412.pdf).

<sup>7</sup> I am very grateful to Mark Manning for his help in preparing this speech and to John Gieve, Victoria Cleland and Ben Norman for helpful comments.

<sup>8</sup> Quoted in Quinn (1997).



*money due to mee is soe farre off that I can not make it useful to mee. All Credit in London is much Shortened of late.”*

Showing all the optimism which continues to characterise bankers today, he added: “*I am attempting a way to enlarge my owne (credit) and doubt not to effect it to his Maties. [Majesties] advantage as well as my owne, if I am (like ye lame dogg) but helpt over this style.*”

Further efficiency gains were then obtained by settling interbank obligations over the accounts of a single institution. This innovation was sometimes put in place by the public authorities; in other cases it developed naturally, such as when the London bankers adopted Bank of England deposits as the ultimate settlement asset in 1854.

## PAYMENTS AND MONETARY AND FINANCIAL STABILITY

To ensure that its liabilities continue to be perceived of higher quality than those of any other issuer, the institution at the apex of the payment system – typically the central bank – has an incentive to exercise close control over the terms on which they are made available to the banking system.

That translates into the traditional monetary stability objective: preservation of the role of the ultimate settlement asset as a store of value and unit of account. It also gives the central bank a strong interest in the stability of the financial system. And within that a reliable and resilient infrastructure for distributing the ultimate settlement asset is a key condition of stability (and of implementing monetary policy effectively).

In an advanced monetary economy, of course, bank deposits constitute by far the largest component of ‘money’; in the UK they make up some 96% of the broad monetary aggregate, M4. Agents rely on interbank payment systems to facilitate the direct transfer of deposits between

banks and thereby also preserve their role as a medium of exchange. And as the sophistication of securities and other markets has grown, the core payment systems have become intertwined with the settlement and clearing systems for the key markets. Together they have become a critical part of the infrastructure not just for the financial system but for the economy more widely. And in the wake of 9/11, all central banks have been giving more attention to the physical and financial resilience of these systems. For example, in our regular *Financial Stability Report*, the Bank of England has included the risk of infrastructure disruption in the list of the top six vulnerabilities facing the financial system over the last two years.

As Alan Greenspan notes in his memoirs: “We’d always thought that if you wanted to cripple the US economy, you’d take out the payment systems. Banks would be forced to fall back on inefficient physical transfers of money. Businesses would resort to barter and IOUs; the level of economic activity across the country could drop like a rock.”

In a paper to be presented at this conference tomorrow, Andrea Gerali and Franco Passacantando consider this in the context of the Great Depression. As confidence in the banking system evaporated, bank deposits ceased to function as a medium of exchange. ‘Scrip’, or substitute money, emerged, typically taking the form of vouchers or coupon books. Such monies had otherwise only been commonly used in isolated lumber or coal-mining communities in the United States – communities lacking banks or financial intermediaries.<sup>9</sup> But while adequate for the purchase of provisions at the local general store, such forms of money were clearly an imperfect medium of exchange and created otherwise unintended credit exposures between agents.

The recent market turbulence offers a further reminder of the importance of resilient

<sup>9</sup> Timberlake (1987).

infrastructure for conditions in financial markets. When markets are fragile, any interruption to normal service could have particularly serious implications: further clouding judgements as to individual participants' solvency; undermining agents' risk management; or affecting asset prices in dependent markets. With volumes and values in several markets having hit record levels during the market turmoil and remaining high for a sustained period, infrastructure providers have experienced a severe stress test and, by and large, have passed with flying colours. CLS, for instance, processed nearly 860,000 transactions (more than \$8trn in value) on 19<sup>th</sup> September, 2½ times the daily average in June.

#### **CURRENT TRENDS IN THE WHOLESALE MARKET INFRASTRUCTURE: NEW MARKETS AND NEW DEMANDS**

Today, central banks around the world still typically provide the ultimate settlement asset and sometimes operate, and also own, key components of the payment and settlement infrastructure. For key elements of the infrastructure central banks have assumed an oversight role. Depending on the particular regulatory architecture in place, this is sometimes shared with the financial regulator, as in the UK.

But this is a dynamic environment: the landscape is broadening and deepening, with niche market-specific facilities, cross-border systems, new entrants and commercial bank providers becoming more important. New sources of risk are emerging, presenting new challenges for central banks in their pursuit of monetary and financial stability.

#### **FINANCIAL INNOVATION AND TECHNOLOGICAL ADVANCEMENT**

The way technology is transforming markets and therefore payment systems is illustrated in the rapid growth in OTC derivatives markets; and the increased penetration of electronic trading platforms – and automated trading strategies – across a range of markets.

According to data released by the Bank for International Settlements<sup>10</sup>, notional amounts outstanding in global OTC derivatives markets rose by almost 40% in 2006 – up more than 260% over the past five years. The outstanding value of the credit segment of the market doubled in value in 2006 alone and trading activity has remained high through 2007, especially during the recent market turmoil.

These markets have traditionally been cleared and settled via bilateral arrangements between the counterparties to the trade, but new automated infrastructure services have emerged, partly in response to an international regulatory initiative led by the Federal Reserve Bank of New York (FRBNY). Major dealers now confirm almost 90% of credit derivatives trades electronically, as against less than 50% two years ago.

An important recent addition to the landscape is DTCC Deriv/SERV's Trade Information Warehouse, which maintains a so-called 'golden copy' of each credit derivatives trade. With appropriate interoperability between systems, these data can support a range of ancillary services: calculating and settling payment obligations, managing collateral, terminating trades and reconciling portfolios. The Warehouse is likely ultimately to be rolled out for other products.

The declining cost of technology has also been a key driver of the rise of electronic trading in recent years. Almost 60% of trade in foreign exchange is now executed electronically and close to 50% in repo.

Automated and algorithmic trading strategies are becoming more widespread across asset classes. The London Stock Exchange (LSE) reports that the proportion of the order flow on the exchange that is automated has risen from negligible amounts just four or five years ago to approaching half today. This not only has implications for the scale of trading activity – volumes have tripled on the LSE's SETS system

<sup>10</sup> Bank for International Settlements (2007a).

over the past five years – but also the design and location of the trading infrastructure. For many algorithmic trading strategies, processing speed is critical. The faster systems can process trades in just one or two milliseconds: a tiny fraction of the blink of an eye. But ultimately speed and thus the ability to gain a competitive advantage depends on proximity to the platform; hence, the old geographical pull of markets has begun to re-emerge with exchanges selling space near their trading platforms to those who want to be first in the queue.

Many new entrants to the trading arena are therefore competing with incumbent exchanges on the basis of processing speed. These new platforms are also looking for lower cost post-trade solutions. As such, those emerging in Europe have looked beyond incumbent providers: new entrants and commercial bank providers of clearing and settlement services have featured strongly in their plans. Such providers not only aim to meet demands in terms of flexibility and cost, but also to offer sufficient breadth to deliver a multicurrency clearing and settlement service.

### GLOBALISATION, REGULATORY CHANGE AND THE MARKET STRUCTURE OF INFRASTRUCTURE

This is part of a general reshaping of the infrastructural landscape in a global market place. Market participants are becoming increasingly international, operating in multiple markets and facing obligations in multiple currencies. Latest international banking data from the Bank for International Settlements<sup>11</sup> revealed growth in excess of 20% in reporting banks' total cross-border claims in the year to end-Q1 2007, taking the total to \$28.5trn.

Banks, therefore, seek infrastructural solutions that will accommodate the international organisation of their businesses. So, while, historically, financial infrastructure has typically evolved along national lines, cross-border alliances and mergers are now more common, both in trading and post-trade: e.g., NYSE Euronext; LCH.Clearnet; Euroclear Group. And

alliances in the form of cross-border clearing and settlement links are also widespread, enabling, for instance, securities traded in Italy to be settled and held in an account in the securities settlement system in Germany.

Commercial bank providers – namely, correspondent banks and global custodians – may be best placed to meet the demand for multicurrency settlement, leveraging their extensive international connections. This could then reinforce their important position in the infrastructural landscape. Indeed, the major global custodians each posted growth in assets held in custody in excess of 20% in just the past year.

And differences between the regulatory regimes for incumbent providers of infrastructure and those for either commercial bank providers or smaller new entrants could tilt the playing field. For example, CLS is subject to close central bank scrutiny, operates as a narrow bank, and has to meet exacting – and costly – resilience standards. New clearing arrangements and bilateral netting schemes are now penetrating the foreign exchange markets, threatening the volumes passing through CLS. In messaging, too, SWIFT – which submits voluntarily to central bank oversight – is beginning to face competition in certain markets from new entrants not subject to oversight. Authorities must be alert to the challenges these competitive developments provide.

Other regulatory initiatives are contributing to a reshaping of the landscape. MiFID, in the EU, and RegNMS, in the US, have sought to encourage increased competition in trading; and the Code of Conduct, recently signed in the European Union, establishes terms under which infrastructures operating in one member state can clear and settle (initially equity) trades in another.

Whether trading, clearing and settlement infrastructure markets can support a wide range

<sup>11</sup> Bank for International Settlements (2007b).

of providers in the long-term remains an open question. There is generally a tendency towards concentration in infrastructure provision because of increasing returns to scale in a fixed cost business and often powerful network effects. This applies equally in the case of commercial bank provision of infrastructure: ECB survey evidence reveals that the ten largest correspondent banks in euro account for around 80% of correspondent banking payment values; and the top-4 global custodians now account for three-quarters of total assets in custody. Indeed, regulators have been giving increasing attention to the potential systemic spillovers from operational or business failures at major commercial bank providers of infrastructural services. That has led, for example, to the initiative in the US to implement 'New Bank', a dormant shell company to take over the functions should one of the two major clearers in the US Treasury market cease operations.

It may be that a competitive environment can be sustained, particularly as the cost of technology falls, lowering barriers to entry, and liquidity bridges and other forms of interoperability are established between systems. But, the jury is still out. Recent evidence on the trading side, particularly in the US, is mixed: some trading platforms, such as Archipelago and INET, have been swallowed up by the incumbent exchanges; others, such as BATS Trading are thriving, keeping the pressure on the exchanges to cut costs and upgrade their services.

I suspect what we are seeing is a redefinition of the market on an international scale. In the process, national incumbents are being challenged by a combination of ambitious foreign incumbents eager to exploit economies of scale and nimble, unencumbered new entrants sometimes specialising in niche products. A process that is likely to lead in time to greater consolidation at international level is currently manifesting itself in terms of fragmentation at the national level as local incumbents are challenged.

The end-game may well be lower transaction costs at both the trade and post-trade level and

more concentrated (if not monopoly) cross-border infrastructure in each. But it may take some time to reach a new equilibrium. Central banks and regulators need not only to prepare for and perhaps help shape the end-game, but also address challenges arising during the transition.

## **ISSUES AND CHALLENGES FOR CENTRAL BANKS AND REGULATORS GOING FORWARD**

Two key challenges, in particular, will need to be met:

### **(I) PRESERVE ENOUGH INFLUENCE TO PROTECT THE COLLECTIVE INTEREST WHILE MAINTAINING A LEVEL REGULATORY PLAYING FIELD**

The resilience and efficiency of the core infrastructure is an important public good and, given the tendency to monopoly, the authorities need to ensure that they maintain sufficient influence to ensure resilience in this increasingly complex landscape. That requires consistent and objective criteria to be applied to new as well as established systems. Such criteria might include: *size* – the volume and value of flows; *type of flow* – the extent to which interdependencies are generated with other systems or underlying financial markets; and *substitutability* – the potential for rerouting flows to other systems.

A changing market structure may also alter the nature of risks posed by the systems themselves. For instance, to the extent that we are entering a phase of competing provision of services at the national level, issues might arise around the potential fragmentation of system liquidity. Equally, we are also seeing pressures for greater consolidation of systems at an international level, where the challenges of lowering single point of failure risks remain at the top of the agenda.

Where new services are offered by commercial bank providers, central banks need to cooperate closely with banking supervisors to ensure that potential sources of financial stability risk in their infrastructure roles are embedded within

regulatory assessments. Indeed, to the extent that new services are multicurrency in nature an international dialogue may be necessary. I am pleased that the Basel Committees on Banking Supervision (BCBS) and Payment and Settlement Systems (CPSS) have agreed to strengthen communication between the committees, for example by holding joint meetings of sub-groups, which will help to support this dialogue.

As recent events have underlined, regulation and public intervention can not only change market incentives for the better but can also have unintended side effects. For instance, the creation of the off-balance sheet vehicles at the centre of the recent market turbulence may be seen in part as a response to the crude regime for capital charges established under the original Basel Accord, under which liquidity facilities under a year in maturity were exempt. That is being remedied under Basel II. But it is a reminder that we need to be very careful to watch for these distortions in the regulation and oversight of payment systems and other infrastructures, so as to ensure that we do not inadvertently alter incentives in a way that may hamper the future development of the landscape.

This issue arises for example in the context of the establishment of ESCB-CESR standards for securities settlement systems. The Bank of England supports the principle of risk-based functional regulation, which implies that similar regulatory standards should be applied to a function – such as settlement – regardless of the status of the institution providing that function. We hope that further moves towards implementation will adhere to this principle, thereby establishing a level regulatory playing field at least between CSDs and ICSDs, but ideally also between traditional infrastructures and commercial banks offering infrastructural services.

Finally, with a wider spectrum of participants, issues arise around the way in which members interface with infrastructures. It is important to ensure that individual member behaviour cannot threaten the smooth-functioning of the

system. Some incidents during the recent market turbulence revealed issues around members' processing capacity, underlining the value in member-level testing to ensure that participants can always support the delivery of the network benefits from the smooth operation of the infrastructure.

## **(II) ENSURE EFFECTIVE INTERNATIONAL COOPERATION IN OVERSIGHT AND OPERATIONS, AND COORDINATION IN RISK ASSESSMENT ACTIVITIES**

The second main challenge is to allow market participants to reap the benefits of globalisation, while ensuring that the risks are adequately controlled. An extended and highly connected network can simultaneously be both robust and fragile: *robust*, because risks may be more effectively shared and dispersed across the system; *fragile* in that major risks can flow more rapidly through the system.

Naturally, market participants have been pushing hard for the removal of obstacles to efficient cross-border settlement and barriers to the seamless cross-currency management of liquidity. Central banks have been urged to consider accepting foreign collateral or implementing other arrangements to facilitate cross-currency liquidity management. Some already do so – the Bank of England, for instance, routinely accepts euro-denominated collateral in its operations – and a recent report from the CPSS<sup>12</sup> encouraged other central banks to consider accepting foreign collateral, at least in emergency circumstances. The Eurosystem has recently begun to explore new options.

Provision of cross-border collateral arrangements may entail a high degree of coordination and cooperation between central banks internationally, for instance in opening custody and correspondent accounts, and sharing information on local infrastructures and market practices.

More generally, strong international cooperation in the sphere of risk assessment and crisis

<sup>12</sup> Bank for International Settlements (2006).



management responses is also clearly important. With increased links between infrastructure providers in different centres and the emergence of new cross-border infrastructures, greater cooperation is also required in the conduct of oversight: not only in terms of assessment of particular overseen cross-border infrastructures against international standards, but also in identifying potential interdependencies between national infrastructures. While existing cooperative arrangements work well, the model needs to expand and continue to evolve.

global financial system and the global economy depend upon.

## CONCLUDING REMARKS

The resilience of the infrastructure of wholesale payment, clearing and settlement systems to both operational and financial shocks remains a key requirement of financial and monetary stability. But the landscape is changing fast in response to technological change and the financial innovation and globalisation it allows. Cross border and global networks are squeezing our national monopolies and commercial banks are playing an increasing role. These changes present several challenges for central banks and regulators:

- We need to establish and apply consistent criteria for the scope of oversight, in order to maintain a level regulatory playing field;
- We need to take full account of new interdependencies between systems when assessing financial stability risks at a national and international level;
- We need to work more closely together in risk assessment and oversight and ensure that cross-border operational arrangements are robust;
- We need to ensure that financial stability risks posed by financial firms operating key infrastructure functions are adequately captured in their regulation.

Meeting these challenges will deliver a robust, resilient financial infrastructure, which the

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## 3 DETAILED SUMMARY OF THE THEMES

### 3.1 PAYMENTS AND MONETARY STABILITY

The first session of the conference, chaired by **Charles Goodhart**, brought together four papers on the theme of payments and monetary stability. Historically, there is a close connection between the roles played by central banks in providing the ultimate settlement asset and preserving the value of that asset through monetary policy. In practice, however, the two topics are often treated as distinct: policy on payment systems is often conducted holding constant the broader framework of monetary policy implementation; likewise, those thinking about monetary policy and its implementation often view the payment system as given. Indeed, responsibility for the operation of payment systems, on the one hand, and the implementation of monetary policy, on the other, falls to different departments in the organisation of many central banks.

However, as highlighted by the first paper, presented by Stephen Williamson, money plays a role in the economy *only* because it can facilitate payments. Monetary theory therefore needs to start by accounting for the need for money and by microfounding its use in payment systems. Monetary policy can only hope to have any potency through the continued use of central bank money as the ultimate settlement asset in the economy.

The paper by Williamson also explores the implications of the link between money and payments for monetary policy. The key tenet is that it is optimal to provide intraday liquidity at zero marginal cost. Alternatively, central banks can remunerate reserves at the short-term nominal interest rate. Both policies are applications of the Friedman (1969) rule and both achieve the same efficient allocation when all agents can deal directly with the central bank. However, complications arise when some agents are confined to holding currency, which for technological reasons cannot be remunerated.

The second paper, by Antoine Martin and Jamie McAndrews, explores whether central

bank money should be supplied via a market and whether it makes sense for central banks to provide reserves overnight only at a positive marginal cost, in contravention of the Friedman rule. Indeed, the main contribution of the paper is to highlight that these two questions are intimately linked. A market will tend to emerge when the holding of reserves carries a positive opportunity cost, leading to a positive supply of funds in the overnight interbank market for reserves. It is likely that eliminating this opportunity cost will affect activity in these markets. The question then arises as to whether overnight markets for reserves are useful or could be done without, with all reserves supplied directly by the central bank.

The third paper by Alexsander Berentsen and Cyril Monnet analyses further the interplay between payment systems, interbank markets and monetary operations by studying optimal policy in a “channel” system. In such a system, the central bank implements policy through a standing lending and a standing deposit facility. The paper shows how uncertainty about the end-of-day position in payment systems induces banks to hold both reserves and collateral. Collateral can be deployed in secured interbank markets and exchanged for reserves. It can also be used to obtain funds directly from the central bank at the standing lending facility. Berentsen and Monnet show how costly collateral leads to interbank market rates that are above the policy rate. They also show how aggregate shortages lead to an increase in the interbank rate away from the policy rate, suggesting a mechanism by which problems in payment systems can spill over into the interbank market.

The final paper of the session, by Elisabeth Klee and presented by Doug Conover, provides evidence on such spillovers. Specifically, it considers the effect of member-level operational outages in the US Large Value Payment system (Fedwire) on the US market for federal funds. The empirical analysis uncovers a statistically significant positive effect of outages both on the level and the (intraday) volatility of the effective federal funds rate. Several factors are found to

determine the magnitude of the effect on the rate: the duration of the outage; the time of day at which it occurs; and the scale of the stricken participant's activity within the system. The paper also shows the way for further research on these issues. For example, the question arises as to how the monetary policy regime affects the strength of the results. In the US context, the results might be stronger on the last day of the maintenance period that is applied to the reserve averaging mechanism operated by the Federal Reserve System. More generally, as suggested by the paper by Berentsen and Monnet, the effect of outages on interbank rates might depend on the size of the spread between the standing deposit and lending rates operated by the central bank, with a smaller spread tending to attenuate the impact on rates.

The remainder of this section provides a more detailed overview of the discussions relating to each of the four papers presented under the theme.

## RESEARCH PAPERS

The first paper of the session entitled "Transactions, credit and central banking in a model of segmented markets", by **Stephen Williamson**, explores monetary policy in an economy that is segmented, such that some agents have direct dealings with the central bank, while others do not. In the model, cheques are the main means of payment, but cheques take time to clear. The role of outside (central bank-issued) money is to create instant liquidity that agents can use for purchases of goods during the day, even while some of the cheques received in payment for goods sold clear only on the next day. Since agents operate under a liquidity constraint of this sort, money is useful, and the way central banks inject money into the economy can affect real consumption and welfare.

Williamson first considers a benchmark case in which every agent can deal directly with the central bank. In this set-up, the central bank optimally provides liquidity on terms that imply a zero marginal cost to the agent – in other

words, the central bank optimally operates a Friedman (1969) rule. In so doing, the central bank can address the frictions associated with agents' liquidity constraints and ensure an efficient level of consumption. Williamson also shows that there is more than one way of implementing a Friedman rule in this model. One policy is to provide within-period loans to households at a zero nominal interest rate. The appropriate within-period balances of outside money are chosen by agents in such a way that, on any day, all planned transactions can be carried out. A second policy that achieves the same efficient outcome is for the central bank to encourage reserve holdings by remunerating overnight reserves at the one-period nominal bond rate. In this case, agents will want to hold sufficient reserves to relax their intraday liquidity constraints, so that, again, the efficient consumption levels can be sustained.

Williamson moves on to consider a set-up in which there is segmentation in access to the central bank. A first group of agents continue to be able to deal with the central banks both intraday and overnight. A second group of agents is confined to holding outside money in the form of currency. The key assumption here is that, for technological reasons, it is not possible to pay interest on currency. This restricts the policy choices of the central bank in dealing with the second group of agents. On the other hand, since there is trade both within and across the two types of agents, monetary policy choices as regards intraday or overnight interest rates offered to the first group of agents also affect indirectly those agents who hold only currency. In particular, monetary policy is shown to affect the overall level of consumption, as well as the distribution of consumption across the two groups. While the optimal policy is difficult to characterise in this more general set-up, Williamson shows that neither a zero-interest overdraft policy nor a policy of paying interest on reserves can fully address the trading frictions in the economy. In particular, none of these policies can achieve an efficient pattern of consumption that involves equal consumption across both groups.

In his discussion, **Charles Kahn** praised Williamson's model as an important contribution to the microfoundation of the relationship between payment systems and monetary policy and to analysis of the importance of the supply of central bank money intraday. The message policy-makers should take away is that increasing the money supply overnight alone has no effect because money is only ever used during the day as a means of payment. Hence, the model allows for a useful discussion of the links between daylight overdrafts, overnight instruments, and reserves. However, its results critically depend on the assumptions on which it is based. In particular, the importance of differential access to the central bank may not be so clear in practice and, therefore, the relevance of this part of the model to current policy debates may also be unclear.

The presentation by **Antoine Martin**, based on joint work with **Jamie McAndrews**, considered the question, "Why are there no intraday money markets?". This paper focuses on differences in the way central banks supply reserves intraday and overnight. Overnight reserves are defined as those held on a central bank account at the end of the day. Intraday reserves refer to additional reserves supplied during the day. Intraday reserves are typically supplied by a standing facility and at a low cost to banks. For example, in the United States, intraday reserves are made available uncollateralised and for a small fee, while the ECB, the Bank of England and others supply intraday balances collateralised and at a zero interest rate. By contrast, holding overnight reserves is costly. For instance, in the United States, the Federal Reserve System does not pay any interest on overnight balances, implying a large opportunity cost of holding reserves overnight. Furthermore, overnight reserves are typically supplied through a market: in the United States, the Federal Reserve System supplies overnight reserves to primary dealers who then redistribute them in the market for federal funds.

The authors examine the factors underlying these different approaches and consider whether

current arrangements could be improved upon. First, they review research in payment economics that suggests that intraday reserves should be supplied at very low cost. The key argument here, also derived in the paper by Williamson, is that a zero-interest policy on intraday credit follows from an application of the Friedman (1969) rule. Moreover, costly reserves could lead banks to delay payments, potentially causing gridlock and increasing the impact of operational problems in payment systems late in the day. Current central bank practice is therefore viewed as consistent with the arguments advanced in the economics literature.

As regards the supply of overnight reserves, economic theory does not provide a definitive answer. In practice, many central banks have traditionally viewed a positive opportunity cost of holding overnight reserves as critical for the implementation of a target policy rate. In turn, a positive opportunity cost creates an active market for overnight funds, as explained further in the paper by Berentsen and Monnet. The authors therefore explore the implications of an alternative policy that would reduce the opportunity costs of overnight reserves to zero, i.e., remuneration of *any* amount of reserves held by banks at the policy rate. Under such a policy, banks could be induced to hold a large amount of overnight reserves, which could then also be used intraday to meet their payment obligations. The separate provision of intraday balances, which exposes the central bank to credit risk, would then no longer be necessary.

However, another likely implication is that activity in overnight markets for reserves would fall, begging the question as to whether these markets play a useful role. Certainly, in contrast to many other markets, interbank markets for reserves do not play the traditional role of aggregating information and price discovery. This is because the price in overnight markets is a policy variable, driven mainly by choices made by the central bank. That said, these markets may still be useful in providing incentives for banks to monitor each other. On the other hand, in a world



where central banks no longer provide intraday credit, this function may be less important.

Finally, the authors consider the case of New Zealand, where the central bank recently changed its framework for implementing monetary policy in a way that is close to the alternative policy considered here. The Reserve Bank of New Zealand (RBNZ) started paying interest on reserves at the policy rate in October 2006, increasing the supply of overnight reserves from NZD 20 million to NZD 8 billion, a 400-fold increase. By contrast, intraday reserves are no longer made available. While it is difficult to isolate the implications of this policy change for the overnight interbank market, this example illustrates that a positive opportunity cost of reserves is not necessary for the implementation of monetary policy. When supplied at zero marginal cost, the amount of overnight reserves could be used to achieve other objectives, for example to reduce the need for separate intraday provision of liquidity.

In his contribution, **Paolo Angelini** argued that operational frameworks in which reserves are supplied at a positive marginal cost might equally allow the pursuit of objectives that are not directly related to monetary policy implementation. For example, in the ECB's operational framework, the high level of compulsory reserves reduces intraday liquidity needs. Moreover, implementation of the policy rate is already (to a large extent) independent of reserve management objectives, with policy rates set effectively through open-mouth operations and using target rates as signalling devices. This allows a flexible and timely adjustment of the overnight reserve supply largely independently of the policy interest rate. The distinction between systems with zero versus positive cost of overnight funds might therefore be less useful than it appears at first sight. Finally, Angelini reviewed the empirical experience of the new policy framework operated by the RBNZ. He reported that on 23 August 2007, following the sub-prime turbulence, the RBNZ amended its operational framework by, de facto, going back to the previous "corridor" or "channel" system –

that is, the subject of the paper by Berentsen and Monnet. In other words, while the new approach is perfectly suited to address situations of unstable liquidity demand in theory, it appears to have been less successful in practice.

This opens up questions for further research: What happened to New Zealand overnight interbank markets throughout these changes? Were the problems that prompted the RBNZ to modify the system in August specific to the money markets in New Zealand, or would they materialise more generally? This discussion also highlights how recent events in financial markets provide ample food for thought on how interbank market rates are affected both by payment systems and the monetary policy regime.

The paper by **Aleksander Berentsen** and **Cyril Monnet** entitled "Monetary policy in a channel system" continued on this theme by offering a theoretical treatment of the mechanisms involved in operating a channel system for monetary policy. Elements of such a system can be found in the policy frameworks operated in Canada, the United Kingdom, the euro area and the United States. The key feature of a channel system is that the central bank targets an overnight interbank rate and that both a standing deposit and a standing lending facility are offered by the central bank at a spread around the desired (policy) rate.

The authors present a dynamic general equilibrium model in the tradition of Lagos and Wright (2005)<sup>1</sup>, whereby banks' use of both outside money (reserves) and secured interbank credit are microfounded and arise in response to payment shocks experienced intraday. The model is used to analyse the interplay between these elements when monetary policy is implemented through standing lending and deposit facilities. In the model, these facilities allow banks to borrow any (i.e., an unlimited)

<sup>1</sup> See Ricardo Lagos and Randall Wright A Unified Framework for Monetary Theory and Policy Analysis, *Journal of Political Economy*, Vol. 113, pp. 463-484, June 2005.

amount from the central banks against collateral at a fixed borrowing rate and to deposit funds with the central bank at a fixed deposit rate. In the presence of uncertainty about end-of-day positions, banks can also borrow and lend in an interbank money market. However, since loans are subject to credit risk, a bank can borrow funds (either in the interbank market or directly from the central bank) only up to the present value of collateral offered in exchange. Collateral is assumed to be costly, but it is nonetheless useful since it enables an interbank market for funds and thus increases aggregate liquidity.

The key results of this analysis are as follows. First, the central bank optimally sets a positive spread. The reason for this is that, with a zero spread, banks do not carry any overnight reserves. Instead they carry large amounts of collateral, which is used at the standing lending facility, while an overnight market for reserves can no longer exist. However, this is inefficient if collateral is costly and reserves can be created at no cost. Second, in the presence of costly collateral, the effective money market rate will be above the policy rate – as observed in practice, for example, in the United Kingdom and the euro area. Third, as collateral becomes more costly to hold, there will be a shift towards greater holdings of reserves. Despite this, on net, more costly collateral reduces welfare. Fourth, an increase in the policy rate and a symmetric increase in the spread have equivalent effects on inflation, consumption and welfare. Finally, an aggregate liquidity shortage tends to increase the policy rate. Moreover, the strength of this effect depends on the cost of collateral, as well as the spread implied by the two standing facilities, with a larger spread leading to a greater increase in the rate.

**Erlend Nier** commended the authors for having succeeded in presenting a framework that was both theoretically sound and offered a wealth of important implications for policy-makers. Indeed, the model could be used to explore a number of areas for future research. For example, against the background of recent

events in money markets, it may be useful to examine in more detail the interplay between secured and unsecured interbank money markets. Moreover, other features of monetary policy regimes, such as open market operations and remunerated reserves could be introduced into the framework. The model could also be used to establish a better understanding of the effect of operational problems in payment systems on money markets, an issue analysed empirically in the paper by Elizabeth Klee.

Finally, Nier questioned the practical validity of the result that changes in the policy rate were found to be equivalent to changes in the spread. Changes in the spread work by affecting short-run liquidity conditions in money markets. These liquidity conditions might well have an effect on economic activity – a variant of the bank lending channel of monetary policy. However, changes in the policy rate could also work through other channels that affect other agents in the economy in a direct way, for example through a standard interest channel of monetary policy.

The objective of the paper by **Elizabeth Klee** entitled “Operational problems and aggregate uncertainty in the federal funds market” is to examine empirically the extent to which operational problems in the US large-value payment system – the Fedwire Funds Service (Fedwire) – can spill over into the interbank market for overnight funds (the federal funds market). Key questions addressed by the paper include: Do operational difficulties at banks participating in Fedwire have a measurable effect on the federal funds market? What factors determine the magnitude of the effect? How does the magnitude of the effect depend on the length of the outage, the time of day at which the outage occurs and the volume of payments ordinarily sent by the affected participant?

The main focus of the paper is the effect of outages on the level and volatility of the federal funds rate – the rate paid between banks in the US overnight market for reserves. The paper also examines the effect of outages on the likelihood of banks using the discount window. Finally, the paper examines

the effect of outages on the likelihood that the Fedwire service is extended beyond its normal operating hours. The paper explains that under the current US framework for monetary operations no interest is paid on reserve balances held overnight with the Federal Reserve System. At the same time, the discount window rate is a penalty rate. During the sample period it was 100 basis points above the target rate set by the Federal Open Market Committee. Both constraints imply that banks have an incentive to manage their reserve balances tightly, resulting in a very active market for overnight funds.

Against this background, the author considers the hypothesis that outages at member banks should lead to a relatively large increase in the effective federal funds rate, an average of the rates paid between banks in the US overnight market for reserves. This is because the bank affected by an outage will continue to receive payments from other banks, but will not make any payments out for the duration of the outage. In other words, the bank becomes a liquidity sink. This reduces the reserves position of other participating banks and increases the demand for end-of-day funds at other banks. More generally, the disruption to payment flows may increase uncertainty about end-of day positions, which might increase demand for end-of day funds and push up rates.

Klee examines this hypothesis using observations from the top 50 Fedwire participants by volume from 1998 to 2005, excluding the days around the 9/11 disruption. She does not have direct information on operational outages at settlement banks, so outliers in payments behaviour are used as a proxy.

The empirical analysis uncovers a statistically significant positive effect of outages thus defined, both on the level and the (intraday) volatility of the effective federal funds rate. The increase in the rate is found to be larger, the longer the duration of the outage and the later it occurs during the day. The effect on the rate is also found to be stronger, the more active is the stricken participant within the system in normal

times. Moreover, discount window borrowing is shown to pick up with outages. These effects are generally transitory: there is no effect on the day following the outage. Finally, outages are shown to increase the likelihood of an extension of Fedwire operating hours. These extensions are also likely to attenuate the effect of outages on the effective federal funds rate, an issue that Klee plans to examine more fully in further work.

In his presentation, **Doug Conover** also compared the increases in the level and volatility in the federal funds rate induced by major outages in their sample and the changes witnessed during August and September 2007 as a result of the turmoil in money markets. This shows that the increase in intraday volatility related to operational outages is significantly less than that observed during the recent events. In addition, the average difference between the effective and target rate is actually negative for much of August and early September. This contrasts with the positive difference of seven basis points associated with banks' operational disruptions.

In conclusion, the empirical exercise documents that outages have external costs on other market participants. This could imply that there is a role for the authorities to ensure adequate resilience against outages. Moreover, while this issue has not been studied directly, there is a possibility that outages at large banks could affect multiple money markets simultaneously. In the discussion, **Nuno Cassola** noted that theory also suggested that the effects should be stronger on the last day of the two-week maintenance period for reserves operated by the Federal Reserve System. Further analysis of this hypothesis could be undertaken.

In the general discussion, the issue was raised as to whether there might be an amplification mechanism at work, by which outages could have a disproportionately large effect at times when money markets were stressed (such as during the recent crisis episode). Moreover, it would be useful to better understand how

outages might affect payment behaviour by other participants over the course of the day. Finally, the paper by Berentsen and Monnet suggests that the force of the spillover from outages to rates might be intimately related to features of the monetary regime. For instance, in channel systems where the corridor is narrower than it is in the United States, the effect on rates of a given outage might be less pronounced.

### 3.2 SYSTEM INTERDEPENDENCIES

Over the past decades, an increasingly complex web of interconnections among payment and settlement systems has developed internationally. Several factors lie behind this development, including globalisation and regional integration; consolidation, both in the banking industry and among infrastructure providers; public policies that encourage interoperability between systems, with a view to increasing efficiency and building liquidity bridges; and technological innovation. Such interdependencies take a variety of forms: direct linkages between systems; indirect linkages, arising from the activities of large financial institutions in multiple systems; and broader common dependencies, such as multiple systems' reliance on a common third-party service provider (such as SWIFT<sup>2</sup>). As a result, the settlement flows, operational processes and risk management procedures of each individual system now depend on other systems, both nationally and internationally.

Interdependencies are particularly strong at the domestic level. For example, banks often participate in several domestic infrastructures; if they are short of liquidity in one system, they might source this from another that settles in the same settlement asset. Some systems, primarily in the United States, have formal cross-margining, cross-guarantee or cross-netting agreements for their common participants. Domestic large-value real-time gross settlement (RTGS) systems are also used to settle net payments from ancillary systems, such as other large-value systems and securities settlement systems settling on a net basis.<sup>3</sup> A prolonged

outage of the RTGS system could thus prevent settlement in these ancillary systems. In some architectures, the cash leg in a delivery-versus-payment (DvP) securities settlement is effected via the large-value system and hence creates a direct link between the security settlement system and the domestic large-value payment system. Also, some domestic payment and settlement systems rely on common providers of communication and messaging services.

International interdependencies are also becoming stronger. An important milestone was the introduction of the Continuous Linked System (CLS), a settlement system that facilitates the simultaneous transfer of the two legs of a foreign-exchange transaction.<sup>4</sup> With CLS ultimately settling net in the large-value payment systems of the fifteen participating countries, it naturally reinforces the links between them.

In many respects, public intervention has served to increase such interdependencies. Both DvP and Payment versus Payment (PvP) were encouraged by the central bank community as vehicles for mitigating credit risks arising via the settlement infrastructure. In each case, the simultaneous settlement of the two legs of a single trade (either cash versus security or currency A versus currency B) is intended to eliminate the risk that one party fails to fulfil its obligation after its counterparty has already fulfilled theirs.

As in the domestic case, overlapping system membership in several countries can create system interdependencies. If, for example, credit concerns were to emerge about an international banking group, it might suffer significant outflows in multiple systems, triggering strategic responses by other participants and potentially disrupting the flow of liquidity in each system.

<sup>2</sup> Society for Worldwide Interbank Financial Telecommunication.

<sup>3</sup> For example, in the euro area, TARGET2 settles net payments arising in EURO1; Fedwire, in the United States, settles net payments arising in the Clearing House Interbank Payments System (CHIPS) and the Depository Trust Company (DTC).

<sup>4</sup> Such simultaneous transfer is known as payment-versus-payment (PvP).

In practice, about a dozen banks participate directly in a substantial number of large-value payment systems internationally.

Current industry initiatives, such as the European Code of Conduct on Clearing and Settlement, will add further direct cross-border links between systems. For example, in response to the Code, several central counterparties have sought non-discriminatory access to clear trades on exchanges in other countries.<sup>5</sup>

Against this background, a group of industry participants was brought together in a panel session to offer insights into the management of risks arising from system interdependencies. The panel session delivered a broad endorsement of ongoing work on interdependencies at the Committee on Payment and Settlement Systems (CPSS). It was suggested that existing standards might have to be extended to take account of new interdependencies. International cooperation on risk assessment could also be improved, particularly in the light of increasing direct links between systems, and cooperative oversight arrangements should continue to be developed. It was acknowledged that multiple system memberships and international system interlinkages increased the likelihood that crises would have a significant international dimension, giving greater prominence to banks' liquidity management strategies and justifying increased public policy attention to issues relating to cross-border collateral management. Again, with international crisis management in mind, panellists saw a clear need for the broad-based stress-testing of systems coordinated at international level.

In a complementary academic session, chaired by **Sean O'Connor**, two research papers were presented, which, respectively, analysed system interdependencies arising from banks' participation in multiple systems, and the role of alternative foreign exchange settlement models in creating links between national payment systems. Jochen Schanz presented a structural, game-theoretic model, investigating how increased centralisation of liquidity management

in global banks might affect financial stability. The settlement model applied and, in particular, the degree of coordination between settlement of the two legs of a foreign exchange transaction, matters for the transmission of shocks between systems. In a complementary simulation-based model, Morten Bech, Walter Beyeler, Robert Glass, Fabien Renault and Kimmo Soramäki conclude that, while PvP settlement can reduce credit exposures between participants of different systems, it may strengthen liquidity links between the systems themselves. In particular, the authors find that these links matter most when liquidity is scarce in at least one of the systems.

The remainder of this section provides a more detailed summary of the panel session and papers presented in this session.

## PANEL SESSION ON SYSTEM INTERDEPENDENCIES

**Denis Beau**, head of the CPSS Secretariat, chaired the panel, which comprised a group representing some of the biggest international banks: **Colin Church** (Citigroup), **Sophie Gautié** (BNP Paribas), **Gerard Hartsink** (ABN Amro) and **Marshall Millsap** (JP Morgan Chase). Given the international orientation of the participants, the focus of the session was primarily on cross-border system interdependencies. Following an overview by the Chair of the ongoing CPSS work in this regard, the panellists were invited to discuss their own organisations' assessment of system interdependencies, how they managed such risks and where they perceived a need for additional public policy attention. Panellists' responses centred largely on four broad issues: risk assessment and resilience standards in an increasingly interdependent world; the role of CLS; firms' management of liquidity and collateral; and business continuity planning on an international scale. The following key insights were drawn from the session.

<sup>5</sup> See [http://ec.europa.eu/internal\\_market/financial-markets/clearing/communication\\_en.htm#code](http://ec.europa.eu/internal_market/financial-markets/clearing/communication_en.htm#code) for more information on the Code of Conduct on Clearing and Settlement.



## RISK ASSESSMENT AND RESILIENCE STANDARDS

There was general agreement among panellists that shocks transmitted via cross-border links could have important ramifications. Therefore, knowledge about interdependencies must be improved in order to be able to better control the associated risks. For example, some institutions have instituted internal programmes to increase awareness among senior staff of the effects their decisions could have on other parts of the business. Similarly, it might be useful to share more information and, where appropriate, coordinate decisions between financial institutions, infrastructure providers and policy-makers. Panellists welcomed the existing opportunities for discussion with authorities, for instance via the CPSS.

It was suggested that standards for operational and liquidity risk management could be raised for key systems, institutions, and infrastructure providers, perhaps via extension of CPSS standards to reflect system interdependencies.<sup>6</sup> Throughput guidelines could also be a valuable tool in encouraging settlement banks to submit their payments as early as possible, in order to limit any spillover effects arising from an operational outage late in the day. Existing vertical links between exchanges, central counterparties and settlement systems should also be borne in mind when analysing the effects of emerging horizontal links.

In this regard, via the promotion of price transparency, open access, interoperability and unbundling of clearing and settlement services, the Code of Conduct was seen to have the potential to trigger substantial change in the infrastructure landscape.<sup>7</sup> Further work may be required to ensure that the Code is fully applied, with scepticism remaining in some quarters that the objective of increased competition will indeed be achieved. Indeed, one panellist cautioned that it might simply accommodate some providers' ambitions for cross-border expansion and thereby facilitate renewed consolidation at the international level.

Furthermore, the Code supports interoperability as a means of fostering competition, but it is as yet unclear what precisely interoperability entails and how the risks arising will be addressed by overseers. It is important that this work be prioritised, as increased interoperability should not be achieved at the expense of safety and resilience.

The prominent role of the large international banks as a source of system interdependencies was discussed. One panellist noted that the top 25-40 international banks conducted multicurrency business and participated – although not always directly – in each of the world's major market infrastructures. The behaviour of such systemically important banks is key to the smooth functioning of the system, and a complete analysis of interdependencies should consider the interplay between the risk decisions of infrastructure providers and those of their largest participants.

## CLS

There was widespread agreement that foreign exchange settlement required further work. A great deal has been achieved with the introduction of CLS, but a third of all foreign-exchange transactions still settle on a non-PvP basis and thereby create risks to financial stability.<sup>8</sup> This is partly owing to the fact that CLS only offers next-day settlement – such that the settlement of same-day transactions can still give rise to credit exposures – and partly because some financial institutions choose to settle outside of CLS. One panellist suggested increasing the number of settlement cycles to allow same-day settlement in CLS. This could

6 CPSS Core Principles for Systemically Important Payment Systems available at <http://www.bis.org/publ/cpss43.htm>; CPSS-IOSCO (International Organisation for Securities Commissions) Recommendations for Securities Settlement Systems available at <http://www.bis.org/publ/cpss46.htm>; CPSS-IOSCO Recommendations for Central Counterparties available at <http://www.bis.org/publ/cpss46.htm>.

7 See [http://ec.europa.eu/internal\\_market/financial-markets/clearing/communication\\_en.htm#code](http://ec.europa.eu/internal_market/financial-markets/clearing/communication_en.htm#code) for the European Code of Conduct on Clearing and Settlement.

8 See [http://www.bis.org/list/cpss/tid\\_56/index.htm](http://www.bis.org/list/cpss/tid_56/index.htm) for details on the CPSS's work on FX settlement.



be particularly desirable for participants in the Far East, whose intraday credit exposures might have a long duration when settling against, for example, the US dollar.

Also, it was argued that central banks – possibly through cooperation with prudential supervisors – should consider imposing direct capital charges for foreign exchange settlement risk exposures, instead of relying solely on moral suasion to encourage PvP settlement. One panellist remarked: “at present, market participants behave as though settlement risk doesn’t have a price.”

#### **LIQUIDITY AND COLLATERAL MANAGEMENT**

Panellists agreed that while CLS reduced credit risk, it posed new challenges for intraday liquidity management. One way to alleviate liquidity pressures would be to facilitate the recycling of liquidity surpluses; that is, the transfer of surplus liquidity from one system to meet a shortfall in another. Liquidity can be transferred via a foreign exchange transaction – as in the papers presented in this session by Schanz and Bech and Renault. Another option is to transfer securities held in one market to collateralise borrowing in another. Existing arrangements for the cross-border transfer of collateral were deemed inefficient and processing lags too long to be of substantial help under stress. For example, links between securities settlement systems are not always real-time. One panellist remarked that the planned introduction of a new security settlement system in the European Union, TARGET2 Securities (T2S), might alleviate this problem.<sup>9</sup>

Linked to this, it was argued that some standardisation in central banks’ lending policies would assist international banks in their liquidity management. Central banks’ policies differ not only in the range of eligible collateral, but also in the administrative and operational processes applied in the delivery of collateral. Panellists echoed calls from a range of industry groups – such as the Payments Risk Committee and the International Institute of Finance – for greater

flexibility in central banks’ collateral eligibility requirements, in particular, in crisis situations.<sup>10</sup> Furthermore, they argued that legal arrangements for the submission of collateral in crisis situations should be drafted ex ante to allow their swift implementation. Overall, the standardisation of operational procedures for accepting collateral might be more important than harmonisation of central banks’ eligibility criteria. However, as noted by one conference participant, central banks have already taken steps to harmonise their procedures, but many additional measures remain firmly in the hands of the market. For example, different cut-off times and other procedural requirements and business practices of market infrastructures may still prevent the timely transfer of collateral when needed.

Furthermore, one panellist remarked that “liquidity doesn’t move in times of stress” and hence even full harmonisation of procedures might not result in smooth transfers. Therefore, banks’ behaviour during a crisis was a key factor in assessing liquidity pressures. Relatedly, some panellists also argued in favour of the harmonisation of supervisory standards for liquidity risk, although one panellist was careful to add that no additional regulation was needed in this area.

#### **BUSINESS CONTINUITY PLANNING**

More generally, in the sphere of business continuity, there was agreement among panellists that payment system operators and participants should have high-quality and well-articulated business continuity plans and that these should be tested regularly. Indeed, with infrastructure providers and the official sector having made great advances in the sphere of credit risk – through the implementation of RTGS, DvP and PvP – operational risk should now be the focus of attention. Central banks should take a central

<sup>9</sup> See <http://www.ecb.int/paym/t2s/html/index/t2s/html/index.en.html> for details on T2S.

<sup>10</sup> This is an ongoing workstream at CPSS. A report was published in January 2006: <http://www.bis.org/publ/cpss71.htm>. The work at CPSS acknowledged industry calls for wider central bank eligibility criteria, as in the report by the New York Payments Risk Committee: <http://www.newyorkfed.org/prc/manage.pdf>

role in any market-wide tests and, if conducted on a truly international scale, the scale and nature of system interlinkages – and behavioural responses – would be revealed. One panellist suggested that it might not be sufficient to involve only large players in crisis management games, although this view was not fully shared among panellists.

## RESEARCH PAPERS

As noted, one of the drivers of increased system interdependence is banks' management of liquidity on a centralised basis. In "Models of foreign exchange settlement and informational efficiency in liquidity risk management", **Jochen Schanz** considers whether we should expect this trend towards global liquidity management to continue, and if so, what the implications are for financial stability.

When a global bank manages its liquidity centrally, liquidity shortages in one currency area may be refinanced not only by accessing the local interbank market, but also by using surplus liquidity held by that bank in other currencies. Surplus liquidity can take the form of foreign central bank money (which could be exchanged against local currency) or of securities that could be used to collateralise a loan in either the local or the foreign market. Schanz focuses on transfers of central bank money under stress, when the solvency of the liquidity-short bank is in doubt, and the bank lacks adequate collateral. Under stress, the solvency risk of the liquidity-short subsidiary matters even for the short (intraday and overnight) exposures under consideration. The entire analysis therefore focuses on credit exposures and how these influence the pricing of domestic interbank loans and foreign exchange transactions.

Schanz's starting point is the assumption that only external, but not internal (within-group) credit relationships, suffer from asymmetric information between the borrower and the lender. When liquidity is managed locally, a liquidity-short bank has to resort to external finance. The author shows that, in contrast, a foreign

exchange transaction in which the liquidity-short subsidiary uses another subsidiary of the global bank as a correspondent involves a mixture of external and internal finance. Schanz's first result is that in such a crisis, a subsidiary that is not granted emergency funding by another subsidiary of the same banking group will not obtain refinancing from any external lender. Indeed, The Joint Forum found that most financial groups expected to rely more heavily on intra-group, cross-border and cross-currency transfers in stress situations.

Schanz then shows that the transition from local to global liquidity management has two consequences for financial stability. First, the transmission of solvency shocks from one institution to another becomes less likely, because banks with high solvency risks would not be able to refinance themselves at all in response to liquidity outflows (neither in the domestic interbank market nor via the intra-group transfer of liquidity). However, this implies that such banks would have to delay settlement of obligations beyond their due date: they would be in technical default. Hence, the second consequence, i.e., technical default, becomes more likely. These results continue to hold when banks' ex-ante liquidity holdings are derived endogenously.

The balance of these effects depends on the degree of coordination of the settlement of the two currencies in a foreign exchange transaction. An exchange of domestic against foreign currency is settled in two separate transactions: one transfer of local currency in the home country's payment system and one transfer of foreign currency in the foreign country's system. These two payment flows may not happen simultaneously, for example, because of time zone differences and the absence of a mechanism for intraday PvP. Schanz shows that the better coordinated the payment flows – the closer to PvP settlement – the more credit exposure is contained within the global banking group, where the creditor is better informed about the liquidity-short subsidiary's solvency risk. Thus, the price of the foreign

exchange transaction becomes more closely dependent upon the true risk of the liquidity-short subsidiary, discouraging refinancing when its solvency risk is high. The incidence of technical default thus rises, but the likelihood of transmission of shocks falls.

Schanz's model shares a problem of many related game theory models under asymmetric information: there is a multitude of predictions of banks' behaviour (equilibria) under both local and global liquidity management, making a general comparison of the two liquidity management strategies difficult. Nevertheless, the author derives the following intuitive result: a global bank that optimally holds a positive amount of liquidity under local liquidity management would hold less if it managed its liquidity globally. Empirically, the ability to economise on liquidity (collateral) holdings is among the main reasons for banks to centralise their liquidity management.

The discussion of the paper was led by **James Chapman**. While the author disregards equilibria relying on unrealistic assumptions, Chapman suggested that more formal mathematical criteria could be applied to weed out implausible predictions. Furthermore, he might usefully investigate the transition from an equilibrium under local liquidity management to one under global management, with the aim being to derive empirically testable hypotheses. Finally, there might be a case for investigating the efficiency of equilibria, that is, whether global liquidity management and improved coordination of settlement of foreign exchange transactions would be desirable for the economy as a whole. However, meaningful statements about efficiency would require more formal modelling of the effects of transmission of solvency shocks and the occurrence of technical default. This, in turn, would require that the associated payment systems be modelled in full, with depositor behaviour endogenised. Schanz therefore felt that such an extension would be beyond the scope of the current work.

In "Congestion and cascades in coupled payment systems", presented by **Morten Bech** and

**Fabien Renault**, the authors use a simulation approach to analyse liquidity and credit risks in the context of interdependent interbank payment systems. In particular, they investigate the operation of two real time gross settlement systems, linked via foreign exchange transactions conducted by banks participating in both systems. Their key objective is to build a model that is able to capture two of the interdependencies identified by the CPSS in their work on system interdependencies: institution-based interdependencies (because global banks participate in both systems); and system-based interdependencies (established through PvP settlement).<sup>11</sup> The main result is that, when liquidity is scarce, imposing PvP settlement of foreign exchange transactions creates a correlation between settlement activities in the two systems: under PVP, settlement can only occur if sufficient liquidity is available in both systems to settle the associated payments; for instance, when one system is congested, it is likely that the other will be too.

The model consists of two symmetric RTGS systems, each settling payments in a different currency. Each RTGS system processes its own local currency payments, as well as the local currency legs of foreign exchange transactions. The two RTGS systems are linked via common participation by a few large 'global banks' and the foreign exchange business they conduct with each other.

The payments network in each system is modelled to reflect empirically observed connections between banks: for instance, in the US Fedwire Funds system. That is, banks are heterogeneous in size and each has a limited number of counterparties. The arrival of payment instructions to the banks is then modelled as a non-homogeneous Poisson process, with the arrival rate dependent on the level of each bank's deposits. In one version of the model, the settlement of foreign exchange transactions is uncoordinated (non-PvP). In the second version,

11 The third type of interdependence, namely environment-based interdependence, such as reliance on common service providers, does not appear to have any interesting implications for intraday behaviour in payment systems: either both systems work, or they do not.

PvP is imposed: the settlements of each of the two associated currency flows occur simultaneously.

When foreign exchange trades are settled non-PvP, intraday credit exposures arise between the global banks active in foreign exchange settlement. If both systems are liquidity-rich, all transactions, including those associated with foreign exchange trades, settle immediately, and the duration of the credit exposures is negligible. The lower the liquidity in a system, the later settlement occurs, and the longer the exposures last. The authors show that this duration can be reduced when higher priority is given to the settlement of foreign exchange transactions. Of course, no credit exposures arise when PvP settlement is imposed.

Another measure of the link between the two systems is the degree to which payment instructions are queued because banks do not have sufficient liquidity to settle them. When settlement of foreign exchange transactions is uncoordinated, there is no correlation between the sizes of the queues in the two systems. In contrast, when PvP settlement is imposed, correlation arises when liquidity is scarce in one of the systems: settlement can only occur if sufficient liquidity is available in *both* systems and hence the average level of queuing within one system depends not only on its own level of liquidity, but also on that in the other system. Again, higher priority of foreign exchange transactions reduces the importance of this link, because quite independent of the available liquidity, foreign exchange transactions are not queued.

The discussion, led by **Stephen Millard**, focussed on issues around the simulation method and its calibration. A disadvantage of the simulation method is that banks' payments behaviour is relatively static. For example, a bank is constrained to settle its outgoing payments as soon as it has sufficient liquidity available: there is no room for strategic delay; nor is strategic choice of liquidity holdings accommodated in the model. The complete analysis of strategic behaviour is one of the

strengths of game-theoretic models, but these require a much more stylised description of the problem under consideration (see the discussion of Schanz's model). It would be difficult to capture the richness of the environment in this study: the authors simulate the interactions between 200 banks and model the settlement of thousands of payments.

With regard to the calibration of the model, it was suggested that payments be allowed to differ in size, perhaps to make the profile and distribution of flows more consistent with empirical observation. It is, however, not obvious whether this would meaningfully change the paper's qualitative results.

### 3.3 CLEARING AND SETTLEMENT ARRANGEMENTS FOR OTC DERIVATIVES

The Over-the-Counter (OTC) derivatives market is a striking case study showing how important it is for the development of the infrastructural landscape to keep pace with financial innovation. Recent developments in this sphere were discussed by a panel, chaired by **Pat Parkinson** of the Board of Governors of the Federal Reserve System, which comprised representatives of major infrastructure providers, as well as representatives of dealing and buy-side communities: **Peter Axilrod** (DTCC), **Ann Marie Davis** (Citadel), **Simon Grensted** (LCH.Clearnet), and **Bob Pickel** (ISDA). Key elements from the discussion are summarised below:

#### BACKGROUND

The OTC derivatives market has expanded rapidly in recent years. As one panellist pointed out, no derivatives market is currently growing at a rate of less than 10% p.a., and annual growth in multi-name credit default swaps (CDS) is approaching a massive 200%. What were once exotic products have become mainstream – “almost everyone is now in CDS!” Consequently, there is a need for infrastructural solutions that can both accommodate larger volumes and facilitate the

management of risk exposures arising between counterparties to a trade.

Historically, OTC derivatives markets have been cleared and settled on a bilateral basis. However, with rising volumes, banks' back offices have found it increasingly difficult to keep up with the pace of volume growth. New centralised, automated infrastructural solutions have emerged in recent years, streamlining processing at different points in the post-trade life cycle. The utilisation of such solutions has been boosted by a Federal Reserve Bank of New York (FRBNY) initiative launched in 2005 to address the particular problem of increasing backlogs of unconfirmed trades. The FRBNY brought together major dealers and their regulators, encouraging them to set and meet targets for backlog reduction.<sup>12</sup> Significant progress has since been made, particularly in CDSs. New industry protocols and enhanced legal documentation have also helped to establish a more robust post-trade environment.

#### **CPSS REPORT: "NEW DEVELOPMENTS IN OTC DERIVATIVES CLEARING AND SETTLEMENT ARRANGEMENTS."**<sup>13</sup>

In addition to the FRBNY initiative, the CPSS has also examined infrastructural arrangements in this field. A CPSS working group published a report in March 2007, tracking progress and developments since the publication of a similar report in 1998 and identifying new challenges.

The report notes the increased penetration of automated services since 1998, including services for matching and confirming trades, storing trade information, terminating contracts, and clearing and settling trades. It also emphasises the marked reduction in documentation backlogs, the more widespread use of collateral to mitigate counterparty credit risks, and the rise in prime brokerage for OTC derivatives. Looking ahead, the report encourages continued progress on several fronts.

- Processing backlogs should be reduced in equity and interest rate derivatives, thereby

extending the scope of the improvements seen for credit derivatives. Increased use of economic affirmation and portfolio reconciliation might also help to mitigate risks prior to confirmation.

- The potential market impact of close-outs should be mitigated, with consideration given to ex ante measures that might be employed. Regular "cleaning" of OTC derivatives portfolios, achieved via participation in multilateral terminations<sup>14</sup> and routine portfolio reconciliation, might help in this regard. Adequate interoperability between systems should be ensured, so as to leverage the benefits of new infrastructural services; maximise the potential for straight-through processing; and ensure data integrity throughout the life cycle.
- Appropriate resilience should be applied to "essential" services in the OTC derivatives sphere.

Panel members were supportive of the work carried out by the CPSS group, praising the careful exposition of the life cycle of an OTC trade and the useful identification of the essential building blocks of resilient architecture. One panellist remarked, however, that the report had come at a time when the infrastructural environment for OTC derivatives was still very much in transition. Hence, a third report might yet be required in order to gauge progress a few years down the line.

12 An industry letter to the President of the Federal Reserve Bank of New York making a commitment to targets for backlog reduction is available at: <http://www.newyorkfed.org/newsevents/news/markets/2005/industryletter.pdf>

13 Available at: <http://www.bis.org/publ/cpss77.htm>

14 Multilateral terminations provide a means by which firms with a large number of transactions and active trading relationships can reduce the number of transactions outstanding between them. Subject to a set of constraints (tolerances) established by the dealer (relating to counterparty credit exposure, portfolio deltas and residual cash settlement), the terminations service will search for offsetting positions among those submitted by participating dealers. TriOptima, the leading terminations service for OTC derivatives, estimates that up to 80% of a typical dealer's positions could be unwound with minimal impact on its net exposure to the market in general.



## WORKING TOGETHER

The panel discussion revealed the importance of cooperative and collaborative efforts in this field, both between market participants themselves and between market participants and public authorities. The FRBNY initiative has triggered a new wave of industry cooperation, reflected, for instance, in weekly meetings of major dealers and buy-side participants. There is strong recognition of the importance of these issues and a clear sense that everyone is working together towards a common goal.

There is no doubt that operational processes were previously cumbersome, involving too much “paper” and excessive manual intervention. But platforms available today can now be used to confirm trades on the trade date. And with no let-up in the pace of innovation, levels of automation will continue to rise and processing lags will be reduced further. Moreover, the importance of industry-agreed definitions, standards and protocols should not be underestimated. The implementation of ISDA’s Novation Protocol<sup>15</sup> in 2005, for example, established a standard for communication in the event of the assignment of a trade from one party to another and was a crucial factor in reducing CDS confirmations backlogs.

## AUTOMATION AND CLEARING

There are, however, formidable barriers to the creation of a financial infrastructure equivalent to that in the exchange-traded markets. Crucial questions include:

- How can straight-through processing be achieved when screen-based trading is less prevalent?
- How can dealers be encouraged to adapt their internal processes to accommodate new automated solutions, particularly if these require changes to front office processes for trade capture and confirmation?

- How can we design central clearing arrangements that are robust to multilateral risks?

The example of SwapClear, LCH.Clearnet’s central counterparty for interest rate swaps, is instructive here. The system achieves straight-through processing for 89% of trades, thereby requiring manual intervention only in exceptional cases. But this requires a not inconsiderable amount of spending on IT and changes to internal processes, to which some banks are reluctant to commit.

Mitigating multilateral risks is also a challenge. SwapClear recently introduced new default management procedures, the third improvement to these processes since the launch of the system in 1999.<sup>16</sup> Despite large outstanding volumes, OTC derivatives products are typically highly illiquid, making it difficult for the central counterparty to mitigate its exposures were a member to default. Under the procedures adopted by SwapClear, a defaulting member’s positions would be hedged in the market, so as to mitigate market risk incurred by the clearing house. The defaulting member’s positions would then be auctioned off to the surviving members. And if these were not taken up, they would be allocated to those members in equal shares. This procedure has knock-on implications for access criteria; access is granted only to highly creditworthy dealers with sufficient capacity to assume a sizeable portion of a defaulting member’s portfolio, and members can only submit trades from their own books or those of a subsidiary.

Will the clearing model be rolled out to other products? This is likely. Credit, in particular, represents an interesting proposition, but this is not a simple task. A question from the floor raised the issue of potential resource constraints in the dealing community following the market turmoil of the past few months. It was suggested

<sup>15</sup> Details of ISDA’s Novation Protocol are available at: <http://www.isda.org/isdanovationprotII/isdanovationprotII.html>

<sup>16</sup> Details available on p. 28 et seq. of the CPSS report (see: <http://www.bis.org/publ/cpss77.htm>).



that this might stymie the introduction of new services involving significant work to adapt internal processes.

Outside of clearing, the landscape is continuing to evolve. The launch of the Depository Trust and Clearing Corporation (DTCC) Trade Information Warehouse a year ago represents an important development. The Warehouse holds records of trades, keeps track of life cycle events, calculates settlement obligations and, via a newly established link to CLS, centralises settlement among dealers. In essence, the Warehouse is performing a service akin to that of a central securities depository in the securities market. In accordance with CPSS recommendations, DTCC is working towards achieving interoperability and open access to the Warehouse. At least ten service providers are already submitting trade details, and data held by the Warehouse is already, or will soon be, feeding other systems – such as CLS for the settlement of CDS cash flows, and Euroclear’s new DerivManager service.<sup>17</sup> While currently available for CDS data only, the Warehouse is expected to be rolled out to other products in due course.

## MARKET TURBULENCE

Notwithstanding the improvements seen in the automation of post-trade processes in the OTC derivatives market, there has been a great deal of talk of late regarding the renewed build-ups in processing backlogs during the recent market turbulence. This was driven by a spike in volumes, particularly in July and August, with turnover increasing by up to 300% for some large dealers in the CDS market.

Importantly, however, had the progress of the past couple of years not been made, the market would have “tipped over”. But no one on the panel was complacent about this, particularly as this episode revealed that backlogs had a greater propensity to arise at precisely the worst possible moment (i.e., when the market was moving quickly and volumes were rising sharply). More should be done to reduce the degree of manual

intervention and perhaps to get front and back office processes more closely aligned.

## EXPOSURE MANAGEMENT AND CLOSE-OUT

Finally, it was appreciated that more needed to be done to ensure that the closing out of a large market participant (or multiple participants) could be effected with minimal spillover. Good information is essential here, and the CPSS’s recommendation that portfolios be regularly “cleaned” (e.g., through participation in multilateral contract terminations and routine reconciling of portfolios) was endorsed by panellists. This could be part of a more general “active risk and relationship management” approach, which would also involve a regular review of contract terms, in order to ensure a full – and, importantly, shared – understanding of rights and obligations, as well as regular – perhaps daily – collateral calls. Such an approach would ensure fewer surprises and might even make close-outs less likely.

## 3.4 NON-BANKS AND RISKS IN RETAIL PAYMENTS

Over the past two decades the retail payments industry has moved from an environment characterised by paper-based payment instruments to one with automated processing by means of electronic information technology. This change has delivered significant efficiency gains and has underpinned impressive growth in the penetration of instruments such as cards.

Automated processing often takes place on a real-time basis and typically involves a variety of entities other than the banks responsible for clearing and settlement, (for instance, in the acquisition, authorisation and back-end processing of payment instructions exchanged between payers and payees, their banks and their technical processors). Several of these entities are likely to be non-bank service providers with an outsourcing or service-provision relationship with the banks. The back-end

<sup>17</sup> This new service is designed to offer comprehensive information on a dealer’s risk exposure.

processing of payments by non-bank companies on behalf of banks is not new to the industry, but in the last five to ten years it has become much more prevalent. Moreover, innovation in retail payments and in the way retail payment instruments are provided to, and can be initiated by, end-users has also led to the emergence of new roles for non-bank service providers. Most notably, non-banks have begun to provide payment services directly to end-users, at least in those countries where this is permitted by law. Prominent examples are internet and mobile phone-based payment solutions.

But what exactly is the role played by non-banks in retail payments, and are there implications for public policy – for instance in terms of risk, efficiency and the preservation of public trust and confidence in payment instruments?

This is the subject of the paper presented by **Simonetta Rosati** and **Stuart Weiner**. The authors investigate the importance of non-banks in retail payments in the United States and in 15 European countries, carrying out their assessment on the basis of a survey of European central banks and research carried out directly by the Federal Reserve Bank of Kansas City. According to the preliminary results presented at the conference, non-banks play multiple roles throughout the payment processing chain for five main payment instruments: cards; electronic cheques; credit transfers; direct debits and e-money and other pre-funded/stored-value instruments.

In particular, non-banks are found to have a prominent role in the United States across all of the payment instruments considered. Their role is growing in Europe, although differences persist among the various countries and payment instruments. But looking ahead, the importance of non-banks is likely to increase further in Europe. Two principal drivers stand out:

- The first is the industry-led initiative to build a Single Euro Payments Area (SEPA), which has fuelled banks' demand for the outsourcing of core processing activities to specialist third-party providers. The

processing of payments is concentrated, with providers handling large volumes of payments (sometimes those of an entire national market) able to achieve significant economies of scale. The third-party processing industry is undergoing a deep restructuring process in Europe aimed at achieving the European scale necessary to better facilitate the shift from national markets to a pan-European market. This has taken place by means of cross-border mergers and acquisitions among national players and the entry of large international IT companies into the payments business.

- Second, the implementation of EU legislation, in the form of the Payment Services Directive, will open up the front-end provision of payment services to non-bank entities (e.g., card companies, money transfer providers, telephone companies and large retailers), with harmonised requirements applied throughout Europe.

The authors go on to map out the risks to which the various payment activities are exposed, relating them to the roles assumed by non-banks in the processing chain. They first contend that certain risks may arise well before the clearing and settlement stage, in activities where non-banks' roles may be very important. Thus, oversight of retail payment instruments should consider the process as a whole, not only clearing and settlement.

Second, looking at the implications of the growing role of non-bank players throughout the processing chain for retail payments, the paper argues that non-banks' presence has shifted the locus of risks in retail payments. In particular, the authors consider that operational risk, in its various forms, has become more critical. This applies not only in terms of the risk of operational disruption, but also in terms of data security and privacy/data protection. Furthermore, in light of concentrated provision of processing services, there may be an increased risk of system-wide impact in the event of disruption to the operations of a major provider.

They recognise that the adoption of new technologies in payment processing, particularly as regards communication networks, has supported the mitigation of credit and liquidity risks associated with real-time payment authorisation (thanks to online communication networks linking merchants, users, their banks and the respective processors). However, the application of new technology to the payment networks and processing models naturally increases the number of points along the processing chain that could possibly be vulnerable to fraud and illicit use (as evidenced by available data). The resulting dissemination of payment-sensitive information through the IT systems of various entities, and at different points in the processing chain (e.g. at retailers or card processors, or on internet servers), increases banks' vulnerability to losses. It also heightens their exposure to risk events arising outside the payment systems themselves and hence outside their direct sphere of influence.

From this perspective, banks have become increasingly dependent on non-banks for the control of risks potentially arising from their retail payment business. Examples from the card industry reveal that, while market-based incentives encouraging the adoption of self-regulation do exist (e.g., card industry standards), under certain circumstances market forces alone may not be sufficient to overcome coordination failures or incentive problems. This is particularly true in the presence of externalities.

Third, the authors underline the importance of the international dimension, arguing that the main threats arise from the global dimension of the open technologies employed (which increases the possible scale and profile of international fraud, particularly fraud involving organised crime) and from the fact that, in several countries, the processing of payment instruments is concentrated in large international processors. Unless appropriate controls are established, this may constitute a system-wide risk.

Comparing the relevant regulatory frameworks in place in the European Union and the United States, the authors identify a number of differences. In the

case of Europe, the clear allocation of oversight responsibilities and power to the Eurosystem ensures that a variety of possible courses of action could in principle be undertaken if deemed necessary (with such options ranging from moral suasion to more pervasive regulatory solutions). In the United States, the oversight of retail payments is a function spread across various state and federal agencies and authorities. For instance, the major supervisory programme concerned with banks' technology providers (which includes payment-related technology) looks at these risks primarily from a banking supervision perspective. Hence, it does not necessarily take into account operational resilience or public confidence in the safe and efficient use of the payment instruments processed by these entities.

Thus, the authors conclude that, in view of the growing role of non-banks in retail payments and the related risk implications, there is an increased need for cooperation not only between banks and non-banks within the industry, but also between bank supervisors and payment systems overseers. Given the global reach of risks in the electronic era, cooperation is essential not only at the national level, but also, increasingly, at the international level.

In his review of the paper, the discussant, **Sujit Chakravorti**, acknowledged the usefulness of the taxonomy of non-bank involvement provided for the various payment instruments and countries, highlighting the complexity of the regulation of payment services in a changing institutional and market environment. He also indicated some ways in which the analysis could be complemented:

- first, by attempting to quantify the risks involved (as, owing to data limitations, the paper does not assess the severity of the various risk categories);
- second, by elaborating on the reasons why payment services are different from other services and the payment industry is somehow “special” (e.g., the presence of network goods in a two-sided market);

- third, by considering the implications of recent trends as regards the role of banks in payments (looking at whether banks are still “special” when it comes to payments, or whether their position has changed as revenue sources have shifted from payment processing to value-added services offered in competition with non-banks); and
  - finally, exploring further the regulatory differences across institutions, countries and payment instruments, as well as the possible implications for innovation by both banks and non-banks.
- key mechanisms for effecting payment and settlement. It also emphasises the important role played by confidence in the integrity of commercial bank money – and, by extension, the infrastructure that facilitates its transfer – in underpinning economic activity. The panel session picked up on aspects of this theme, with panellists noting that, while there had been some evidence of a preference for central bank money during the crisis, confidence in the infrastructure on which markets depend had remained intact. Market participants had, therefore, continued to take portfolio decisions on the assumption that settlement would occur as expected. However, an operational outage during this period would probably have had a severe impact.

### 3.5 FINANCIAL STABILITY VULNERABILITIES AND PAYMENT SYSTEMS

This final session of the conference was designed to stimulate debate on financial stability risks arising in payment and settlement systems. Two research papers were presented in a session chaired by **Nigel Wicks**, followed by a policy-oriented panel discussion. Taking place against the backdrop of recent turmoil in financial markets, much attention was paid in this session to the resilience of key infrastructures during the crisis and constraints on the flow of liquidity within and between payment systems.

These discussion points echoed the key financial stability themes introduced in the introductory paper of this publication: (i) the tendency towards concentration in infrastructure provision, which may generate “single point of failure” concerns; and (ii) strategic interaction between payment system participants, which, depending on the system’s design, has the potential to affect counterparty credit exposures and liquidity risks.

The paper presented by Gerali and Passacantando sheds some light on the first of these issues. Although not dealing with operational disruption to core infrastructure per se, the paper offers some insight as to the potential implications of the unavailability of

But agents’ behaviour within payment systems is also important and, as panellists acknowledged, it is not just a system’s design, rules and procedures that matter in this regard, but also the way in which these are applied by participants. And were current liquidity concerns to turn into serious solvency concerns among system participants, it is likely that the infrastructure would face an even stiffer test.

This touches on the second financial stability theme highlighted in the introductory paper: strategic interaction between system participants. Aspects of this are considered in the paper presented by Galbiati and Soramäki, in which the authors apply new agent-based modelling techniques to examine the trade-off between the cost to banks of generating liquidity to meet their payment obligations, and the cost of delaying settlement until anticipated incoming funds have been received. The authors show that, in the absence of a vehicle conditioning the timing of payments within a system, agents will typically generate too little liquidity.

This is a potential source of fragility, as payment systems will typically operate with a limited liquidity buffer. Panellists discussed the implications of constraints arising from either agents’ natural incentives to economise on their liquidity holdings or the inadequacy of existing liquidity bridges between systems.

While acknowledging that, during the recent market turmoil, an increasing preference for liquidity had actually reinforced liquidity recycling *within* payment systems, panellists stressed the importance of mechanisms to recycle liquidity *between* systems. Cross-border collateral arrangements were seen to have a key role to play in this regard.

The importance of agents' behaviour, for both system resilience and liquidity efficiency, argues in favour of close contact and cooperation between overseers and banking supervisors. Such a dialogue would also be valuable in ensuring a consistent regulatory approach where banks themselves provide infrastructure services (i.e., a "functional approach" to oversight and regulation). For this to be effective, however, there needs to be a meeting of minds and perhaps greater harmonisation of both the tools employed and the general regulatory approach. This also argues in favour of adopting an analytical approach, such as that contained in Galbiati and Soramäki, which allows the simulation of agents' responses to alternative stress scenarios. This might facilitate both *ex ante* stress-testing exercises and the formulation of *ex post* crisis management plans.

The remainder of this section provides more detailed summaries of the panel session and the various papers presented.

#### PANEL SESSION ON FINANCIAL STABILITY VULNERABILITIES AND PAYMENT SYSTEMS

This panel session, chaired by **Alexandre Lamfalussy**, began with a review of the performance of infrastructure during the recent market turbulence. The panellists – **Alberto Giovannini** (Unifortune Asset Management), **Andrew Gracie** (Crisis Management Analytics Ltd), **Peter Praet** (Nationale Bank van België/Banque Nationale de Belgique), **Daniela Russo** (ECB) and **John Trundle** (Euroclear SA/NV) – considered the lessons learned and identified key policy questions arising from the turmoil. A number of issues raised in previous sessions

were revisited, with panellists offering insights on important issues such as: the implications of changes in the market structure of infrastructure provision; liquidity and collateral management; and the conduct of oversight in a changing landscape. Key points raised in the discussion are presented below.

#### MARKET TURBULENCE

Overall, the performance of infrastructure during the recent market tensions has been reassuring. Although credit and debt markets are still in the midst of financial turmoil, payment systems and market infrastructures have held up well, with no major operational disruptions experienced. Many payment systems, CCPs and securities settlement systems have been able to accommodate peak volumes, with CCPs also successfully executing more frequent margin calls.

The solid performance of the market infrastructure may be seen as a reflection of the great strides made in recent years to ensure effective regulation and high standards of resilience (e.g., effective DvP arrangements in securities settlement systems, intraday finality, and the selection of adequate collateral). While OTC markets have struggled to cope with the recent volume spike, owing to the continued lack of standardisation in what remain largely bilateral processes, the ability of payment and settlement systems to settle record volumes without difficulty has instilled valuable confidence.

Market infrastructure has the potential to spread risks widely through the system. Therefore, notwithstanding the robustness of the infrastructure during what has been a testing period, there is no room for complacency. Having primarily been a liquidity shock, rather than a solvency shock, this episode has not placed the infrastructure under *extreme* stress. Perhaps the most striking aspect of the recent crisis has been the disproportionate scale of the systemic consequences, given the size of the initial shock, reflecting a synchronous, and abrupt, increase in banks' liquidity demands. Such non-



linear behaviour among market participants is a potential threat to the performance of infrastructure, which may be amplified by the design and operation of that infrastructure. In particular, operational disruption to, or strategic behaviour within, systems (e.g., owing to a lack of relevant information for risk assessment in the absence of standardised procedures) may affect the flow of liquidity, creating additional demands and further exacerbating non-linear responses. Indeed, it would be interesting to model the effects of an operational disruption during such financial turmoil.

Furthermore, the recent crisis also highlights the fact that the success of any efforts to establish common rules, standards and processes will depend on their effective implementation by participants. Changes in banks' liquidity preferences during this recent episode – i.e., liquidity hoarding, shortening of maturities and a preference for central bank money – have reinforced the effective recycling of liquidity within payment systems, probably contributing to the smooth functioning of the market infrastructure as a whole. But it is not entirely clear what would have happened had liquidity preferences been different.

### THE MARKET STRUCTURE OF INFRASTRUCTURE PROVISION

There was a consistent view among panellists that recent initiatives in the European Union's regulation of financial markets – e.g., through the implementation of MiFID and the Code of Conduct – had the potential to trigger major changes in the market structure of infrastructure provision. In particular, these initiatives are aimed at reducing national monopolies and encouraging competition at the international level. But such developments also raise questions about the potential effects of increased interoperability and enhanced access (both to a wider range of market participants and competing infrastructures). Here, further analysis is required in order to better assess the financial stability implications of increased competition, as measures to improve efficiency

do not necessarily go hand in hand with enhanced financial stability.

With particular reference to the European context, it was suggested that more needed to be done to analyse the relative advantages and disadvantages of architectures with “single” and “multiple” points of failure. The trade-off in concentrated systems between increased liquidity efficiency on the one hand and increased risk on the other is not always obvious. For instance, in systems such as TARGET2 and EURO1, participating banks are better informed about their exposures. In fact, more generally, risks are perhaps more easily identified and managed in a concentrated environment. And while the impact of a shock is typically imagined to be greater in concentrated architecture, this might not be so in the face of contagion between multiple interoperable infrastructures. Furthermore, the globalisation of financial markets and further technological developments are making it increasingly difficult to define the geographical scope of the various systems.

Growing system interdependencies and the increased importance of intermediaries in providing services critical to the functioning of infrastructure also require further policy reflection. As discussed in the panel on interdependencies, potential stability effects arising from the complex relationships between markets, systems and participants are not always easy to anticipate and need careful consideration.

### LIQUIDITY AND COLLATERAL MANAGEMENT

In light of recent market events, one might anticipate a move towards more secured transactions. Accordingly, there is clear value in taking steps to ensure easy and effective mobilisation of collateral, particularly in times of stress and in support of access to central bank liquidity. Panellists emphasised the benefit, in such circumstances, of access to a large, diversified pool of collateral which could be used flexibly across markets and systems. Robust and effective cross-border solutions are important in



this regard. These solutions could be facilitated by widely harmonised central bank eligibility criteria. However, progress might be difficult to achieve in this regard, owing to differing central bank risk tolerance levels and persistent operational barriers. Closer cooperation between central banks, infrastructure and market participants on such issues is essential. As expressed in the high-level remarks, careful consideration should be given to cross-border collateral arrangements, with a view to facilitating the provision of liquidity – by central banks that wish to do so – in the *right* currency, to the *right* participants and against adequate collateral.

#### THE SCOPE AND CONDUCT OF OVERSIGHT AND SUPERVISION

Oversight of payment and settlement systems is typically seen as a central bank function, with the objective being to promote safety and efficiency by monitoring existing and prospective systems, assessing them against objective standards and, where necessary, taking action to mitigate risk. Payment and settlement oversight is distinct from prudential supervision, which focuses instead on the soundness of individual financial institutions.

To date, overseers' primary concern has been to ensure that systems do not act as channels for the transmission of shocks between their participants. Panellists reflected on whether concerns similar to those addressed by oversight standards should not also be addressed by relevant prudential regulation. This would recognise the importance of participant-level behaviour in the smooth functioning of infrastructures and address the risk that system resilience was undermined by individual participants. If applied to settlement risk (including risks stemming from intraday credit/exposures), the current supervisory framework should offer adequate tools to ensure consistent risk management measures for banks and infrastructure.

Increased alignment of the objectives of overseers and prudential regulators might also be desirable in the context of the greater prominence of firms operating as infrastructure providers. There was clear consensus among panellists on the need for a functional approach

to regulation and oversight, with a view to ensuring that similar risks were addressed by similar regulation, regardless of the status of the infrastructure provider. This would ensure a level regulatory playing-field. At the same time, standards should be applied in accordance with the scale of the risk being addressed (i.e., a risk-based approach should be adopted).

But the application of risk-based functional regulation is fraught with difficulty, and panellists were careful to stress that this should not be applied in a naïve way. Importantly, a functional approach need not mean that the same standards be applied to all institutions in the same way; rather, it implies the application of similar standards within a regulatory framework appropriate to the institution concerned. Broadly neglected in the past, some progress has recently been made in this regard in the European Union in the context of the establishment of ESCB-CESR standards for securities settlement systems and CCPs.

It was also suggested that the micro-prudential approach currently applied in the oversight of payment and settlement systems might not adequately capture all sources of systemic risk, particularly in a world in which systems were increasingly interdependent. And more might need to be done to establish a proactive policy in the sphere of crisis management and resolution so as to ensure that the critical functions of infrastructures were not interrupted. In particular, test arrangements and simulation exercises are important in ensuring readiness to deal with crisis situations, especially in the context of globally interdependent players and infrastructure. An important new characteristic of modern crises is that interdependence: (i) makes it more difficult to identify the source of the crisis and to gather all the information relevant to a comprehensive risk assessment; and (ii) has the potential to create simultaneous shocks across markets and infrastructures.

This clearly calls for increased cooperation between supervisors and overseers. But one of the challenges in establishing a stronger

relationship is that supervisors and overseers appear to be adopting different approaches in pursuit of their risk-mitigation objectives. Three main differences were identified by panellists:

- central bank overseers typically pay more attention to (very) short-term liquidity issues than do prudential regulators;
- while overseers follow a largely *ex ante* approach, with minimum risk control measures explicitly enforced, supervisors tend to focus more on *ex post* assessment of the prudential measures adopted by regulated entities; and
- banking regulation is based in large part on capital requirements, while central bank oversight applies a combination of credit limits and collateral requirements.

There is a clear need to reduce this “cultural” gap between oversight and supervision and more closely align the objectives, responsibilities and conduct of these two vehicles for public intervention. This could be achieved via the establishment of an active dialogue between central banks and regulators, including close coordination and cooperation between the CPSS and the BCBS.

## RESEARCH PAPERS

In their paper, “An agent-based model of payment systems”, **Marco Galbiati** and **Kimmo Soramäki** pick up on some of the issues associated with bank behaviour in payment systems and, in particular, the flow of liquidity within a system. Liquidity risk crystallises in a real-time settlement system when participants’ holdings of the relevant settlement asset are insufficient (causing delays and possible systemic gridlocks), so it is important to understand the determinants of banks’ liquidity choices.

The authors develop a model of reinforcement learning in which banks refine their liquidity choices over time in response to their observation

of other banks’ behaviour, taking account of the expected cost of delaying settlement. Modelled as a repeated game, the sequence of events is as follows. At the start of the day banks choose how much liquidity they wish to hold, deploying this liquidity within the system as random payment orders arise. To the extent that insufficient liquidity is available to execute such orders, banks may be forced to delay payments, with the combination of liquidity and delay costs incurred constituting a bank’s “pay-off”. The following day, banks play the game again, adapting their choices in accordance with observed behaviour during the previous period. Banks eventually converge on an equilibrium aggregate level of liquidity for the system.

As might be expected, with low delay costs relative to liquidity costs, banks tend to generate limited liquidity, allowing queues to build. As delay costs rise (again, relative to liquidity costs), banks raise additional liquidity. Indeed, the equilibrium liquidity choice is shown to be an S-shaped function of delay costs. The aggregate level of liquidity generated in the system is found to be inefficient. In particular, the total costs of the system could be reduced if all banks posted more liquidity. This reflects *positive* externalities in liquidity provision, in that each unit of liquidity posted by a bank facilitates settlement (and hence reduces delays) for other banks in the system.

The authors build on this “base case” scenario to consider, for instance, the implications of alternative network topologies and alternative scenarios for operational resilience. They find that concentrated systems are more efficient – achieving higher recycling ratios – than dispersed systems. And, in the presence of operational risk, banks insure against disruption by posting additional liquidity.

The paper is based on numerical simulations and does not, therefore, derive its results analytically. However, the authors offer some explanations for the observed phenomena. Consider, for example, the conclusion on the issue of concentration, which some in the audience found

surprising: in a concentrated system, liquidity is returned to the originating bank more often, leading to better recycling and hence greater liquidity efficiency. Also, it turns out that if the same volume of payments is distributed across fewer banks, the liquidity balance of each bank becomes more stable. This implies that, in more concentrated systems, liquidity buffers are less likely to be exhausted. Hence, buffers can be smaller in proportion to the value of payments to be settled and liquidity usage is therefore more efficient. Finally, as pointed out by the discussant, **Cornelia Holthausen**, fewer members internalise a greater proportion of the positive liquidity externality.

This is one of the few studies applying an agent-based approach to the modelling of payment systems. In so doing, this work facilitates the study of strategic effects arising in the presence of complex liquidity flows and liquidity cascades. Holthausen suggested that the authors might usefully calibrate the model using real data, so as to allow equilibrium choices to be investigated with realistic values for liquidity and delay costs. Others in the audience agreed, suggesting alternative assumptions for the functional form of delay costs, alternative network topologies and alternative arrival rates for payment orders. Holthausen also suggested extending the paper to consider different liquidity regimes, whereby, for example, banks could modify their liquidity holdings during the day and perhaps extend intraday credit to one another.

Finally, the discussant commented on the potential value of this framework in examining a range of policy measures, such as information dissemination in the event of an operational incident, the optimal provision of central bank liquidity and alternative system designs.

The panel discussion emphasised the importance of confidence and trust in the payment systems and market infrastructures that lie at the heart of the financial system. In “The Loss of Confidence in Bank Money in the Great Depression”, **Andrea Gerali** and **Franco Passacantando**

provide evidence in this regard. Their paper focuses on the implications of the loss of confidence in bank money during the Great Depression. While the bank failures that took place during the Great Depression contributed to the contraction of the money supply, Gerali and Passacantando argue that, in addition, bank failures reduced the acceptability of bank money as a payment medium. The wave of bank failures increased the risk of using bank money and thus gave rise to a “loss of trust”. The resulting increase in transaction costs had an impact on consumption and investment. One implication here is that central banks’ responsibilities with regard to the oversight and operation of payment systems could mitigate the effects of such a crisis.

In explaining the Great Depression, Gerali and Passacantando first present the seminal and prevailing view advanced by Milton Friedman and Anna Jacobson: the fall in output was amplified by a sharp decline in money supply, reflecting the Federal Reserve’s misinterpretation of the problem, as well as external constraints, such as gold standard rigidities. The authors then offer their own view, which focuses not on the quantity of money, but rather on “transaction services” associated with the use of a given quantity of money. The capacity of money to serve as a means of payment depends on a confidence factor, because most transactions are based on instruments bearing credit risk. Credit risk has three components: debtor risk; settlement risk; and systemic risk. All three components are deemed to have played a role in reducing the acceptability of bank money in the Great Depression. The initial disruption to the use of money as a means of payment was the spate of bank failures, with payments using bank money ultimately declining even more sharply than M2. Subsequently, the increase in transaction costs associated with the use of alternative means of payment had real effects on the economy.

Friedman and Schwartz regard the bank failures as being important only in so far as they led to a reduction in the stock of money. They stress that

the impact of such a contraction of the money supply would have been “equally severe and probably even more so” in the absence of bank failures. Gerali and Passacantando, on the other hand, emphasise that the loss of confidence in bank money and the public’s unwillingness to use it as a means of payment was crucial and, indeed, limited the effect of more expansionary monetary policy on economic activity. They consider that their approach complements the explanation put forward by Ben Bernanke, adding payment services as a key explanatory variable. Bank failures disrupted the ability of the financial system to channel funds from savers to good borrowers, with the increases in borrowing costs and credit rationing turning a normal recession (prior to October 1930) into a full depression. Thus, banking crises exacerbated the recession.

In their empirical analysis, Gerali and Passacantando use two proxies: to measure confidence, the value of bank deposits held in suspended or failed banks; and, to measure the use of bank money as a means of payment, the ratio of bank debits (the sum of all transactions that affect bank deposits, including those between two clients of the same bank) to bank deposits. The results support their claim that the loss in confidence reduced the use of bank money as a means of payment. Gerali and Passacantando then provide anecdotal evidence to illustrate their claim that the decline in transaction services had a sizeable effect on real activity. They provide examples of the loss in confidence and the increased transaction costs associated with the use of alternatives to bank money. For instance, many communities within the United States introduced various forms of barter, scrips or stamp money.

In their conclusions, the authors stressed that the Great Depression was not a unique event. Disruptions to payment systems had occurred also in other crises, e.g., in Russia and Argentina more recently. Gerali and Passacantando observed that the payment system had so far performed well during the recent turbulence in the financial markets,

while the interbank market had suffered a crisis of confidence. They concluded that policy actions to restore confidence played a key role in such circumstances. Liquidity injections and macroeconomic policies were obviously important. But, in 1933, deposit insurance and emergency lending powers employed by the Federal Reserve System were essential to restoring confidence.

In his discussion of the paper, **James Moser** stressed that the authors had presented a compelling and interesting explanation of an episode of economic history that still fascinates many researchers. However, their approach may have focused too much on one of the three dimensions of bank money, namely its role as a medium of exchange. The other two dimensions – i.e., its role as a unit of account and a store of value – also needed to be taken into account if a supply shock to bank money was to be comprehensively described. A positive shock increasing the value of money in its other dimensions could offset the decline of its value as medium of exchange.

Turning to the empirical evidence, Moser suggested clarifying the definition of the variables. He also pointed out that the negative correlation between the proxies for confidence and use of bank money for payment purposes was driven by the rise of the first, and the decline of the second, series during 1930-1933. In other periods, there was no clear correlation between the series. The authors should take into account that 1930-33 was special, for example by including an indicator variable for this period, and check whether their results continued to hold. Finally, some cross-country comparison might be useful. For example, Canada too had suffered a Great Depression.

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