SYSTEMIC RISK IN INTERNATIONAL SETTLEMENTS

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Abstract

The recent growth in the movement of global funds has raised concerns about the potential for systemic risk in the payments system. Given the sheer growth and large volume of transactions currently processed through such payment systems, participating financial institutions contract serious intraday credit exposure. Such exposure can give rise to settlement failures and consequently, systemic risk. To prevent such settlement failures from turning into a systemic crisis, central banks and regulatory authorities need to play a balancing act -- while filling the potential liquidity gap as implicit guarantors of the settlement system, they must catalyse risk reduction policies to reduce the externality problem, that is to reduce systemic risk. This paper examines the extent to which different settlement systems affect the nature and potential vulnerability of the financial system to systemic risks. An important consideration throughout the analysis is whether externalities can be reduced if individual institutions fully internalise the costs of their actions.

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SYSTEMIC RISK IN INTERNATIONAL SETTLEMENTS

1. Introduction

The recent growth in the movement of global funds has raised concerns about the potential for systemic risk in the payments system.[1] The payments system is the channel through which funds are transferred between financial institutions in the form of electronic debit and credit-book entries. Given the sheer growth and large volume of transactions currently processed through such payment systems, participating financial institutions contract serious intraday credit exposure. Such exposure can give rise to settlement failures and consequently, systemic risk. To prevent such settlement failures from turning into a systemic crisis, central banks and regulatory authorities need to play a balancing act -- while filling the potential liquidity gap as implicit guarantors of the settlement system, they must catalyse risk reduction policies to reduce the externality problem, that is to reduce systemic risk.

This paper examines the extent to which different settlement systems affect the nature and potential vulnerability of the financial system to systemic risks. An important consideration throughout the analysis is whether externalities can be reduced if individual institutions fully internalise the costs of their actions. The proposed standards for payments and risk control features (Lamfalussy Report), including the length of time during which participants are exposed to credit and liquidity risks, are addressed (BIS, 1993). Moreover, given the international nature of present day payment settlements, the role of various regulatory and legal structures need to be considered. The paper discusses the role of public intervention through prudent regulation in the payments system by considering the cost, risk, and efficiency arguments for reducing systemic risk through various systems. Economic theory suggests that government action can be justified if there is an externality. Systemic crises can cause the economy to suffer from suboptimal economic performance which can

affect society as a whole. The ultimate effects of a “chain reaction” failure of financial institutions can exact economy wide losses which were not accounted for in the original costs. Clearly, the risk preceding such systemic crises implies lost economic efficiency and therefore calls for appropriate pre-emptive regulatory responses. In so far as payment systems generate externalities, their prices need to reflect the appropriate incentive schemes for financial institutions. There has already been some debate between countries on the appropriate design of payment systems reflecting their different approaches to regulation. While the EU has been leaning towards systems with collateralised overdrafts, the U.S. prefers a non-collateralised system with a fee for overdrafts.

A significant cost of reduction in payments-related credit in settlements systems through charges on overdrafts and collateralisation is the pressure to create private sub-management systems as low cost alternatives. Consequently, the very reasons – namely, better risk management – for which collateralised methods are replacing other systems are undermined. As regulators, the ultimate goal is to find methods to internalise the costs of such activities, and the creation of intermediate private netting markets might only serve to introduce further credit risk into the system. Thus, if the ultimate responsibility is to lie with the lenders of last resort, it might be easier for central banks to avoid agency problems by actively managing such risk themselves and discouraging such private sub-management systems. With any system, the systemic nature inherent in a single settlement failure requires the establishment of minimum regulatory standards whether in terms of interest charges, collateralisation requirements, or loss sharing agreements. The paper concludes by discussing the establishment of such standards and the associated trade-offs between their costs and ability to reduce risk.

2. Background

2.1. Systemic Risk -- An Externality Problem

Systemic risk is to financial markets what dirty smoke is to the environment. In calculating the cost of production, the factory owner fails to account for the costs which the smoking chimney imposes on society. The dirty smoke is an externality. Its production has an impact on the welfare of society, but that impact is external and it is not priced through the market. The factory owner does not pay for the extra costs of laundry or for the medical bills the smoke precipitates. This failure introduces a fundamental shortcoming into the workings of the market so that the costs to the factory do not reflect the costs of the pollution to society as a whole. The result is pollution. The factory produces more smoke than would be the case if all society's costs were accounted for in the factory's balance sheet. Similarly, financial firms do not always price the costs that their losses might impose on society as a whole into their activities. Taking risks is what financial institutions are for, but markets, in reflecting only the private calculation of risk, underprice the risk faced by society. Consequently, similar to pollution, investors in free markets may participate in excessive risk taking. (Eatwell and Taylor, forthcoming)

The debate on payments settlement systems has concentrated on the appropriate pricing of credit exposure to account for negative externalities caused by settlement failures. Such failures could be the result of time delays, institutional shortcomings, or liquidity gaps. Each of these issues could lead to serious systemic crises, and therefore the role of guarantor becomes crucial for the success of the entire financial system. At the same time, it is also important that the guarantor establish appropriate incentives to reduce moral hazard behaviour. While the central bank acts as the ultimate guarantor, it also needs to foster a greater sense of responsibility within market participants through appropriate regulation. Herein lies the critical

trade-off between payments systems -- the need for liquidity vs. the need to reduce unnecessary credit exposure.

2.2. Payment Systems

There are two types of payments systems: real time gross settlement (RTGS) and multilateral netting system. The most important feature of an RTGS system is that it provides instant settlement with finality as soon as a payment order arrives provided that sufficient funds are available in the account of the sending bank. Settlement refers to the actual transfer of funds from a sending to a receiving bank. Finality means that the settlement is unconditional and irrevocable. In an RTGS system, real time implies that payment orders are continuously executed while gross settlement means that for each payment order, the total gross amount of funds is transferred. Settlements in netting systems do not occur immediately upon receipt of payment orders. The system immediately informs the receiver if the order meets some minimum criteria, but the actual settlement does not occur until the end of the day. At this point, the system calculates the net payments or settlement obligations for all participants and then the settlements are completed.

A crucial difference between RTGS and netting systems is that netting systems only have contingent finality. Although most netting systems disallow any retraction of the orders and in this sense the orders are final, the finality is conditional upon the probability of settlement failure. That is, if a failure occurs because one or more participants in the system have insufficient funds, the netting system has to allow them to rescind their orders. Therefore, the finality is highly dependent on the daily success of settlement. Netting systems are also different in that they do not need to be operated by a single settlement agent since the system has two separate operations: clearing and settling. The clearinghouse receives and records all payment orders and checks whether the minimum criteria are fulfilled before calculating the net settlement obligations of each participant. The

settlement agent then completes the actual transfer of funds. Thus, the clearinghouse can be managed by any private, public, bank, or non-bank organisation. However, the settlement agent needs to have the endowment of a guarantor and therefore central banks seem to be the natural choice. Consequently, separating roles is not possible in an RTGS system. Table 1 lists the various RTGS and netting systems presently in operation and planned in selected countries.

Recent debates and research on interbank settlement systems have concentrated on the pricing of daylight overdrafts to control their use. Faulhaber, Philips and Santomero (1990), and Humphrey (1989) have examined the role and optimal design of a pricing mechanism with the Federal Reserve in the US. The result has been the introduction of a fee for daylight overdrafts which the Federal Reserve began in 1994. Alternatively, European central banks have decided to collateralise rather than price overdrafts. This choice fits the long run desire of European countries to progressively move towards settlement systems with little intraday credit exposure as evident in their desire to meet the Lamafalussy Standards. i.e., RTGS. These standards specify that European Union countries must have RTGS systems in place before they can be linked under an all encompassing system within the Union, i.e., *Target.* There has already been progress in most EU countries including the UK which has not even joined the EMU. There are larger private opportunity costs to collateralising overdrafts, as financial institutions must deposit their loanable funds as non-interest bearing reserves with the central bank; however, the total benefits of these reserves which include benefits to society as a whole outweigh their costs if they minimise systemic risk associated with settlements.

2.3. Settlement Risk

Settlement risk refers to the risk that financial losses may occur when payment systems are used for settlement. Settlement risk is present in different forms to different payment systems, usually as credit,

liquidity, or unwinding risk; however, the interrelationship of these risks can make it difficult to differentiate between them.

Credit risk arises when the purchaser of an asset defaults by failing to settle any or all of its obligations. Credit risk is a function of the potential loss exposure when a buyer initiates a transaction ordering its bank to transfer funds but then cannot make payment without going into an overdraft situation. Credit risk arises when the two sides of a transaction do not pay simultaneously. In payments systems, credit risk can be separated into “first payer risk” and “receiver risk.” First payer risk refers to the risk faced by the party who pays first in case the corresponding payment is not received from the counterparty. Receiver risk arises when a receiver assumes that a received payment is final before it actually is and pays its obligation. Receiver risk also exists in RTGS systems when financial institutions are indirect users. That is, they are not members of the payments system but use a bank which is a member. An indirect user is exposed to receiver risk due to the time lag between the time its bank receives payment and notifies its customer. Credit risk can be easily overlooked in payment systems since the extension of such credit is not intentional but the result of routine payment operations; furthermore, such extensions usually last for less than one day. However, given the large size of such exposure, the risk can be real and significant to indirect users.

Credit risk is especially acute in foreign exchange transactions due to the involvement of payments systems from different countries. The main risk in the settlement of forex transactions is that one party settles its part while the other party fails to do so. This is often referred to as Herstatt risk.[2] Such cross currency settlement risk is the result of non-overlapping hours of the payment systems caused by the differences in time zones in which the major central banks are located. Although credit risk is present in both RTGS and netting systems, it is smaller in the latter especially if there is lots of “traffic” with other users in the system. Heavy traffic means that the netted amount of payment due or owed would be small resulting in little credit

exposure. Thus, a bank with little or no dealings with other banks benefits relatively less from the netting system's ability to limit credit risk.

2.4. Unwinding Risk

Unwinding risk can be the result of receivers not being able to settle transactions due to some instructions being revoked or unwound. Unwinding occurs when there is settlement failure in netting systems and the daily payment orders need to be revoked. Unwinding causes serious losses to netting users, for these users may have already used the amounts to make payments in other systems which will now be defaulted. These costs only increase in light of the international nature of payment systems in present day transactions. Moreover, after unwinding occurs, users need to renegotiate their positions which might lead to further financial losses. The management of unwinding risk is even more difficult than credit risk since the creditworthiness of all parties in the netting system rather than only that of the counterparties in the transaction needs to be verified to prevent settlement default. Clearly, there are high information requirements for the successful management of such risk since unwinding risk exposes every user to every other user's risk. Unwinding risk is a systemic risk because of its ability to affect more than one user. The chain reaction caused by the settlement failure of one transaction can be widespread. Some netting systems allow for the day's transactions to be unwound to limit the damage, but given the size of present day payments, this can amount to more than $1 trillion. Thus, unwinding can raise doubts and concerns for investors regarding the stability of the entire system thus creating a systemic crisis from a local individual settlement problem.

2.5. Liquidity Risk

Liquidity risk exists when payment orders cannot be settled due to a lack of liquidity even though all parties are financially healthy.

Although liquidity risk exists in both RTGS and netting systems, its presence is more poignant in RTGS systems since gross settlements require greater liquidity to settle exposing every participant to every other participant's liquidity risk. Unlike other transactions, immediate liquidity at settlement time is crucial and even a temporary liquidity shortfall can create severe problems. Liquidity risk can be reduced if all parties in the payment system retain sufficient liquidity, i.e., cash or reserve balances, which can be used for clearing purposes. However, maintaining liquidity has serious opportunity costs to participants, since cash or reserve balances held by financial institutions do not earn interest income. Consequently, a trade-off exists between reducing liquidity risk and the costs of maintaining sufficient liquidity in the system. Liquidity risk is a systemic risk since a liquidity shortfall for one participant can lead to liquidity shortfalls for other counterparties resulting in a chain reaction of systemic liquidity shortfall. As mentioned before, RTGS systems are more prone to suffer from liquidity risk than netting systems since a shortage at any time would bring the entire system to a halt.

Credit risk remains prevalent in all systems whereas unwinding and liquidity risk are more peculiar to specific systems. The degrees of unwinding and liquidity risk depend on the type of system in practice. Unwinding risk exists exclusively in netting systems whereas liquidity risk is present mainly in RTGS systems. If any one participant suffers from any of these risks, they expose all other participants as well; herein lies the systemic nature of the problem.

3. Risk Management in RTGS and Net Settlement Systems

Recent reforms in net settlement systems in different countries have concentrated on reducing systemic risk as well as the interventionist role of the central bank in case of a systemic failure. For RTGS systems, efforts have centred on reducing the growing credit exposure of central banks. The objective of these reforms and regulations has been to improve the safety features of payment systems by forcing

private participants to internalise the social costs of third party risk (Passacantando, 1991). Bank's exposure to such payment risks ceases when settlements are finalised through payments received from the central bank. Thus, at a very basic level settlement risk can be lowered by reducing the size of a bank's exposure as well as by preventing unnecessary payment delays. Furthermore, it has been widely accepted that systemic risk in payment systems can be better controlled in RTGS systems rather than net settlement systems.

4. Risk Management in RTGS

Central banks provide RTGS systems to commercial banks and other selected institutions such as government agencies, and in some countries, clearing houses for securities and derivatives exchanges (BIS, 1997). Current design issues in RTGS systems vary by different countries but two aspects which are commonly discussed for better risk management are policies for central banks granting intraday credit and establishing queuing systems. Intraday credit is useful in an RTGS system since it is able to reduce payment blockages which may arise when receiving banks do not execute their transactions before checking that the sending banks are "covered." In an RTGS system, the "cover principle" ensures that the sending bank has sufficient reserves, or cover, in its reserve account at the central bank before payment execution. An important systemic risk concern in the RTGS system is the risk of a liquidity shortage. This risk can be reduced by increasing the liquidity held by the its member banks. As mentioned before, the opportunity costs of retaining liquidity can be high. Consequently, individual banks do not want to bear the entire cost of potential chain reactions caused by liquidity shortages and choose a level of liquidity which is lower than the social optimum; yet again, an example of how private banks do not internalise the costs of their activities which can have negative externalities on society as a whole.

Central banks often provide minimum intraday liquidity to payments systems for the smooth running of the RTGS system. Although

unlimited central bank intraday credit could reduce ensuing delays caused by the "cover principle," it might create a moral hazard problem so that banks would begin to manage their intraday liquidity less efficiently while assuming that the central bank will bail them out of a liquidity crisis. Reserves held at the central bank under minimum reserve requirements, collateralised intraday loans/overdrafts as well as non-collateralised loans/overdrafts are extended to member banks under intraday liquidity programs. Essentially, the central banks face a trade-off whereby they reduce liquidity risk in the payments system while simultaneously increasing their own credit risk. However, as a central bank they realise that the social costs and systemic impact of a liquidity shortage far outweigh the higher potential credit risk they face. Clearly, central banks face less credit risk if only collateralised loans are made. Although collateralised loans from the central bank are cheaper for private banks than clearing their balances, liquidity risk still exists. Collateralised loans are still relatively costly to banks since they could invest the same collateral in higher interest bearing assets. Consequently, the opportunity cost still exists motivating private banks to hold less liquidity than is required to eliminate liquidity risk from the entire system.

Although RTGS systems are supposed to operate continuously, some payment orders are not always executed. In the standard case, for instance, when a sending bank has insufficient funds, the payment order will be rejected unconditionally by the central bank and returned to the sender. The sending bank may then prioritise this particular payment order and then resubmit it to the RTGS system when sufficient funds are available to cover the transaction. However, the rejected payment order of the sending bank can lead to settlement delays for other banks which may have already included this payment in their daily liquidity management. A build up of such delays can cause a gridlock of the entire payment system. The systemic costs of such delays can be large and need to be accounted for. A bank is forced to delay its payment when it has insufficient liquid reserves or has already exceeded its permitted overdraft or credit limits with the

central bank. As discussed above, one solution is to provide temporary liquidity in the payments systems through intraday credit. Similarly, banks can learn to manage their payment traffic with lower levels of liquidity. This option has high costs for private banks since they need to employ better liquidity management systems such as input sequencing and splitting payment orders. Each of these measures entail high costs including extra equipment, staffing, etc. Moreover, such measures to increase liquidity will benefit all participants in the payments system. Thus, if left to the private banks alone, they might not necessarily take on such costly responsibilities for fear of "free riders" who might take advantage of the banks who do incur the costs.

At a very basic level, the following definitions might help to elucidate the problem. Humphrey defines payment reserves or overdraft limits

$$\bar{L} = \sum_i \bar{l}_i$$

of private banks as
The $\bar{l}_i$ represents the limits for each bank while the $\bar{L}$ is the aggregate limit for all of the banks in the entire system. Settlements occur at a rate *r* times the number of permitted overdrafts:

Thus in order to prevent settlement delays, when overdraft limits *($\bar{L}$)* are reduced, the rate at which the settlement payments are made (*r)*

$$S = \bar{L}r$$

needs to increase and vice versa. As mentioned before, some central banks are granting intraday credit to increase *($\bar{L}$).* Increasing *(r)* is a solution, but it imposes high costs on private banks and raises their suspicions about the free rider problem. Central bank intervention is justified since the social costs of settlement delays and gridlock can be large and systemic. Therefore, central banks need to consider subsidising the costs of increasing *(r)* and preventing gridlock. The probability *(p)* of gridlock and its social costs can be defined:

$$p(G)=p(1-S)$$
$$p(G)=p(1-Lr)$$

$$SC=PC+p(G)$$
$$SC=PC+p(1-Lr)$$

$$0 \leq p \leq 1$$
$$G=Gridlock$$
$$PC=Private\ costs$$
$$SC=Social\ Costs$$

The key to preventing settlement delays from becoming a systemic problem is the probability *(p)* of gridlock; ideally, private banks should be solely responsible for any delays they might cause and the subsequent costs. Since gridlock is the result of settlements which are not executed or *(1-S),* the central bank can try to subsidise the costs of increasing *(r)* through "optimisation" (BIS, 1998). In this case, increasing *(r)* might be considered a public good. As an alternative to returning the payment order to the sender, optimisation requires that unexecuted payment orders remain in centrally located and managed queuing system. In this case, the central bank retains all payment orders which require cover in a centrally located queue which releases them as soon as sufficient funds are available. Such a system might provide a more orderly flow of payments since the system can more efficiently manage payment requests which will offset and provide cover to each other to some extent. Of course, a moral hazard problem might arise if banks rely too heavily on this queuing system to manage intraday liquidity. It may also increase interdependence and settlement risk if banks begin to anticipate and direct final payments ahead of the queue. Nonetheless, it is at least one way to prevent the spread of a temporary payment gridlock into a system wide problem. Table 2 describes the differences between queuing systems in some countries.

5. Delivery-versus-Payment Systems

Another common method to reduce a specific type of credit risk, called principal risk, in various securities transactions in RTGS

systems has been the use of delivery-versus-payment (DVP). DVP eliminates the credit risk inherent in a transaction because it requires all payments to occur with finality at the same time. Such settlement procedure requires that a link exist between a real time security clearing system and a monetary clearing system before a securities transaction can be completed. The US and the Swiss use such DVP systems to ensure that securities are transferred from the seller to the buyer if and only if funds are transferred from the buyer to the seller. Since this requires real time payment finality in every transaction, DVP only works in an RTGS payments scheme. DVP can also be used in foreign exchange transactions to eliminate the cross-currency settlement risk; in this case, it is called payment-versus-payment (PVP). PVP requires that both systems have RTGS systems, overlapping operation times, and the payment orders must be sent during these overlapping times. While such synchronisation of operating hours may be easily arranged within Europe, it requires longer hours of operation in other places. In response, the US Federal Reserve plans to extend their operations to 18 hours per day by the end of the year, but other financial centres have not indicated any changes so far. Moreover, although the dollar side of settling forex transactions is conducted through CHIPS, an RTGS system, most of Europe and Japan still use netting systems.

Although DVP systems eliminate credit risk, its costs can prohibit its immediate adoption. There are vast technical and co-ordination requirements which would require the absorption of greater information for each RTGS system in every country. Furthermore, another potential cost of DVP systems is its effect on increasing systemic risk. The linking of RTGS systems for simultaneous settlement of each part of forex or other securities transaction might reduce cross-currency settlement risk, but it can lead to further settlement delays. If the settlement of one part of the payment order is conditional upon settlement of another, a delay in one system will cause settlement delays in others. These delays could be the result of liquidity or more mundane technical problems, but in any event,

domestic RTGS systems will essentially be importing problems of foreign RTGS systems due to the links between them. Therefore, although DVP systems eliminate some types of credit risk (cross-currency settlement, Herstatt, etc.), they can be interrupted themselves for no fault of their own. This situation is only exacerbated after considering their potential to create systemic problems especially if liquidity problems occur as exchange rates and securities prices rapidly change (BIS, 1995).

6. Risk Management in Net Settlement Systems -- Centralised vs. De-centralised

Although credit risk exists in netting systems, the main concern in these systems is unwinding risk. Unwinding risk is most prevalent when a netting system fails to settle. Thus, reforms and efforts to reduce unwinding risk focus on the reducing the probability of settlement failures. The BIS and other authorities have recently been encouraging members of netting systems to improve and pay greater attention to their risk management efforts. Central banks distinguish between "secured" netting systems and all others. In a secured system, credit exposures due to intraday overdrafts can be controlled *ex ante* through caps and *ex post* through loss sharing agreements. A secured system is one that is able to settle all of its net obligations at the end of a clearing cycle even when the largest net-debit position is unable to settle. Banks can establish a settlement guarantee by posting collateral in advance, depositing capital at the clearing house, forming joint back-up settlement agreements with other members, agreeing to a government guarantee, etc.

If the settlement failure is the result of temporary liquidity problem, it is reasonable to assume that the central bank can play an important role. However, if the failure is related to a solvency problem, any assistance from the central banks will only exacerbate the situation in the long run. Therefore, it is crucial that the authorities are able to decipher the source of the failure. In cases where settlement failure

stems from a liquidity crunch and the allotted collateral in the system is insufficient, the central bank could offer assistance. The situation could be described more aptly using similar definitions as before; however, in this case it is the total aggregate shortfall, $\overline{F}$, rather than the aggregate net overdraft limits, $\overline{L}$, of the banks which are of importance.

$$\overline{F} = \sum_i \overline{f}_i$$

It is also assumed that under a net settlement system, in accordance with the Lamfalussy standards, a temporary shortfall is appropriated to the other banks according to an *ex-post* loss sharing rule supported by their joint collateral, $\overline{C}$. If $F - C \leq 0$, where the total shortfall $\overline{F}$ is less than the amount of available collateral put forth by the private banks, indeed the private banks have successfully internalised the social costs of their activities. However, the critical situation arises when $F - C > 0$, where the total shortfall is greater than the available collateral. In this case, if in fact it is a problem of illiquidity and not insolvency, the central bank might step in to compensate for the temporary shortfall in the private banks' collateral to prevent a systemic crisis. That is, the central bank could add additional liquidity, A, to the existing pool of collateral, C, so that $A + C = F$. By providing the additional liquidity A, the central bank provides a public good which would otherwise not be available if left to the private market alone. Of course, such provisions have social benefits and avoid possible settlement failures and their ensuing problems. Again, the significant factor which needs to be considered before providing the A is whether it is only a temporary liquidity problem and not related to insolvency issues; in some cases it may be that illiquidity could turn into insolvency without central bank intervention.

Other settlement risk management efforts in netting systems which have been encouraged by central banks includes direct monitoring by banks of other banks. The financial exposure created by one bank for another in this system provides a strong incentive for creditor banks to

monitor debtor banks. Moreover, private financial institutions may have better access to information on other banks than is possible for central banks or other banking supervisors. However, a natural shortcoming in such decentralised bilateral monitoring arrangements in netting systems is the free rider problem. Banks realise that any excess losses created by a member of the netting system will be shared amongst all of the remaining members. This cost spreading feature provides less incentive for banks to monitor other banks as closely as they should. One solution has been to increase the costs specifically for that bank which has failed as an effective monitor by making it pay greater amounts in collateral relative to the other members. Such is the basic idea in Calomiris' recent scheme for banks to police themselves by requiring every bank to finance a small proportion of its assets by selling subordinated debt to other institutions – namely, foreign banks – with the stipulation that the yield on this debt cannot be more than 50 basis points higher than the rate on corresponding riskless instruments (Calomiris, 1998).[3] The yield cap guarantees that banks cannot compensate these debt holders with large spreads when they participate in high risk activities. As the essence of Calomiris' recommendation is to reduce these very risks, investors will only buy subordinated debt when they are sure that the bank's activities are low risk. If in fact a bank is unable to convince other banks of their aversion to risk, they are not allowed to function. In this way, Calomiris exploits the access to greater and better information which other fellow bankers rather than supervisors are believed to have. His solution aligns the incentives of private banks and regulators alike by mandating that the social costs of high risk activities are not borne by the government alone.

However, even with a larger burden in case of a failure, decentralised monitoring within a netting system might not promote sufficiently effective and intensive monitoring. This problem is further exacerbated when more participants enter the system. In this case, not only is there a greater burden as a result of more banks to monitor, but banks realise that potential losses are further reduced as they are

shared between even more participants. Centralised monitoring has been considered as an alternative so that monitoring duties are left to a central authority. In this case, moral hazard problems may arise given that participants are not under the constant scrutiny of other members. Further complications may arise when such a central authority makes choices regarding the use of common resources to bail out temporary liquidity crises. In any case, net settlement systems seem more naturally attuned to private rather than centralised risk management methods given the information advantages participants have compared to regulators. However, without appropriate incentives such private monitoring can be inefficient and further exacerbate the large social costs it intends to mitigate.

7. Is Co-existence an Alternative?

In considering netting systems with decentralised risk control mechanisms or gross settlement systems with centralised risk controls such as collateralised overdrafts, neither one seems to dominate over the other. Ideally, central banks try to minimise their credit risk exposure and prefer RTGS which are settled without the use of central bank intraday credit. Although secured net settlement systems are preferred by private banks, they leave the central banks far more exposed. Optimisation through queuing and intraday liquidity provisions by the central bank might promote RTGS, but the costs of maintaining non-interest bearing reserves or pledging collateral remain high for private banks. One market based solution has been to offer more incentives such as paying interest on end-of-day reserves. It has even been suggested that an active market for intraday credit might emerge as a result of such incentives. In this way, not only are the costs for private banks minimised, but the probability of gridlock is simultaneously reduced through market based incentives.

Another solution has been to consider the benefits of each system and examine whether they can coexist while promoting risk control measures. It is possible for more than one payment system to serve an

economy as in the cases of the US and Japan (Horii and Summers, 1993).[4] However, research suggests that the existence of two systems may solicit private banks to choose the lower cost rather than the lower risk alternative. While netting systems are less costly for private banks in terms of liquidity management, they give rise to unwinding risk in cases of a settlement failure. Research has shown that the cost of holding extra liquidity in an RTGS system exceeds the benefits of the reduction in systemic and settlement risk (Garber, 1992). In Garber's analysis, the opportunity cost of holding securities as collateral is estimated to be 25 basis points. The expected cost of settlement failure in netting systems is the actual loss on the liquidity advances from the central bank, *A,* to make up the total shortfall, *F - C.* The actual loss is calculated as the probability of repayment, i.e., if it is a bank failure, repayment = 0, multiplied by its net debit position. The results in this analysis indicate that the aggregate cost of settlement failure in a netting system is only half the cost of retaining liquidity in an RTGS system suggesting that a netting system is the lowest cost alternative. An important caveat is the assumption that central banks are assumed to be risk neutral rather than risk averse in this exercise – an assumption which could substantially increase the expected costs of settlement failure in netting systems (Folkerts-Landau and Garber, 1992.)

The present evolution of payments systems indicates that there will be the European RTGS systems with collateralised interest free overdrafts and the U.S. RTGS systems with uncollateralised overdrafts with interest charges. The lack of a common design of wholesale payments systems for the major international currencies suggests that there might be a preference for one system over another. For instance, it has been suggested that at planned levels of interest charges and collateralisation, the interest free collateralised system in Europe could cost more than the interest charge based uncollateralised overdraft system in the U.S. As a result of the lower total costs, there would be a preference to conduct all financial transaction in U.S. dollar terms. Given the relative liquidity of the U.S. money and

foreign exchange markets, the U.S. market could become the preferred environment for financial transactions to a point where it could isolate and render other markets ineffective. Therefore, in assessing the co-existence of systems across markets, it is not only important to consider the liquidity arguments of each system but also the relative level of interest charges and collateralisation requirements so as not to violate certain minimum standards by exacerbating distortions between different markets.

8. Policy Considerations – Shift towards Collateralised RTGS Systems

The phenomenal growth in payment systems has not only increased the risk of settlement failure but the systemic impact of such failures. An appropriately designed payment system is crucial for financial stability and efficient operation especially during periods of financial distress. Many countries have undertaken reforms to reduce the credit risk associated with the growth of intraday credit exposures in net settlement systems and in RTGS systems with central bank provisions for overdrafts. To internalise some costs of the externalities in netting systems – namely, to prevent systemic crises – central banks have encouraged caps and/or charges on overdrafts and loss sharing agreements. Using such market based incentives, the liquidity benefits of a netting system are preserved as participants are required to contribute a limited amount of collateral to a pool (equal to the largest net debit position in the pool) rather than fully collateralise their own net debit positions. However, by and large, especially in Europe, recent efforts have sought to reduce intraday payments-related credit in netting systems by restructuring them into RTGS systems with collateralised overdrafts. Despite the apparent liquidity advantages of netting arrangements, there are several reasons to explain this gradual shift. First, systems, markets, and financial instruments are evolving at much faster rates than the political bodies who find it difficult to keep updating the rules to prevent abuse. Second, the immense task of co-ordinating legal rules inherent in non-synchronised settlement systems

across international boundaries, i.e., Herstatt risk, forex transactions, can be complex even in a co-operative and legal environment. Finally, central banks continue to be forced into the role of lenders of last resort and can limit their exposure more through collateralised RTGS than netting systems.

As mentioned before, the replacement of netting with RTGS systems with collateralised overdrafts might encourage an active market for intraday credit. i.e., payments made during periods of low liquidity could qualify for discounts whereas others would pay different premia depending on liquidity in the market at that particular time. Again, the risk of insufficient liquidity within an RTGS system raises concerns about settlement delays and ultimately, gridlock. Some suggested solutions to this problem were for central banks to pay interest on bank reserves to encourage holdings of settlement liquidity, "optimise" payments through efficient queuing mechanisms, and the linking of RTGS systems with securities settlement systems to complete delivery-versus-payment.

Another cost of reduction in payments-related credit in both RTGS and netting systems through charges on overdrafts and collateralisation is the pressure to create private sub-netting systems as low cost alternatives to RTGS systems with collateralised or interest bearing overdrafts (Landau and Garber, 1992). There will be some private financial institutions for whom the liquidity argument will present strong arguments to partake in such private sub-netting arrangements. Consequently, the very reasons – namely, better risk management – for which collateralised RTGS systems are replacing netting systems are undermined. In this case, central banks would hope to regulate these private netting systems but even then would increase the overall risk in the system by possibly distorting payment patterns and adding further to the externalities of the overall payments systems. As regulators, the ultimate goal is to find methods to internalise the costs of such activities, and the creation of intermediate private netting markets might only serve to reduce the central bank's

direct exposure to credit risk by assuming some of their burden only on a temporary basis. However, in the end, as lenders of last resort, the ultimate responsibility lies with the central banks and to avoid agency problems it might be easier to actively manage such risk on their own.

9. Conclusions

The build up of systemic risk in netting systems is essentially the result of the collection of credit extensions issued by banks to each other. These "orders" are netted against each other and settled in cash or by delivery of the appropriate securities, foreign exchange, etc. at the end of the clearing cycle. If any of the participants in this system default by exceeding their net debit position, it may be necessary to unwind the entire set of transactions. Another type of settlement risk in netting systems is caused by the lag in payments so that a participant who is owed a payment prematurely considers it final. That is, there may be a habit of assuming payment finality even though in the interim settlement lag, the payee may receive additional information from elsewhere in the system which might affect the status of the final payment. Clearly, there are advantages to accessing such information especially for private banks who can minimise the costs of maintaining liquidity for payment purposes, but in cases of settlement failures, the potential for systemic disruptions is large. RTGS systems try to eliminate such systemic risk by posting early warning indicators into payments and settlement systems. They require financial institutions attempting to make a payment or effect a settlement to post "cash in advance" (or collateral or securities). RTGS systems do not allow the insolvency of a single financial institution to be transmitted to others through the payments system since settlements are never conditional on the solvency of the paying institution.

Most EC countries have indicated their strong preference for adopting RTGS systems in the very near future. For some of these countries,

their reasoning lies in removing interbank credit altogether from the payments systems to reduce the "inherently uncontrollable" nature of interbank credit in netting systems.[5] Others in the EC have questioned the legal standing of netting systems, particularly the lack of a common approach to insolvency and its effects on multinational participation which might cause the entire system to be unwound. The use of RTGS systems has only recently become more widespread. This delay is in some part due to the significant liquidity costs discussed before. These costs can be lessened if central banks were willing to pay interest on reserve balances, encouraging financial institutions to hold larger clearing balances in excess of the legal minimum. These balances coupled with collateralised overdrafts would not only provide greater liquidity for RTGS systems, but the collateral could also support delivery-versus-payment securities transactions. One way by which collateralisation internalises the costs of the risks in payments systems is by reducing the threat of gridlock. In some ways, such collateralisation is a way of privatising the clearing and payments systems. It not only reduces the need for central banks to monitor and control risk taking by financial institutions, it limits the extent of the financial safety net.

One way of resolving the apparent conflict between different approaches towards establishing payment systems is to recognise that there is a trade-off between the efficiency of the financial system and the amount of risk assumed by the public sector. To the extent that regulatory differences between countries exist at any point in time, they will reflect national preferences and judgements regarding risk and efficiency, and national preferences on the risk-efficiency spectrum at that particular time. On the other hand, given the large value and international nature of present day wholesale payments, the effects of any disruptions arising could pose a systemic threat around the world. Consequently, while it is important that each country decide on its degree of regulatory action, the systemic nature inherent in a single settlement failure requires the establishment of at least

minimum standards whether in terms of interest charges, collateralisation requirements, or loss sharing agreements.

Differences in financial innovations and technological advances in recent years might play a role in encouraging market participants to engage in regulatory arbitrage. If financial regulation is too restrictive in one jurisdiction, both providers and users of financial services can simply move to a less restrictive and less costly jurisdiction. Competitive pressures could result in financial centres becoming engaged in competitive deregulation. This could lead to a bare essential approach to financial regulation as authorities compete to have firms locate within their jurisdictions resulting in a less than socially optimal level of regulation overall. There are important implications for domestic and international payments systems. If financial institutions engage in regulatory arbitrage, it is important for different national authorities to co-ordinate the regulatory policies in order to avoid not just the risks inherent in competitive deregulation, but also the dangers of lax rules in one country having an adverse effect on the ability of other countries to enforce financial regulations. Furthermore, to the extent that regulatory laxity represents a higher level of risk, the possibility of systemic spillover effects on more conservatively regulated jurisdictions needs to be considered. Finally as discussed earlier, although different regulations to some extent will expectedly exacerbate distortions between markets by providing certain advantages and disadvantages to different participants, they should all uphold at least certain minimum standards.

Thus, there is obviously a clear need for the co-ordination of regulatory policies. In this regard, national authorities will have to find a balance between national autonomy and co-ordination with other authorities. Since the economic case for international policy co-ordination in wholesale payment systems is based on the presence of cross-border transactions and spillover effects, these could be used as points of reference in determining the boundaries of co-ordination efforts on regulation. Herring and Littman have argued that measures

aimed at agents at the microeconomic level rather than systemic stability should be directed by national preferences, while international co-ordination efforts should focus on issues of global systemic significance (Herring and Litman, 1995). This raises questions of whether the regulatory framework should be focused on the organisation of markets rather than institutions. Systemic stability regulations tend to be institutionally focused and this follows directly from the nature of systemic risk which is assumed to be triggered by institutional insolvency. However, one of the features of financial markets today is the increasing blurring of distortions between different types of financial institutions and other related agencies, i.e., in this case, clearing and settlement agents. The evolving nature of their various roles means that regulations which are too narrowly focused will be rendered obsolete very quickly. Thus, the importance of institutional focus within an international context is further highlighted within a regulatory framework to manage systemic risk in payment systems.

Notes

1. Only a few decades ago, this risk was relatively low when the daily payment flow of foreign exchange transactions was roughly equivalent to the capital stock of a single large US bank. However, recently the average daily turnover has exceeded the combined capital of the top 100 US banks.

2. In 1974, *Bankhaus Herstatt* – a small German Bank active in the forex market – went into liquidation after the German part of its trades was irrevocably settled but before the US side was settled through CHIPS.

3. Although there are many difficulties in Calomiris' argument, he suggests some solutions from the outset, e.g., to avoid "cronyism" and collusion within a specific market, buyers of such subordinated debt would have to be outsiders, i.e., foreign banks.

4. The net settlement systems, CHIPS and FEYSS, depend for final settlement on the gross settlement of the Fed and the Bank of Japan, respectively.

5. Bank of England, 1998.

Table 1: Funds Transfers Systems in Selected Countries

Country	*Name of RTGS System*	*Type*	*Year of Implementation*
Belgium	ELLIPS	RTGS	1996
	CH	Net	NA
Canada	IIPS	Net	1976
	LVTS	Net	1997
France	SAGITTAIRE	Net	1984
	TBF	RTGS	1997
	SNP	Net	1997
Germany	EIL-ZV	RTGS	1987
	EAF2	Net	1996
Italy	BISS	RTGS	1989
	BI-REAL	RTGS	1997
	ME	Net	1989
	SIPS	Net	1989
Japan	BOJ-NET	Net+RIGS	1988
	FEYCS	Net	1989
	Zengin	Net	1973
Netherlands	FA	RTGS+Net	1985
	TOP	RTGS	1997
	8007 SWIFT	Net	1982
Sweden	RIX	RTGS	1986
Switzerland	SIC	RTGS	1987
United Kingdom	CHAPS	RTGS	1984
	Euro version of CHAPS	RTGS	1999
United States	CHIPS	Net	1970
	Fedwire	RTGS	1918
Cross Border	ECU	RTGS	1983

Source: Bank for International Settlements (1998)

Table 2: Intraday Credit Policies and Centrally Located Queues in RTGS Systems

Countries Whose RTGS Systems Provide:	*Centrally Located Queue*	*No Centrally Located Queue*
Central bank intraday credit	Belgium	United Kingdom
	France	United States
	Germany	
	Italy	
	Netherlands	
	Sweden	
No central bank intraday credit	Switzerland	Japan

*BIS, 1997-1998.

REFERENCES

Bank for International Settlements (1990), *Report of the Committee on Interbank Netting Schemes of the Central Banks of the Group of Ten Countries, Lamfalussy Report,* Basle.

Bank of England, (1998) "The Development of a UK Real-Time Gross Settlement System," *Bank of England Quarterly Bulletin*, 34: 163-168.

Bank for International Settlement, Annual Report, various years.

Duncan, G., (1994) "Clearing House Arrangements in the Foreign Exchange Markets," Speech at the International Symposium on Banking and Payment Services (Washington D.C.: Board of Governors of the Federal Reserve System)

Eatwell, J., and Taylor, L., forthcoming, *The Future of Financial Regulation: World Financial Authority.*

Edwards, F., (1996) *The New Finance: regulation and Financial Stability*, Washington: AEI Press.

Eisenbeis, R., (1995) "Private sector solutions to Payment Systems Fragility," *Journal of Financial Services Research,* 9: 327-49.

Garber, P., and Weisbrod, R., (1992) *The Economics of Banking, Liquidity, and Money*, Lexington: DC Heath and Co.

Humphrey, D., (1989) "Market Responses to Pricing Fedwire Daylight Overdrafts," *Federal Reserve Bank of Richmond Economic Review,* Vol. 75.

Kasman, B., (1992) “A comparison of Monetary Policy Operating Procedures in Six Industrial Countries,” *Quarterly Review*, Federal Reserve Bank of New York, Vol. 17.

Richards, H., (1995) “Daylight Overdraft Fees and the Federal Reserve’s Payment System Risk Policy,” *Federal Reserve Bulletin*, Vol. 81.

Schnadt, N., (1994) *The Discount Rate of Bank Bills on the UK Money Market*, London School of Economics, mimeo.

Vital, C., (1994) “An Appraisal of the Swiss Interbank Clearing System,” Speech at the IBC International Payment Systems Conference (London, April 1994)