

**IMF Paper on Policy Analysis and Assessment**

© 1998 International Monetary Fund

This is a *Paper on Policy Analysis and Assessment* and the author(s) would welcome any comments on the present text. Citations should refer to a *Paper on Policy Analysis and Assessment of the International Monetary Fund*. The views expressed are those of the author(s) and do not necessarily represent those of the Fund.

PPAA/98/4

INTERNATIONAL MONETARY FUND

Monetary and Exchange Affairs Department

**The Payment System and Monetary Policy**

Prepared by Omotunde E.G. Johnson<sup>1</sup>

May 1998

**Abstract**

Achieving the primary objective of price stability without unduly compromising the operational efficiency of the payment system constitutes a major problem for central banks. Routine monetary policy presumes a given institutional and technological framework, including aspects of the payment system. Such a monetary policy concerns itself with intraday and interday credit for payments settlements and with float. Liquidity shocks and panics sometimes pose an additional challenge. In recent years, major and rapid institutional and technological changes in the payment system (mainly to lower risks and augment operational efficiency) have affected the monetary policy decision-making process, particularly in the short run.

JELClassification Numbers: E51, E52, E58

Author's E-Mail Address: OJohnson@imf.org

---

<sup>1</sup>Prepared initially for Payment and Settlement Systems Workshop at the Bank of England (January 12–16, 1998). I would like to thank William Alexander, Daniel Hardy, Timothy Lane, Nicholas Roberts, Gabriel Sensenbrenner, and Valeria Fichera, for comments on earlier drafts. The views expressed in this paper are those of the author and do not necessarily reflect those of the IMF.



## I. INTRODUCTION

Monetary policy considerations happen to be only one factor determining the role that a central bank can play in the payment system,<sup>2</sup> if we assume, as seems reasonable, that the central bank has, legally, an important role in the conduct of monetary policy as well as in fostering stability and soundness of the financial system. Increasingly, central banks have come to focus on price stability as their primary objective, although some central banks may see maintaining the external value of the currency (the exchange rate) as the primary objective. In any event, this means that the effective conduct of monetary policy has become the primary preoccupation of central banks.

In general, the instruments and the intermediate targets used by central banks to target inflation could be one or more interest rates and some monetary aggregates, such as base money, M1, or M2. In monetary operations, a concerted shift from direct to indirect instruments is occurring world-wide. Hence one observes a decline in use of instruments such as selective credit controls and bank-by-bank credit ceilings, and a relative increase in use of instruments that are market-oriented, where “price” is the basic determinant of allocation, and with access criteria that are transparent, objective, and uniformly applied, where quantitative ceilings get used in conjunction. The latter instruments include reserve requirements, a variety of refinance standing facilities like overdrafts or discount window lending (used at the initiative of the commercial banks), money market refinance instruments (typically in the form of repos and reverse repos and used at the initiative of the central bank), and open market

---

<sup>2</sup>For an introduction to payment systems and recent payment system policy initiatives, see Summers (1994), as well as Johnson, et al (1998).

operations (typically in the form of central bank outright purchases and sales of government securities).<sup>3</sup>

The above developments have occurred in the context, *inter alia*, of a growing complexity and efficiency of financial markets and financial instruments, globalization and integration of markets, and sustained growth in private capital flows. Short-term (daily, weekly, monthly) monetary operations themselves are increasingly conducted with use of a liquidity management framework, which rely on models from basic monetary theory (money demand, money multiplier, etc.), some short-term information system,<sup>4</sup> and lots of judgement about the short-term evolution of particular parameters and market reactions (especially over the short-term) to policy initiatives.<sup>5</sup>

---

<sup>3</sup>In this regard, see, for example, the collection of papers in Baliño and Zamalloa (1997).

<sup>4</sup>Typically a short-term information system will comprise two broad categories of information: one that describes monetary conditions and another set often referred to as supplementary indicators. The first set will include data such as the components of base money, total base money, and broader monetary aggregates. The second category will include data on interest rates, exchange rates, aggregate business activity, aggregate demand, balance of payments developments, government finance, and labor market conditions (wages, employment, unemployment). The more direct is the impact of monetary and credit policy actions by the central bank on a supplementary indicator the more useful is that indicator. Hence, central banks give pride of place to information on interest rates, exchange rates, and other variables that affect or reflect supply and demand conditions in financial markets.

<sup>5</sup>For example, in the very short term, a central bank may want to: (i) develop very detailed procedures for making judgements on the desired change in base money (net of changes in required reserves) that it wants to effect; (ii) make projections of changes in base money likely to originate from so-called autonomous factors (e.g., credit to government, foreign exchange intervention, balance of payment developments, etc., depending on the system) and then (iii) to design its monetary operations, carefully assigning different instruments the roles (contributions) that they should play in bringing about the changes desired in base money.

In none of this does one normally seem to mention explicitly the payment system. In addition, the worldwide growing (operational) independence, and the narrowing of the focus, of central banks, and the resulting preoccupation with inflation as the primary objective of these institutions, have resulted in increasing support for central banks worrying less and less about the effect of monetary policy and operations on the state of unemployment, the level of economic growth, and bank failures. Why in this context should the payment system be treated differently? Here we run across the first concern of the monetary authorities: a moral hazard problem and the challenge of not allowing concerns for the payment system to compromise achievement of monetary objective(s). In other words, the inability to settle by one or more participants could force the central bank to extend special credits to prevent a systemic crisis in the financial system. The dilemma here is greater in the case of the payment system than for the other areas mentioned above, because in the payment system one is dealing with money—typically fiat money—the medium of exchange and the ultimate means of settling debts. In addition, central bank money normally has a monopoly as legal tender and forms the base for all other components of money.<sup>6</sup>

A major payment system initiative in recent years with explicit concern for monetary policy has been the TARGET (Trans-European Automated Real-Time Gross Settlement Express Transfer) System. In November 1994, the European Monetary Institute (EMI) released a note (EMI, 1994) that described why the European Union central banks planned to

---

<sup>6</sup>As central banks come to see themselves as guarantors against systemic failures in the financial (including payment) system, they have been putting in place risk control measures to reduce systemic risks and hence the probability that they would be called upon to rescue the system from systemic collapse, and, ipso facto, reduce the potential credit risks to the central banks themselves (see also Section III below).

link the national RTGS systems, which were operating (or were about to operate), in line with one of ten principles (principle four) aimed at establishing minimum common features for systems, in the context of harmonization of payment systems in the European Union countries.<sup>7</sup> A report on the TARGET system (EMI, 1995) gave a detailed description of the future system, explained how that system would be organized, how it would operate, and its possible future links with other payment systems.

The analysis of the existing large-value payment systems in the member countries showed that more than 25 systems were dealing, exclusively or in part, with large-value payments, and that those systems generally were independent and not linked. Indeed, the exchange of large-value payments between countries was relying on correspondent banking arrangements, which, after all, had been assessed to be inconsistent with the requirements for implementing a single monetary policy. Therefore, in line with principle four, the central banks decided that the future European large-value payment system should allow the exchange in real time, on a gross basis, of payments in central bank money, based on the linkage of the RTGSs that operated (or would soon operate) in European Union countries.

---

<sup>7</sup>See EMI (1993). Principle four stated that each member state should have, as soon as feasible, an RTGS system through which as many large-value and time-critical payments as possible should be channeled. A *gross settlement system* is a transfer system in which settlement of funds or securities transfers occurs individually on an order-by-order basis (that is, without netting debits against credits) according to rules and procedures of the system. In a *real time gross settlement system*, processing and settlement take place in real time (continuously). Since RTGS precludes accumulation of unsettled balances and the associated extension of interbank intraday credit, it helps avoid the systemic disruptions that could result if a major segment of the system could not settle at some deferred prescribed time (typically end of day). This has been a major reason for the popularity of RTGS systems among large value systems owned by central banks. For a more complete discussion of the advantages and disadvantages of the typical RTGS and the typical netting system, see Summers (1994) and Johnson, et al (1998).

Apart from this interesting case, recently, major changes have been occurring in the payment system—because of reforms to address speed, reliability, and financial risks, in the systems, or because of endogenous changes, as financial institutions make payments innovations in search of greater profits—enough to force the monetary authorities to take note of the payment system in the monetary policy decision-making process. This is because of the impact of these changes on money demand and money supply, on the effectiveness of monetary policy instruments, and on the usefulness of certain intermediate targets. Indeed, it is the importance and rapidity of these developments in recent years that have brought payment systems into the normal preoccupation of persons narrowly concerned with monetary policy.

If one turns the tables around and looks at the problem from the perspective of the payment system, one also begins to see why persons who would consider themselves payment system experts have come to take an interest in the relationship between the payment system and monetary policy. The point is that what monetary authorities consider appropriate monetary operations and the stance they take in the conduct of monetary policy can have implications for the operational efficiency of the payment system, because of the effect on the cost and quantity of liquidity. So can monetary policy afford to ignore the operational efficiency of the payment system? If not how much should it care?

In all these areas we still need a lot of theoretical and empirical research work. In the meanwhile, practical people have found various answers. Hence what we have now is a menu of “best practices” that have been shown to foster the achievement of desirable objectives for payment system risk and efficiency as well as for monetary policy, while taking into account

the particular circumstances (institutions, state of economic development, and evolutionary path of the payment system) of countries.

The rest of the paper is divided into three basic sections. Section II deals with issues of routine monetary operations and the payment system—when institutional and technological changes are given—namely, central bank credit policy without sacrificing the main objective of monetary policy and addressing payment system float. Section III discusses liquidity shocks and panics originating from, or aggravated by, the payment system as a major challenge to routine monetary policy. Finally, Section IV discusses the importance of institutional and technological changes for monetary policy and operations, particularly in the short run.

## **II. ROUTINE MONETARY OPERATIONS AND THE PAYMENT SYSTEM**

If the primary objective of monetary policy is price stability, then monetary operations vis-a-vis the payment system should not, under normal circumstances, create unforeseen and unpredictable difficulties for the achievement of this objective. This, we believe, is the most important underlying principle in the analysis of monetary policy and the payment system. A typical payment system expert, we also believe, would want, in addition, that monetary policy not threaten the operational efficiency of the payment system. Coming up with clear principles to reconcile these two objectives remains, in our estimation, a major analytical problem.

When the monetary authorities supply base money to the economic system, in the context of its liquidity management, either to influence the price level directly or to do so via some intermediate target, it presumes a certain institutional and technological framework that in turn affects money demand function, the money supply process (money multiplier), and the



nature of the transmission process relating base money and inflation. The payment system is part of that institutional and technological framework. This would seem a fundamental analytical point to realize in any theoretical and empirical work on monetary policy and the payment system. In general, the most important payment system related institutional and technological factors include: the type of large value transfer system (including key features); the state of development of money markets, especially intraday and overnight markets; the major payment instruments in use; and the reserve maintenance system—in particular whether or not reserve averaging occurs and the extent to which required reserves can be used for intraday settlements.<sup>8</sup>

Between countries, of course, in so far as payment systems differ in important details, there will be differences in real demand for bank reserves.<sup>9</sup> Hence, other things being equal, if, for instance, one country has a large value transfer system with (daily) net settlement (and

---

<sup>8</sup>One often-cited disadvantage of a real time gross settlement (large value) system is the risk of gridlock from insufficient intraday liquidity (in terms of clearing or reserve balances) to ensure high operational efficiency of the system. This disadvantage has been addressed, by central banks in various countries, through some combination of sophisticated queuing mechanisms, central bank intraday credit facilities, and central bank reserve management policy (including required reserve policy).

<sup>9</sup>In fact, these differences may be between groups of countries, as there may be strong international linkages between financial change and development of countries conditional on their income levels, their financial market orientation, and their general economic interrelations with each other (say via integration of financial markets or international trade and payments). Thus, in discussing initiatives and developments in payment systems, it has been possible to group countries as industrial countries, middle-income countries, low-income countries, and economies in transition [see, for example, Johnson, et al. (1998)]. Also, at least for the industrial countries, there is evidence of a strong similarity in the behavior of velocity across countries for which a significant part of the explanation is the common institutional and technological changes in the financial systems [see, e.g., Bordo, et al (1997)].

“reasonable” allowance for credit exposures and bilateral debits), while another has a strict real time gross settlement system (with little or no intraday credit from the central bank), the optimal bank reserves per unit of real output to achieve any given rate of inflation is expected to be higher for the latter than for the former country. In so far as reserves comprise domestically generated fiat money—that is they are liquid liabilities of countries’ own monetary authorities—this difference in optimal reserve “need” should not have significant welfare effect and, ipso facto, no particular impact on the ability of the central bank to achieve its inflationary objectives.

Other institutional and technological factors in the payment system also cause differences in optimal reserves-GDP ratios to achieve any given rate of inflation. These factors include: the average length of time taken in processing and settling payments; the account structure of banks, in particular the extent to which these are centralized in, say, a single reserve account at the central bank, and related to that the access to information on unsettled accounts; and the liquidity management expertise in the financial institutions of countries, due both to back-office procedures and to money management activities. Forecasting of system-wide demand for bank reserves (long-run and short-run) both within and across countries is clearly aided by an understanding of these and other factors in the payment system.

#### **A. Central Bank Credit Policy**

An important component of monetary policy is central bank refinance policy. Thus, credit policy in the payment system has become a prominent topic. But the discussion has not been confined strictly to monetary policy issues; for those concerned with credit to facilitate the operational efficiency of the payment system, also salient has been the question of how to

limit the credit risk of the central bank. It would seem useful to keep a clear focus on the reasons (risk reduction vs inflation control) for specific procedures and rules in this area, even though the central bank may be the policy maker in both cases. As regards the credit itself, for real time gross settlement (RTGS) systems, the basic issue has been whether the central bank should grant intraday credit at all, while for net settlement systems the debate has centered around the automaticity of overnight credit of the central bank to facilitate settlement.

### **Interday credit**

One could safely say that a consensus has emerged that there should be nothing automatic about lending by the central bank to facilitate end-of-day settlement in payment systems (net or gross). The general view would be that lending for this purpose should be treated as normal refinance credit. In this light, central banks would typically want banks, for end-of-day payment settlement purposes, to use standing facilities of the central bank; would limit banks' access to such facilities, particularly when the credit is uncollateralized; and would charge interest in line with the current stance of monetary policy.

Some central banks will not even lend without collateral. When done for reasons of credit risk, the logic of strictly collateralized lending is clear; it is not so clear that this restriction is necessary for monetary policy reasons. In sum, one could see some logic in limiting the aggregate of such lending, for monetary policy reasons, while asking for collateral, for risk control reasons.<sup>10</sup>

---

<sup>10</sup>Of course the demarcation should not be exaggerated, since the requirement of collateral may also have the indirect effect of limiting credit demand.

The relationship between the applicable interest rate(s) on the facilities and market interest rates also varies across countries. Whether or not the lending is collateralized, typically, *changes* in the ratio of the basic interest rate(s) levied on such “refinancing” to current short-term market interest rates are intended to signal changes in the stance of monetary policy. But the normal *level* of such a central bank rate in relation to current short-term market interest rates would clearly depend on whether the credit is seen as facilitating operational efficiency of the payment system, as well as on the normal place that such a rate plays in the structure of central bank interest rates. In this light, short-term overnight rates of central banks can vary all along the spectrum from below market rates (which is rare) to what are essentially penalty rates and an upper bound for market rates.

From a strictly monetary policy point of view, the case appears strong for charging penalty rates on central bank facilities used by banks to complete their (end-of-day) payment settlements. For once the monetary authorities have provided “adequate” overall liquidity to the system, the idea would be to create an incentive for a bank to look to the market first for funds. In that case, when the bank comes to the central bank for (settlement) credit, the central bank receives information about the “tightness” of liquidity in the system or the creditworthiness of the bank. If the nature of the information is clear, the monetary policy decision-making process benefits; the central bank has one more piece of data to help it assess the appropriateness of its monetary policy stance (and also the state of individual banks). Obviously, where financial markets are not active or integrated nationally, central banks may need to play a positive role in developing such markets and, in the meanwhile, more actively engage themselves in normal financial market (funds recycling) activities than otherwise.

## Intraday credit

From a monetary policy perspective, the most interesting, even if obvious, questions related to intraday credit in the payment system, are: why is there a demand for intraday credit and what factors determine this demand? who should supply intraday credit—the central bank, the market, or both? does the level of such credit ever matter for inflation? The first question is the one most researched and also, perhaps, least contentious, the second the most contentious, and the third the least researched and yet the most important for monetary policy.

Basically the demand for intraday credit arises especially in real time gross settlement (RTGS) systems.<sup>11</sup> For the value of fund transfers that occur during any single day is typically several times the underlying bank reserves available for final settlement. Averaging of reserve holdings for purposes of meeting required reserves and permitting intraday use of all reserve balances for payment settlement purposes helps in satisfying some of the demand for intraday reserves. But this may still not suffice to ensure tolerable operational efficiency of the system. In any event, bank reserves must turn over several times during the day (hence the notion of “turnover ratio”) when settlement is real-time gross.<sup>12</sup> The challenge to policy makers is preventing *gridlock*, avoiding major constraints on payments processing speed and volume

---

<sup>11</sup>We are talking here, of course, of explicit credit. In net settlement systems, for instance, banks effectively create inside money by having bilateral debit and credit balances during the day. As others have pointed out before, these would show up clearly as explicit credit if banks, for example, had to borrow in some market to make the payments, rather than accumulate debit balances.

<sup>12</sup>The rapidity with which this turnover ratio increased in the United States can, for instance, be seen from the evidence that the ratio of average daily payments through the major payment networks (for both wire transfers and checks) to average daily reserve balances maintained with the Federal Reserve Banks rose from 0.9 in 1960 to 30 in 1985; see Mengle, Humphrey, and Summers (1987).

that could result in transaction levels well below what the particular payment system can handle.

Part of the institutional and technological environment with which monetary policy must contend in the payment system is, of course, the set of devices available to raise, efficiently, the turnover ratio, and thus support greater gross transfers for any given level of reserves. In particular *queuing* systems get devised. For instance, systems and criteria are put in place to delay payments (“delayed sends”) until covering funds become available. This sort of queuing of payments could be centralized—by having the payments organization or system designing and doing the queuing, as in the SIC system<sup>13</sup>—or it could be decentralized by having the sending financial firms do the queuing.<sup>14</sup>

Because of its relatively high demand for bank reserves and the need to take into account considerations relating to monetary policy as well as operational efficiency and credit risk of the central bank, the provision of intraday liquidity is given serious consideration when central banks design RTGS systems. Not surprisingly, central banks come out with different solutions. For example, in their respective RTGS systems, the central banks of China, Germany, Japan, Korea, and Switzerland do not provide any intraday liquidity; the central banks of Denmark, Italy, Netherlands, Portugal, Spain, Sweden, and Thailand provide it through collateralized overdrafts; and the central banks of Australia, France, and the United Kingdom provide it through intraday repos. The central banks of United States (to prime

---

<sup>13</sup>see “Payment Systems in Switzerland” in BIS (1993), pp. 351-383

<sup>14</sup>Some form of queuing may be the required trade-off for the removal of systemic risk under an RTGS system, when the central bank is not prepared to take on the credit risk of substantial intraday lending to banks.

banks within limits) and Mexico provide intraday uncollateralized overdrafts. Also, some RTGS systems (e.g., those of Australia, France, and Hong Kong SAR) have both queuing and intraday credit. When no intraday liquidity is provided by the central bank, the RTGS systems, except in Japan, have sophisticated queuing mechanisms. In addition, Japan and Switzerland, for example, have intraday financial markets, again an important part of the institutional and technological environment.

This brings up another issue of major practical importance, namely, finding indicators to use as benchmarks for the pricing (supply price) of intraday credit, when the central bank provides such credit. As we have argued, a central bank in extending such credit could have both monetary policy objectives and payment system operational efficiency to worry about.

Leaving aside any relevant adjustment for policy signaling, in principle, the price (interest charge) would be equivalent to the sum of the administrative costs, the opportunity cost of the funds, and some adjustment for risk. If a market existed and all risks were internalized, this risk adjustment would include the credit risk connected with the overdraft. In the absence of an actual intraday private market for funds, such as the intraday market in Japan, a central bank must look for proxies. A reasonable approach would start with the interest rate prevailing in a fairly similar funds market and adjust it for risk, maturity, and implicit charges for other services jointly supplied.<sup>15</sup> Another approach would start with some

---

<sup>15</sup>For instance, in the U.S. the rate on day loans used by broker/dealers to finance securities purchases prior to delivery and payment by customers was thought by some as a relevant rate to use to approximate a daylight overdraft price. Naturally, it was recognized that this rate should be adjusted for the factors mentioned above; see Mengle, Humphrey, and Summers (1987). In the event, a far more modest fee was charged when the Fed introduced its fee than what would have been produced by such an exercise (see Johnson, et al).

central bank overnight interest rate, adjusted for maturity and for the degree of relative collateralization. In Thailand, for example, the interest rates for borrowing under the Intraday Liquidity Facility of the Bank of Thailand are linked to the previous day's repurchase market rates.

The issue of whether the level of intraday credit matters for interest rates and inflation is a difficult one that requires some more serious research. In this context, there is some formal analysis to suggest that, in principle at least, the intraday and interday markets cannot be neatly segmented and that movements in intraday conditions and rates will indeed influence interday rates (see VanHoose, 1991).<sup>16</sup> This would imply that, particularly as intraday markets develop, central banks may need to take this connection into account as they formulate their monetary policy. In practice, central banks generally seem, for the time being at least, of the view that any links between interday and intraday liquidity quantitatively are not yet of major importance.<sup>17</sup> Hence, monetary policy, whatever the intermediate targets, still effectively operates in practice on end-of-day reserve balances and interday and/or overnight interest rates.

---

<sup>16</sup>VanHoose (1991) develops a model of bank behavior over a trading day that incorporates intraday and overnight periods. The representative bank maximizes profits and determines its reserves, earning assets, interday loans or borrowings in funds markets (24-hours or overnight) and intraday loans or borrowings. VanHoose derives the market equilibrium and shows that the equilibrium interest rates in intraday, overnight, and 24-hour funds markets are related.

<sup>17</sup>See, e.g., Ettin (1988).



## B. Float

Historically, one major element of the payment system that has preoccupied monetary policy has been *float*. Float is a consequence of a time difference between the crediting of a payee's account and the debiting of a payer's account as a result of a payment transaction. The causes of float include central bank or commercial bank operational procedures (for example, crediting customers' deposit accounts when they lodge a check before the payee's bank itself receives credit for the check from the payer's bank); weaknesses in the rules or regulations (whether bank-specific or more general) governing those procedures; transportation lags in the case of paper-based payments; delayed or only partial processing of payments because of insufficient resources to finish the task by the end of the business day; and delays because of the time taken to identify and rectify processing errors.<sup>18</sup>

The central bank has a strong interest in reducing significant float, *inter alia* because of its implications for monetary management. At the operational level, the size, and even direction, of appropriate monetary operations is more difficult to set when float results in significant day-to-day volatility in the exogenous (nonmonetary policy) sources of reserves, both in the aggregate and between individual banks (see, for example, Young, 1986; and Hoel, 1975). In addition, large and variable float hinders the development of deeper and more efficient interbank and other wholesale financial markets (for instance, because of uncertainty of timing of settlement); this can slow down the shift toward use of market-based instruments of monetary policy.

---

<sup>18</sup>For a more detailed discussion of the nature and causes of different types of float, see Veale and Price (1994).

Forecasting and assessing demand for (and hence movements in) bank reserves, as well as broader money and credit aggregates, is further complicated by measurement issues, as well as by possible endogenous factors in float. In measurement, there are questions about the appropriate definition of “money,” in the face of significant float.<sup>19</sup> There have also been questions about the measurement of float itself, which relate to specific accounting procedures for payments.<sup>20</sup> The issue of possible endogenous factors in float may arise in an inflationary environment, because higher inflation increases the incentives to create float and therefore may be associated with higher float—in the absence of enforceable limits on payments lags—especially in systems that are not very competitive.<sup>21</sup>

Hence, even leaving aside its well-known welfare effects,<sup>22</sup> the fact that float can be very unpredictable and unstable causes serious difficulties for monetary management making policy makers anxious to reduce their average level, in relation to base money, as quickly and as much as economically feasible. Short of more fundamental reforms to speed up the payment

---

<sup>19</sup>For example, one suggestion in the U.S. has been that bank float needs to be subtracted from demand deposits *a second time* to measure M1 appropriately; see Liang (1986).

<sup>20</sup>For example, in their work on central bank float in Russia over 1992/93, Sundararajan and Sensenbrenner (1994) note that measuring strictly payment-related float required adjusting data on incompletely processed payments for interenterprise arrears (effectively trade credit) measured through the payment system and for the difference in timing between accounting and payment of government deposits between the central bank branches and the head office.

<sup>21</sup>Sundararajan and Sensenbrenner (1994) found some evidence that this occurred in Russia.

<sup>22</sup>The adverse welfare effects of float arise mainly from the waste resulting from procedures used by agents to generate and reduce float in reaction to its distributional effects.

process, several partial solutions can be (and have been) adopted to reduce float.<sup>23</sup> Funds *availability schedules* are an example. Under such an approach, the credit for a check (or debit for a payment order) is delayed to a time equivalent to that in which the corresponding debit (credit) would normally be processed and posted. Related is, also, *provisional crediting* of a check, where the value is credited to the payee's bank account, but the value cannot be withdrawn until the payment is finally settled. In some cases it may be possible to discourage float through imposition of appropriate pricing. When the United States adopted the Monetary Control Act of 1980, for example, measures to reduce the float by both availability schedules and pricing the remaining float were introduced (Young, 1986). The pricing involved an explicit interest charge by the Federal Reserve on the proportion of banks' reserves that could be attributed to float.

A second approach comprises attempts to *reduce some of the operational delays* and backlogs within and between banks. This can often be achieved through better staffing, improved operational procedures, and better training of processing staff, or through establishing dedicated document delivery services to reduce transportation delays where possible.

A third approach involves the affected parties offsetting the costs of float (or maximizing the gains from float) by *more active cash and short-term investment management*,

---

<sup>23</sup> Account consolidation also helps to reduce float, by eliminating inter-branch float for banks.

including management of payments flows. Banks themselves may often assist their customers in such arrangements, for fear of losing them to competitors.<sup>24</sup>

### III. LIQUIDITY SHOCKS AND PANICS

In the absence of institutional and technological changes, routine monetary policy and operations get tested by liquidity shocks and panics (which can give rise to unexpected credit squeeze) that can be payments related. Since these can matter for inflation, it is no surprise that even those narrowly concerned only with monetary policy and operations have taken a keen interest in the measures that payment organizations and payment system regulators have, or can, put in place to reduce the likelihood that the payment system will be the origin of liquidity shocks and panics in the financial system, forcing unplanned and inflationary injection of base money by the monetary authorities. In addition, of course, the monetary authorities are concerned about preventing unwarranted deflation resulting from such shocks and panics while avoiding the moral hazard problem of being seen as a guarantor always ready to provide enough liquidity to prevent gridlock or a breakdown of the payment system or, indeed, bank failures for other reasons.

Yet, in this area, it is not clear that monetary policy can be guided only by concerns with inflation, because of the monopoly of the central bank in the production of the legal tender, the medium of exchange and the ultimate means for settling debts. Consideration of

---

<sup>24</sup>See the discussion of cash management services, in this context, in Veale and Price (1994), pp. 156-8.

the welfare effects of liquidity shocks and panics—namely, disruption of production and inducing suboptimal intertemporal consumption patterns—may be unavoidable.

In reality, of course, it is probably the case that most liquidity shocks and panics do not originate strictly in the payment system, even though they end up putting pressure on the payment system in view of their impact on the ability of individual financial institutions to settle their obligations after clearing.<sup>25</sup> Hence measures get introduced by country authorities to improve the soundness of financial systems. Hopefully, then, as bank licensing becomes more stringent, banking supervision and governance of banks improve, and as bank branching is permitted everywhere, liquidity shocks and panics emanating from within the financial system but outside the payment system will decline in significance (frequency and severity). Liquidity shocks emanating from outside the domestic financial system—abroad or due to developments in the real sector—will continue to occur, of course.

Thus, the approach of policy makers has been straightforward and logical, namely, in addition to measures to improve the soundness of the financial system, policy makers are also instituting measures to reduce settlement risks in the payment system by ensuring payment finality<sup>26</sup> within the payment organizations, without special intervention by the central bank. Major initiatives in the industrial countries, for example, during the last two decades, can indeed be viewed in this context: inter alia, the steps taken by central banks to ensure that private large-value transfer systems (LVTs)—especially net settlement systems—take

---

<sup>25</sup>For a good introduction to the literature on banking panics, see Calomiris and Gorton (1991). In this regard, also of relevance is Freeman (1996).

<sup>26</sup>Payment is final when it becomes irrevocable and unconditional.

appropriate measures to contain intraday bilateral exposures and ensure settlement finality within the systems via exposure limits (debit caps and bilateral credit limits), collateralization and loss-sharing agreements, and reduction of the time lags in settlement; the move by central banks toward real-time gross settlement (RTGS) systems; limits and collateral in central bank credit policies vis-à-vis RTGS systems; the emergence of the Lamfalussy standards as a framework for assessing and regulating private netting systems; initiative in the European Union countries to develop minimum common features for their payment systems; and cooperation among industrial countries, under the aegis of the BIS, to coordinate several aspects of their payment system policies and take other measures (such as increasing overlap of operating hours and ensuring intraday finality within systems) to reduce payment risks in foreign exchange transactions.<sup>27</sup>

The above initiatives and measures contribute to reducing drastically liquidity shocks, leaving routine monetary policy and operations to worry mainly about institutional and technological changes. The central bank may increasingly have become seen as a guarantor of payments settlement because of legal obligations of the central bank, in perhaps the majority of countries, to promote monetary and financial stability, and related to this because of a growing consensus that final settlement of clearing systems should take place on the books of

---

<sup>27</sup>For example, Japan, by extending the hours of its main foreign exchange settlement system, BOJ-NET, until 5:00 p.m. Tokyo time, has facilitated a greater overlap with CHIPS and Fedwire. The U.S. Federal Reserve has also decided to increase its hours of operating Fedwire, so that it will fully overlap with systems in Europe as well as with part of the business day in Japan. The risk in settling securities transactions has mainly been reduced by adopting systems with delivery versus payment (DVP). This is best achieved by linking book entry securities transfer and registration systems to payment systems.

the central bank;<sup>28</sup> here, again, the dominant consideration is risk—in this case systemic risk—rather than price stability as such. But, at the same time, the measures enumerated above to contain settlement risks have simultaneously reduced the chances that the central bank will be called upon to “bail out” a payment system in systemic crisis. What is good for risk is also, here, good for monetary policy.

#### IV. INSTITUTIONAL AND TECHNOLOGICAL CHANGES

In the context of monetary policy, institutional and technological changes basically engender changes: (1) in income velocity of money;<sup>29</sup> (2) in the money multiplier; (3) in the nature of the transmission processes and the lag structures involved, and hence the speed and predictability of the effect of central bank reserve changes on the price level; and (4) in the effectiveness of different instruments at the disposal of the monetary authorities in affecting intermediate or proximate targets of monetary policy, and hence in the optimal mix of policy instruments. In other words, institutional and technological changes in the payment system have enormous implications for monetary policy and operations. The institutional and

---

<sup>28</sup>While banks can, as a matter of principle, settle using bilateral accounts with each other, or on the books of some private settlement agent (clearing bank), settlement by banks on the books of the central bank—whether gross or after multilateral netting—can be seen as facilitating a reduction of systemic risk. Payments using central bank money result in claims on the central bank which cannot fail (become insolvent) or have liquidity problems; from the perspective of agents other than the central bank, such payments, therefore, do not have any credit or liquidity risks associated with them.

<sup>29</sup>See, e.g., Bordo, Jonung, and Siklos, (1997), for a discussion of the evidence of a long-run relationship between velocity of money and institutional and technological changes, specifically in the financial system. For a theoretical analysis of the role of technological changes in the financial sector, see, e.g., Ireland (1994).

technological changes, as we have stated already, could be endogenous, emanate from regulatory changes, or induced by incentives created by public policy changes of the authorities (monetary and nonmonetary).

### A. The Long Run

It is interesting that, whereas there has been recognition that institutional and technological changes can cause changes in money demand, and ipso facto, velocity, components of the payment system get hardly mentioned explicitly in this literature. Instead the literature most frequently mentions “monetization” and “increasing financial sophistication,” both factors themselves being represented by proxies such as increasing ratio of nonbank financial assets to total financial assets, declining currency-money ratio, and rising share of labor force in non-agricultural pursuits.<sup>30</sup> Hence, we need tests that explicitly include payment system proxies for “increasing financial sophistication” and “technological changes in the financial system.”

Long-run studies support the hypothesis of a U-shaped income velocity over time, within countries, and at any time across countries, as an outcome of the opposing influences on money demand of increasing monetization and financial sophistication, and of technological

---

<sup>30</sup>Bordo, Jonung, and Siklos (1997), for example, estimate a velocity function for five countries (Canada, U.S., U.K., Sweden, and Norway) to test the hypothesis

$$v_{it} = \beta_0' + \beta_1' \Phi_{it} + \beta_2' \Omega_{it} + \epsilon_t$$

where  $v$  is velocity,  $i$  refers to the country, and  $t$  to time;  $\Phi$  is a vector with elements real per capita permanent income and a proxy for the opportunity cost of holding money; and  $\Omega$  is a vector with elements being the institutional factors mentioned in the text.



changes.<sup>31</sup> Similarly, the money multiplier<sup>32</sup> is expected to increase with real per capita income over time and across countries, for any given structure of real interest rates on deposits, mainly because of declining desired currency-money ratio (as the banking habit spreads and banks and bank branches multiply) and increasing financial sophistication (within banks and in the financial system as a whole) so that banks better manage (that is, better economize on) reserves. We need to isolate more clearly the effect of the payment system factors in this empirical analysis. In the meanwhile, we would posit that increasing income velocities and money multipliers are what we expect to see with most of the institutional and technological changes taking place in the payment systems around the world, although in a few cases the effect could be the opposite (such as a move from net settlement to gross real time settlement in large value transfer systems, which could cause the money multiplier to fall).

---

<sup>31</sup>See, e.g., Bordo and Jonung (1987) and Ezekiel and Adekunle (1969).

<sup>32</sup>Recall that the money multiplier,  $m$ , is equivalent to:

$$m = \frac{\frac{C}{D} + 1}{\frac{C}{D} + \frac{R}{D}}$$

where  $C$  is currency outside banks,  $R$  is bank reserves (vault cash plus reserves held at the central bank), and  $D$  is bank deposits. Also recall that:

$$M = m \cdot H$$

where  $H (=C+R)$  is high-powered or base money.

## B. The Short Run

It is in short run (policy-oriented) analysis that there has been any real and explicit concern for the effect of changes in the payment system, although the theoretical and empirical literature is still relatively thin. For velocity and the money multiplier can change significantly in the short term because of major institutional and technological changes in the payment system within a short period of time. As a result, there are implications for the monetary policy decision-making process. Conceptually, four different, but closely interrelated, areas of decision making could be affected by major payment system reforms and endogenous changes, as the monetary authorities try to take into account the short-term impact on velocity and the money multiplier.<sup>33</sup>

First are the *monetary policy target and instrument settings*—for example, the aggregate volume of reserves the central bank should supply for consistency between demand for reserves and the central bank's desired monetary policy stance; the pricing or the quantity limits in standing central bank credit facilities; and the appropriate relationship between very short-term interbank interest rates (which the central bank directly affects) and other interest rates and financial variables (over which the central bank has less direct influence). Second are the *choice of appropriate target or indicator variables* for monetary policy—for example, the

---

<sup>33</sup>Recall that, abstracting from uncertainty and seasonal factors, the currency-money ratio, in the short term, will be a function of income per capita and interest rates on bank deposits. The reserve-deposit ratio, in the short term, will be a function of interest rates in money and financial markets (e.g., central bank interest rates on discounts and advances, commercial banks' interest rates on loans, and market interest rates on securities that banks keep in their portfolio); of course, in a complete analysis, all these rates are determined in a general equilibrium framework. For an illustrative partial-equilibrium empirical analysis, see Khatkhate, Galbis, and Villaneuva (1974).

relative weights (or reliability as indicators) attached to price and quantity variables (interest rates versus reserve money) while demand for the key operational quantity variable (reserve balances) is shifting. There may be effects on quantity variables at the level of the banking system, as well as at the level of the central bank's balance sheet. Third is the appropriate *design of monetary policy instruments*; for example, the design of reserve requirements or of central bank standing credit facilities, or the nature and timing of central bank market operations, might need to be adjusted. Fourth, of course, is the *monetary policy transmission mechanism* itself—for example, the efficiency with which central bank actions in respect of the supply of reserves feeds through to interest rates in different markets and subsequently through to other economic and financial variables of ultimate interest.

As an example,<sup>34</sup> in June 1987, the Swiss Interbank Clearing system (SIC) was introduced with no intraday liquidity facility but with a queuing system. When liquidity requirements were reduced in January 1988, the effects on money market rates indicated that banks had apparently introduced improved liquidity management systems, probably in response to the SIC queuing system. Thus, monetary policy turned out to be easier than expected. The Swiss National Bank also was led to modify its Lombard facility to a flexible one, *inter alia* in order to enhance its ability to respond to money market rates in a timely manner (see Rich, 1992; and Swiss National Bank, 1989).

Recent experience from various countries indicates that payment system initiatives that can be major and speedy enough to affect velocity and the money multiplier and hence influence the central bank's monetary policy decision making in the short term include:

---

<sup>34</sup>This example is based on Lybek (1996).

(1) arrangements that reduce float; (2) development of clearinghouses and refinements of risk-reduction measures in those houses to facilitate safe and reliable netting arrangements and less frequent intraday settlement cycles; (3) moves to electronic payments (for both retail and wholesale payments); (4) centralization of commercial banks' reserve accounts at the central bank; (5) moves from net settlement to real-time gross settlement (RTGS) systems; and (6) introduction of payment instruments that reduce the use of cash or even of deposits. To reiterate, in designing their liquidity management framework and in an attempt to improve the effectiveness of monetary operations, those concerned with monetary policy and operations in central banks will find it useful to keep track of such developments in the payment system and to refine techniques to assess the short-term effects on monetary variables of policy interest.

## REFERENCES

- Baliño, Tomás J. T. and Lorena M. Zamalloa, 1997, *Instruments of Monetary Management* (Washington: International Monetary Fund).
- Bank of International Settlements, 1993, *Payment Systems in the Group of Ten Countries*, prepared by the Committee on Payment and Settlement Systems of the central banks of the Group of Ten countries (Basle, December).
- Bordo, Michael D. and Lars Jonung, 1987, *The Long-Run Behavior of the Velocity of Circulation: The International Evidence* (Cambridge: Cambridge University Press).
- Bordo, Michael D., Lars Jonung, and Pierre L. Siklos, 1997, "Institutional Change and the Velocity of Money: A Century of Evidence," *Economic Inquiry*, Vol. 35 (October), pp. 710-24.
- Calomiris, Charles W. and Gary Gorton, 1991, "The Origins of Banking Panics: Models, Facts, and Bank Regulation," in *Financial Markets and Financial Crises*, edited by R. Glenn Hubbard (Chicago: University of Chicago Press), pp. 109-173.
- Ettin, Edward, 1988, "Commentary" in *Restructuring Banking and Financial Services in America*, edited by William S. Haraf and Rose Marie Kushmeider (Washington: American Enterprise Institute for Public Policy Research), pp 113-155.
- European Monetary Institute (EMI), 1993, *Report to the Committee of Governors of the Central Banks of the Member States of the European Economic Community on Minimum Common Features for Domestic Payment Systems* (Frankfurt: Working Group on Payment Systems, November).
- \_\_\_\_\_, 1994, *Note on the EMI's Intentions with Regard to Cross-Border Payments in Stage III* (Frankfurt: Working Group on Payment Systems, November).
- \_\_\_\_\_, 1995, *Report to the Council of the European Monetary Institute on the Target System* (Frankfurt: Working Group on Payment Systems, May).
- Ezekiel, Hannan and Joseph O. Adekunle, 1969, "The Secular Behavior of Income Velocity: An International Cross-Section Study," *International Monetary Fund Staff Papers*, Vol. 16 (July), pp. 224-239.
- Freeman, Scott, 1996, "The Payments System, Liquidity, and Rediscounting," *American Economic Review*, Vol. 86 (December), pp. 1126-1138.
- Hoel, Arline, 1975, "A Primer on Federal Reserve Float, Federal Reserve Bank of New York Monthly Review Vol.57 (October), pp. 245-253.
- Ireland, Peter, 1994, "Economic Growth, Financial Evolution, and the Long-Run Behavior of Velocity," *Journal of Economic Dynamics and Control*, Vol. 18 (May/July 1994), pp. 815-48.
- Johnson, Omotunde E. G., Richard Abrams, Jean-Marc Destresse, Tonny Lybek, Nicholas M. Roberts, and Mark Swinburne, (1998), *Payment Systems, Monetary Policy, and the Role of the Central Bank* (Washington, IMF).
- Khatkhate, D. R., V. G. Galbis, and P. Villaneuva, 1974, "A Money Multiplier Model for a Developing Economy: The Venezuelan Case," *International Monetary Fund Staff Papers*, Vol. 21 (November), pp. 740-7.
- Liang, Ming-Yih, 1986, "Bank Float, Mail Float and the Definition of Money," *Journal of Banking and Finance* Vol. 10 (December), pp. 533-548.

- Lybek, Tonny, 1996, "Swiss Monetary Policy and the Introduction of SIC, 1987-89," Memorandum, Monetary and Exchange Affairs Department, IMF.
- Mengle, David, David B. Humphrey, and Bruce J. Summers, 1987, "Intraday Credit: Risk, Value, and Pricing," Federal Reserve Bank of Richmond *Economic Review* Vol. 73 (January/February), pp. 3-14.
- Rich, Georg, 1992, "Die Schweizerische Teuerung: Lehren für die Nationalbank," *Geld, Währung and Konjunktur*, Swiss National Bank, No. 10 (March), pp. 73-88.
- Sundararajan, V., and Gabriel Sensenbrenner, 1994, "Linkages Between Payment System Reforms and Monetary Policy: The Recent Experience in Russia and Other Former Soviet Union Countries," in *Frameworks for Monetary Stability*, ed. by Tomás J.T. Baliño and Carlo Cottarelli (Washington: IMF), pp. 611-54.
- Summers, Bruce J., 1994, *The Payment System: Design, Management and Supervision* (Washington: IMF, 1994).
- Swiss National Bank, 1989, "Die Geldpolitik im Jahre 1988," *Geld, Währung and Konjunktur*, Swiss National Bank, No. 4 (December), pp. 345-60.
- VanHoose, David D., 1991, "Bank Behavior, Interest Rate Determination, and Monetary Policy in a Financial System with an Intraday Federal Funds Market," *Journal of Banking and Finance* Vol. 15 (April), pp. 345-365.
- Veale, John M., and Robert W. Price, 1994, "Payment System Float and Float Management," in *The Payment System: Design, Management and Supervision* edited by Bruce J. Summers (Washington: IMF, 1994).
- Young, John E., 1986, "The Rise and Fall of Federal Reserve Float," Federal Reserve Bank of Kansas City *Economic Review* Vol. (February), pp. 28-38.