

---

# Monetary Policy Without Reserve Requirements: Case Studies and Options for the United States

*By Gordon H. Sellon, Jr. and Stuart E. Weiner*

Over the past decade, the level of required reserve balances held by depository institutions in the United States has declined dramatically. Indeed, most depository institutions can now meet reserve requirements by holding vault cash rather than by maintaining balances at the Federal Reserve. Part of this decrease resulted from the Federal Reserve's decision to reduce reserve requirements in 1990 and 1992 to reduce bank costs and stimulate lending. More recently, depository institutions have been able to cut required balances even further by sweeping funds from reservable to nonreservable accounts, circumventing reserve requirement regulations.

The decline in reserve balances has fueled a debate over the role of reserve requirements. On the one hand, proponents of reserve requirements argue that low reserve balances may complicate

monetary policy operations and increase short-term interest rate volatility. Thus, they advocate the Federal Reserve take actions to stop the continuing erosion of reserve balances. On the other hand, critics of reserve requirements argue that lower reserve requirements remove a distortionary tax on depository institutions and need not complicate monetary policy operations.

In a previous article, we provided an analytical framework for thinking about these issues (Sellon and Weiner). That article suggested that monetary policy can be conducted in a world of low or zero reserve requirements as long as there continues to be a demand for central bank balances. Such demand is likely to arise from the need of financial institutions to hold central bank balances for settlement purposes and to transact business with the government. The demand for settlement balances is likely to be behaviorally different from the demand for reserves, however, leading to two potential problems for monetary policy operations. First, because the demand for central bank balances arises from payments needs rather than from a mandated linkage to deposit liabilities, the structure of the payments system becomes an important factor in the design and implementation of monetary policy operating procedures. Consequently, changes in the payments system may affect the demand for settlement balances and complicate monetary policy.

---

*Gordon H. Sellon, Jr. is an assistant vice president and economist at the Federal Reserve Bank of Kansas City. Stuart E. Weiner is a vice president and economist at the bank. The authors would like to thank Roger Clews, Kevin Clinton, and Michael Reddell for helpful discussions in the course of the preparation of this article. Stephen Monto, an assistant economist at the bank, helped prepare the article. The views expressed herein are solely those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of Kansas City or the Federal Reserve System.*

Second, short-term interest rate volatility could increase as reserve requirements decline if the demand for central bank balances becomes more difficult to forecast or if the interest sensitivity of this demand is reduced. Increased interest rate volatility would be of concern to the extent it had negative effects on economic activity.

While these potential problems are valid in theory, it is not clear how important they are in practice. To judge their practical importance, in this article we examine how three countries—Canada, the United Kingdom, and New Zealand—conduct monetary policy without using reserve requirements. The experience of these three countries provides insight into the linkages between the payments system and monetary policy and into the connection between reserve requirements and interest rate volatility. This insight is particularly helpful in understanding the implications of a further reduction of reserve balances in the United States. The analysis suggests that reserve requirements are not essential for the conduct of U.S. monetary policy provided the Federal Reserve is sufficiently flexible in modifying existing mechanisms for providing liquidity to the banking system.

This article has four main sections. The first section reviews the implications of declining reserve requirements for monetary policy. The second section describes how the central banks in Canada, the United Kingdom, and New Zealand conduct monetary policy without reserve requirements and examines the relationship between the payments system and monetary policy procedures. The third section uses the experience of these three countries to analyze the connection between reserve requirements and interest rate volatility. The final section draws implications for the United States and discusses some of the options open to U.S. policymakers in addressing the declining effectiveness of reserve requirements.

## I. DECLINING RESERVE BALANCES: ANALYTICAL ISSUES

Over the years, the role of reserve requirements as a monetary policy instrument has diminished. In the United States, as in many other countries, reserve balances have declined as reserve requirements have been cut and as financial institutions have attempted to minimize the costs of holding reserves. Operating in a world with low reserve requirements, however, raises important conceptual and practical issues for central banks.

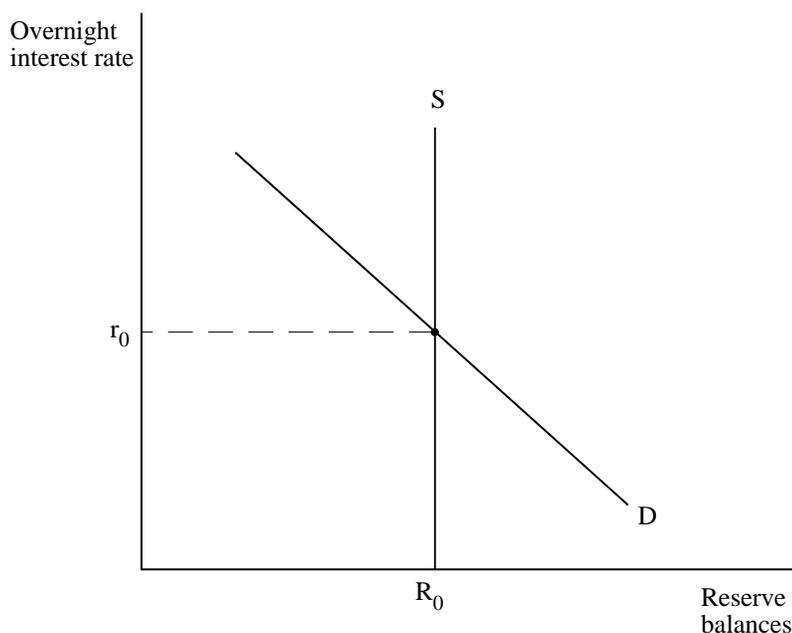
### *The declining importance of reserve requirements*

In the United States and many other countries, banks and other depository institutions are required to maintain a fraction of their deposit liabilities in the form of reserves—balances held at the central bank or vault cash held at the institution.<sup>1</sup> Generally, depository institutions do not have to meet reserve requirements on a daily basis but only, on average, over a period of one or more weeks.<sup>2</sup> Like many central banks, the Federal Reserve does not pay interest on reserve balances. Thus, to the extent that reserve requirements force depository institutions to hold higher balances than necessary for normal business purposes, reserve requirements constitute a tax on depository institutions.

While reserve requirements are seen as a burden by depository institutions, historically central banks have viewed reserve requirements as an important instrument of monetary policy. Traditionally, reserve requirements have been viewed as a means for a central bank to limit the amount of credit extended by banks or growth in the money supply.

The role of reserve requirements in monetary policy has changed in recent years, however, as

Figure 1



many central banks have abandoned operating procedures designed to control reserve or money growth and instead have emphasized control of short-term interest rates. Under such an interest rate operating procedure, reserve requirements may still be useful to the extent that they help stabilize the demand for reserves. This point is illustrated in Figure 1, which shows the market for reserves. The demand for reserves  $D$  is derived from reserve requirements plus depository institutions' desired holdings of excess reserves. The supply of reserves  $S$  is determined by central bank actions to supply reserves through open market operations and its discount or lending facility and by nonpolicy factors affecting reserve supply. In this framework, the central bank is

able to control the short-term interest rate  $r$  by altering the amount of reserves it supplies to institutions so as to offset the effects of shifts in reserve demand and in nonpolicy factors that shift reserve supply. To accomplish this, however, the central bank needs to be able to forecast both the demand for reserves and the nonpolicy factors affecting reserve supply. Reserve requirements may be useful in the implementation of monetary policy insofar as they help produce a more stable or more predictable demand for reserves (Weiner 1992).

Many central banks have begun to weigh the smaller monetary policy role of reserve requirements against their obvious cost to depository

institutions. In the United States and a number of other countries, reserve requirements have been lowered, and several countries have eliminated reserve requirements altogether (Bank of Japan). In addition, the effectiveness of reserve requirements has been eroded by financial innovations that reduce the amount of reserve balances that depository institutions are required to hold. In the United States, over the past three years, depository institutions have substantially reduced reserve balances by “sweeping” funds from reservable deposit accounts to nonreservable deposit accounts.<sup>3</sup> As a result, reserve balances at the Federal Reserve have fallen to their lowest level in 30 years, and most depository institutions can now meet their reserve requirements by holding vault cash rather than by maintaining reserve balances at the Federal Reserve.

#### *Monetary policy implications of lower reserve requirements*

Although reserve requirements have become a less important policy instrument, it would be a mistake to conclude that the disappearance of reserve requirements has no implications for monetary policy. Indeed, in a world in which reserve requirements are low enough to be non-binding or even zero, central banks face important conceptual and practical issues in implementing monetary policy.

The main conceptual issue concerns the nature of the demand for central bank balances in the absence of reserve requirements. Without reserve requirements, depository institutions are likely to continue to hold balances at the central bank in order to settle interbank payments and to carry out transactions with the government. In the framework shown in Figure 1, there will still be a demand curve, but it will now represent a demand for settlement balances rather than a demand for reserve balances. However, this demand for settlement balances is likely to be

behaviorally different from the demand for reserve balances. Indeed, the demand for settlement balances is mainly determined by institutional features of the payments system that affect the timing of payments. In contrast, in a world with reserve requirements, the demand for reserve balances depends mainly on the level of reservable deposits held by an institution, which may bear little relationship to payments needs.<sup>4</sup>

These differences have two important practical implications for monetary policy. First, in a system with low or zero reserve requirements, monetary policy operating procedures are likely to be more closely linked to the structure of the payments system because the demand for settlement balances depends largely on payments needs.<sup>5</sup> As a result, changes in institutional aspects of the payments system may influence the demand for settlement balances, affecting the central bank’s ability to forecast this demand and complicating the implementation of policy. For example, a technological improvement in institutions’ ability to monitor their settlement balances could reduce their need for settlement balances and make it more difficult to forecast this demand.<sup>6</sup>

A second implication of lower reserve requirements for monetary policy is the potential increase in the volatility of short-term interest rates. Such volatility may be important to the extent it is transmitted to longer term rates and has a negative effect on the real economy. Short-term interest rate volatility could rise as reserve balances fall if the demand for central bank balances becomes more difficult to forecast. Interest rate volatility could also rise if the demand for central bank balances becomes less sensitive to interest rates. In this situation, errors in forecasting demand or nonpolicy supply factors would result in greater interest rate variability (Sellon and Weiner).

## II. OPERATING WITHOUT RESERVE REQUIREMENTS: CASE STUDIES

While these concerns about the monetary policy implications of low reserve requirements are valid in theory, it is not clear how important they are in practice. One way to judge their importance is to look at how other countries conduct monetary policy without relying on reserve requirements. The experience of three countries—Canada, the United Kingdom, and New Zealand—illustrates that reserve requirements are not essential to the implementation of monetary policy and, at the same time, highlights the connection between the payments system and monetary policy in a world without reserve requirements.

### CANADA

In Canada, the current framework for implementing monetary policy was introduced with the full elimination of reserve requirements in 1994. Prospective changes in the Canadian large-dollar payments system, scheduled for late 1997, will require significant changes in these procedures.

#### *Current system*

In Canada, the decision to eliminate reserve requirements was largely motivated by the distorting effects of reserve requirements on the financial system (Clinton 1997, Montador). Because they applied only to banks, reserve requirements were seen as a differential and unnecessary tax on the banking system. In addition, as in the United States, the effectiveness of reserve requirements was being eroded by financial innovation. The elimination of reserve requirements in Canada was authorized by the 1991 Bank Act, and a phaseout of reserve requirements began in June 1992 (Clinton 1997). Reserve requirements were fully eliminated in June 1994.

The basic strategy for implementing monetary policy in Canada centers on the Bank of Canada's control of the supply of settlement balances to affect overnight interest rates. Desired settings for the overnight rate are derived from objectives for short-term interest rates and the exchange rate that are thought to be consistent with the long-run objective of price stability.<sup>7</sup>

Generally speaking, a central bank's ability to influence overnight rates depends heavily on how well it can forecast the demand for settlement balances. It must be able to forecast demand in order to determine how much to adjust the supply of balances to achieve a desired interest rate.<sup>8</sup> Thus, a key element in this framework is the existence of a well-defined demand for settlement balances.

In Canada, the demand for settlement balances is determined by the need for banks to hold funds at the Bank of Canada, which in turn depends on institutional features of the Canadian payments system and on rules and incentives to hold settlement balances that are set by the Bank of Canada. Unlike the United States with its large number of banking organizations, in Canada there is a relatively small number of settlement institutions. There are currently 12 bank and nonbank direct clearers that are required to settle their transactions on the books of the Bank of Canada. The key institutional feature shaping their demand for settlement balances is that payments made during the day clear overnight. Settlement occurs the following morning but is backdated to the previous day.

This retroactive feature has two implications for the demand for settlement balances by direct clearers. First, retroactive settlement creates uncertainty for an institution about its final settlement balance position. Second, at the time its settlement position is known, it is too late for the institution to adjust its position further. If the

institution has a negative balance, its only option is to borrow funds from the Bank of Canada.<sup>9</sup> If it has a positive balance, it incurs a cost in terms of interest foregone.

In Canada, the existence of a well-defined demand for settlement balances stems from the uncertainty created by the retroactive nature of the settlement system and from the Bank of Canada's ability to affect the opportunity cost of holding settlement balances. While there is no reserve requirement for direct clearers, holding either a positive or a negative position entails a cost, which creates an incentive for an institution to target a zero balance. These costs stem from two requirements. One, institutions with a negative balance on any day are required to take a collateralized loan from the Bank of Canada and pay the published Bank Rate, which is aligned with prevailing short-term money market rates. Two, institutions with a negative cumulative position over a monthly averaging period are required to take a collateralized loan at the Bank Rate or pay a fee in lieu of the loan. Although clearing institutions are penalized for daily or period overdrafts, they receive no interest on positive settlement balances. The combination of the average settlement balance requirement, the fee on overdrafts, and the non-payment of interest on positive balances creates a system in which clearing institutions will have a well-defined demand for settlement balances which aids the Bank of Canada in achieving its overnight interest rate objective (Clinton 1997).<sup>10</sup>

At the time reserve requirements were eliminated, the Bank of Canada also made changes to its operating procedures to improve the efficiency and transparency of its policy actions. The principal change was the introduction of an explicit operating band for the overnight rate as a means of clarifying its desired target for the overnight rate. This band, which is made public,

permits the overnight rate to fluctuate within a range of 50 basis points.

The Bank of Canada implements policy by choosing a target for the overnight rate within the operating band. The Bank attempts to achieve this target principally by engaging in repurchase agreements during the day to maintain the overnight rate within the band. When rates threaten to move above the upper limit of the operating range, the Bank can conduct Special Purchase and Resale Agreements (SPRAs) to temporarily increase the supply of settlement balances. Similarly, Sale and Repurchase Agreements (SRAs) can be used to absorb settlement balances to prevent the overnight rate from falling below the lower limit of the operating band.<sup>11</sup>

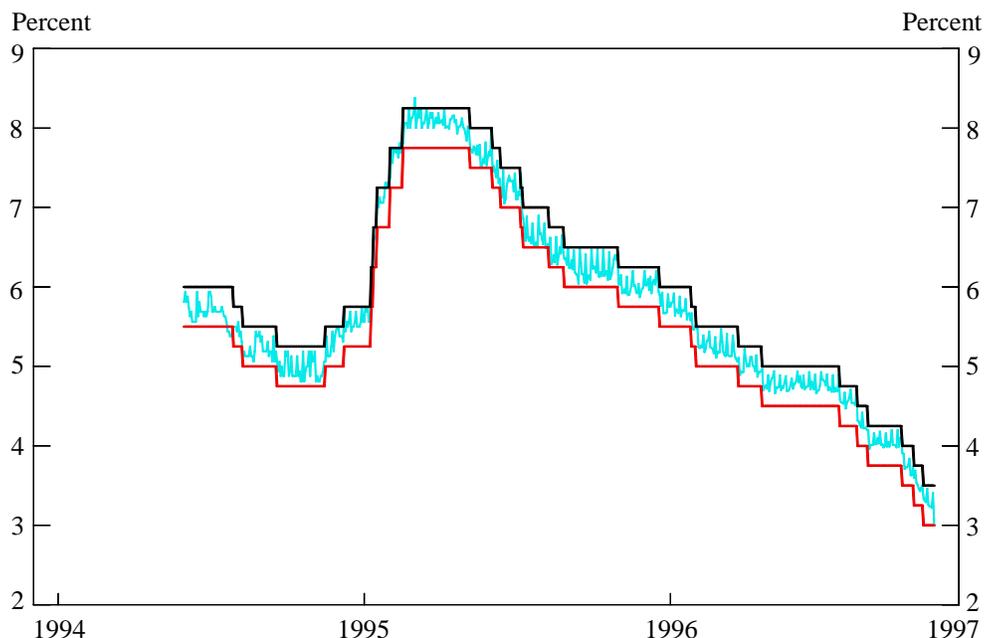
In addition, the Bank of Canada uses its control over government deposits on its books to affect the supply of settlement balances.<sup>12</sup> For example, if increased demand for settlement balances threatens to push the overnight rate above the target, the Bank will transfer government deposits from its books to the clearing banks. This transaction increases the supply of settlement balances and reduces the upward pressure on the overnight rate.<sup>13</sup> The combination of repurchase agreements and transfers of government balances allows the Bank of Canada to maintain the overnight rate within the operating band.

The overall effectiveness of this system in maintaining close control over the overnight rate is illustrated in Chart 1. Since 1994, the Bank of Canada has been very successful in maintaining the overnight rate within its announced operating band without relying on reserve requirements.

### *Prospective changes*

When the current Canadian system was devel-

Chart 1  
OVERNIGHT RATE AND OPERATING BAND



Source: Bank of Canada.

oped, it was recognized that changes in the structure of the payments system would require changes in monetary policy operating procedures. With the scheduled introduction of the Large-Value Transfer System (LVTS) in late 1997, the Bank of Canada has indicated that it will alter its framework for implementing monetary policy (Bank of Canada, Clinton 1997).

From a monetary policy standpoint, the key feature of the LVTS is it will eliminate all of the present uncertainty about settlement balances faced by clearing institutions. Institutions will be able to track transactions on a real-time basis throughout the day and will have the opportunity to make final adjustments in their balances during a presettlement period at the end of the day.<sup>14</sup>

Consequently, the demand for settlement balances is likely to be fundamentally different than under the current system. Indeed, under the LVTS, direct clearers will be able to achieve a zero balance position each day. As a result, there will be no need for a system of averaging in this new framework. The Bank of Canada plans to set the system supply of settlement balances equal to zero each day using an afternoon auction of overnight government deposits. Once the system supply is set at zero, clearing institutions will be able to trade with each other to eliminate any individual surplus or deficient balances.

Without adjustments to monetary policy operating procedures, the overnight rate could become quite volatile under the LVTS, since the rate will

depend primarily on the daily distribution of settlement balance excesses and deficiencies. Thus, the Bank of Canada intends to change its procedures for maintaining its operating band for the overnight rate. Instead of using repurchase agreements during the day to enforce the limits of the operating band as under current operating procedures, the Bank will effectively act as a residual supplier and purchaser of settlement balances.<sup>15</sup> Clearing institutions with a settlement balance deficiency at the end of the day will be able to finance this deficiency by obtaining a collateralized overdraft at the Bank Rate. The Bank Rate will serve as the upper end of the operating range for the overnight rate since institutions would be unlikely to pay more than the Bank Rate to secure additional settlement balances.<sup>16</sup> Similarly, the Bank will pay interest on positive balances held at the end of the day at a rate 50 basis points below the Bank Rate. This rate paid on settlement balances will serve as the lower end of the operating range since institutions would not accept a lower rate on positive balances in the market. With these changes, the Bank of Canada expects to be able to continue to maintain close control over the overnight rate.

### *UNITED KINGDOM*

While Canada's experience in implementing monetary policy without reserve requirements is relatively recent, the United Kingdom has operated without binding reserve requirements for more than a decade. As in Canada, monetary policy operating procedures have undergone recent changes.

#### *The traditional policy framework*

In the UK, reserve requirements have been seen as a discriminatory tax that distorts financial intermediation (King). Thus, formal reserve requirements, in the form of a "cash ratio deposit,"

were lowered over a period of years until they were no longer binding on bank behavior. The remaining requirement of 0.35 percent of deposits has no operational significance for monetary policy and is viewed as a tax whose sole purpose is to provide operating income for the Bank of England.

The Bank of England implements monetary policy by managing the supply of settlement balances in the banking system so as to influence short-term interest rates in a manner consistent with a long-run goal of price stability. This general approach to monetary policy is very similar to that of the Bank of Canada. However, the operating procedures employed by the Bank of England are very different from those used by the Bank of Canada. These differences reflect both variation in the structures of financial institutions and markets in the two countries and different choices made by the central banks in operating methods.

In the UK, monetary policy has traditionally worked through two types of financial institutions. Settlement banks are large commercial banks that are members of the wholesale clearing associations. Discount houses are specialized institutions that operate in sterling money markets and that, historically, have served as an intermediary between the Bank of England and the settlement banks. Until the recent changes in money market operations (March 1997) discussed in the next subsection were made, the Bank of England conducted open market operations and discount window lending primarily through the discount houses so as to affect the supply and cost of settlement balances to the banking system.

Settlement banks in the UK must meet a daily settlement balance requirement. They are required to maintain a positive balance in their settlement account at the Bank of England at the end of each

business day. Unlike the current Canadian system, in the UK there is no averaging of balances. In addition, settlement balances earn no interest. Individual banks that face a prospective deficiency or surplus in their end-of-day balance can transact with other money market participants, selling or buying assets, to adjust their settlement balance. If there is a systemwide shortage or surplus of settlement balances, the Bank of England conducts open market operations or lending operations to adjust the overall amount of settlement balances.

The Bank of England uses its ability to manage the supply of settlement balances to influence short-term interest rates. The Bank of England accomplishes this by creating a daily shortage of settlement balances in the banking system and then supplying additional funds through open market operations and lending operations. By controlling the price and terms of access to these funds, the Bank can influence money market rates. For example, under the old system used prior to March 1997, a settlement bank wishing to obtain additional balances could withdraw secured deposits from a discount house which could then sell assets to the Bank of England during any one of three regularly scheduled daily rounds of open market operations. However, the Bank of England restricts the types of assets that it will purchase in an open market operation and determines the rates at which it will conduct transactions. Indeed, these “dealing rates” for conducting open market transactions are the main policy lever employed by the Bank of England to affect money market rates.<sup>17</sup> By raising or lowering these rates, the Bank influences the marginal cost of settlement balances, pushing market rates higher or lower.

While the Bank of England implements monetary policy through its influence on money market interest rates, it does not aim for the same

degree of control over short-term rates as in Canada. For example, the Bank of England has no explicit target or operating band for interest rates and conducts open market operations in a variety of short-term maturities (King). Despite the lack of formal interest rate targets, however, the Bank of England has been successful in operating monetary policy without relying on reserve requirements. As illustrated in Chart 2, the overnight rate, while quite volatile in the short run, tends to track the Bank’s dealing rate quite closely over a longer period of time.

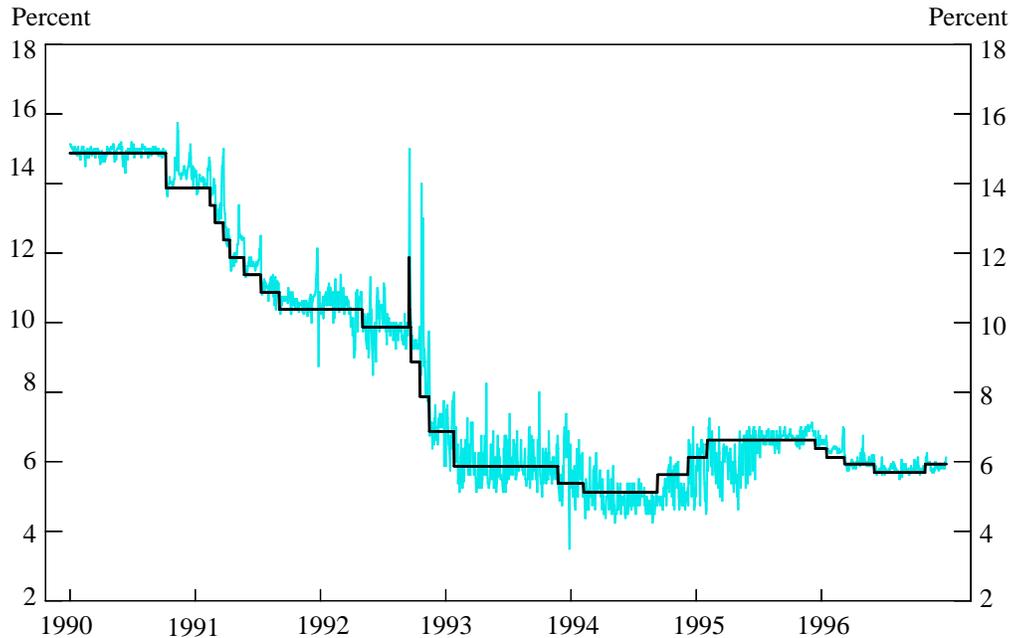
### *Recent changes in procedures*

Over the past few years, the Bank of England has made some important changes to improve the efficiency of its operating procedures and to adapt these procedures to changes in the payments system. Both types of changes are designed to increase the liquidity of money markets.

In March 1997, the Bank of England introduced major changes in its daily money market operations (Bank of England 1997). Generally speaking, these changes expand the flexibility of open market and lending operations and are a continuation of structural changes made over the past several years.<sup>18</sup> One change is an expansion of the range of instruments used in open market operations. Historically, discount houses who wished to obtain funds in open market transactions were restricted to the use of Treasury bills or certain eligible commercial bills.<sup>19</sup> In situations where the supply of these bills was limited, the money market would experience liquidity pressures as discount houses attempted to obtain bills to sell to the Bank of England. These liquidity pressures, at times, contributed to increased interest rate volatility. By expanding the range of instruments used in open market operations to include both fixed-rate and variable-rate repurchase agreements in government securities (gilt repos), the Bank of England aims

Chart 2

## UNITED KINGDOM: OVERNIGHT RATE AND BAND 1 DEALING RATE



Source: Bank of England.

to reduce liquidity pressures associated with the limited availability of eligible bills.

In addition to expanding the range of assets used in open market operations, the Bank of England has also enlarged the set of counterparties in open market operations and discount window lending. The Bank now conducts daily open market operations with institutions other than the discount houses and provides late-day lending assistance directly to settlement banks.<sup>20</sup> These actions are also designed to improve the efficiency of money markets by increasing market liquidity.

As in Canada, changes in the payments system in the UK have also had implications for mone-

tary policy. In 1996, the UK implemented a real time gross settlement (RTGS) payments system aimed at reducing intraday credit exposures in the large-dollar payments system. RTGS lowers credit risk by requiring that funds be available to cover a transaction before a transaction is completed. Such a system can place enormous demands on intraday liquidity, however. These demands may be difficult to meet in a system with low reserve requirements because the low levels of settlement balances held to meet end-of-day requirements may be insufficient to meet intraday liquidity requirements. As a result, the Bank of England has developed an intraday repo facility to meet intraday credit needs (Bank of England 1994). Under this system, settlement institutions can obtain additional settlement bal-

ances on demand during the day by engaging in collateralized repurchase agreements with the Bank of England. No interest is charged on these transactions, but the transactions must be unwound by the end of the day to remove the excess liquidity prior to end-of-day settlement.<sup>21</sup>

As compared with Canada, payments system changes in the UK have had a smaller effect on monetary policy. In Canada, as discussed above, the move from retroactive to same-day settlement has had major implications for operating procedures. In the UK, the introduction of RTGS has been structured to minimize the implications for monetary policy. In principle, the provision of intraday liquidity under RTGS could spill over into the overnight market and affect a central bank's ability to control overnight liquidity and influence the overnight rate. However, the intraday facility in the UK was designed so that the provision of intraday liquidity would not affect the Bank of England's leverage over short-term interest rates (Dale and Rossi).

### *NEW ZEALAND*

New Zealand is a third country that has conducted monetary policy without reserve requirements for a number of years. As in Canada and the United Kingdom, monetary policy operating procedures in New Zealand are currently undergoing significant changes.

#### *Current procedures*

Reserve requirements were eliminated in New Zealand in the mid-1980s as part of a set of larger policy initiatives designed to increase the efficiency of the economy by reducing distortions caused by taxes and government regulation (Evans and others). Thus, as in Canada and the UK, reserve requirements in New Zealand were seen as imposing a significant cost on

financial institutions while, at the same time, having little operational use in monetary policy.

The general approach to monetary policy in New Zealand is broadly similar to that in Canada and the UK. The Reserve Bank of New Zealand uses its control over the supply of settlement balances to influence interest rates and exchange rates in a manner consistent with a goal of maintaining price stability. As compared with the other two countries, however, New Zealand operating procedures are more quantity-oriented and place less emphasis on the control of short-term interest rates.

In New Zealand, the focal point of monetary policy operations is the amount of settlement balances or "settlement cash" held at the Reserve Bank of New Zealand (Huxford and Reddell). Most banks choose to hold balances at the Reserve Bank in order to clear directly transactions with the government and the Reserve Bank and to settle interbank transactions. If a bank has a settlement account, the Reserve Bank requires that this account have a nonnegative balance at the end of the day. This daily balance requirement, similar to that in the UK, gives the central bank leverage over short-term interest rates. By controlling both the supply of settlement balances relative to the demand and the opportunity cost of holding these balances, the Reserve Bank can influence short-term rates.

To implement policy, the Reserve Bank uses open market operations to achieve a target level of settlement cash balances. This target is set so that errors in forecasting settlement balances will lead the banking system occasionally to face a prospective shortage. In this situation, the Reserve Bank is the only source of additional balances. To obtain these balances, however, banks must sell a special asset called "Reserve Bank bills" to the Reserve Bank and pay a penalty rate for these funds.<sup>22</sup> The combination of a

limited supply of Reserve Bank bills and the penalty rate on additional settlement balances causes banks to attempt to fund settlement balance deficiencies in the money market, transmitting settlement balance pressures to market interest rates. At the same time, the Reserve Bank pays interest on positive settlement balances held at the end of the day. However, this rate is set sufficiently below market rates that banks have an incentive to dispose of excess balances in the money market, rather than relying on the Reserve Bank's payment of interest.<sup>23</sup>

In this framework, when the Reserve Bank feels that a change in monetary policy is warranted, it can alter the settlement cash target or issue public statements of its intentions. Thus, for example, a lowering of the settlement cash target will increase the likelihood that banks will face a settlement balance deficiency, placing upward pressure on market rates. Similarly, an increase in the cash target will place downward pressure on rates.<sup>24</sup> In recent years, the Reserve Bank has also placed increased emphasis on public statements to convey its policy intent. These statements plus the publication of the Reserve Bank's own inflation projections and desired conditions for short-term interest rates and exchange rates convey changes in the stance of monetary policy to financial markets.

### *Prospective changes*

As in Canada and the UK, ongoing institutional changes in the New Zealand payments system have implications for monetary policy operating procedures. In addition, the Reserve Bank of New Zealand has recently undertaken a comprehensive review of its procedures for implementing monetary policy. If proposed changes are adopted, the Reserve Bank of New Zealand will move away from implementing policy through a settlement cash target in favor of an explicit operating band for interest rates.<sup>25</sup>

One important institutional change in New Zealand is the introduction of a real time gross settlement (RTGS) system for the large-dollar payments system. As in the UK, adoption of RTGS in a system without reserve requirements will increase intraday liquidity pressures. Like the Bank of England, the Reserve Bank of New Zealand plans to respond by introducing an intraday repurchase facility so that banks can obtain additional funds in their settlement accounts as needed during the day. This change is expected to prevent intraday liquidity pressures from affecting the volatility of overnight and other short-term rates.<sup>26</sup>

More fundamental changes in monetary policy operating procedures may also be forthcoming.<sup>27</sup> The Reserve Bank has recently proposed replacing much of the institutional framework used to target settlement cash balances with a framework relying on an explicit target range for the overnight cash rate. This proposed system has many similarities to the new framework to be used by the Bank of Canada. The main feature of this new system would be a target range of 20 to 50 basis points for the overnight rate. The upper end of this range is the rate at which the Reserve Bank would provide additional settlement balances through repurchase agreements. The lower end of the range would be the rate paid by the Reserve Bank on settlement balances. Monetary policy would operate, not by targeting the amount of settlement cash balances, but by changing the cash rate range to influence other short-term interest rates and exchange rates. The Reserve Bank believes that these changes are likely to increase its leverage over short-term interest rates and the efficiency and transparency of monetary policy operations. The Bank also feels that this new framework provides administrative convenience in operating with a real time settlement system.

### III. RESERVE REQUIREMENTS AND INTEREST RATE VOLATILITY

One of the principal monetary policy issues connected with reducing or eliminating reserve requirements is whether interest rate volatility would rise. Although previous research suggests that volatility may be greater in countries with low or nonbinding reserve requirements, an examination of recent interest rate volatility in Canada, the United Kingdom, and New Zealand suggests that there is no clear relationship between reserve requirements and volatility. Indeed, the experience of these three countries suggests that interest rate volatility may depend more on the mechanism for providing liquidity to the settlement system than on the level of reserve requirements.

#### *Evidence on volatility*

Volatility of short-term interest rates is a concern to policymakers to the extent it is transmitted to prices of longer term assets and has a negative effect on economic activity. Volatility of short-term rates may also complicate the ability of financial markets to discern the stance of monetary policy. In such circumstances, central banks may want to explore ways of reducing or limiting volatility.

Evidence that reserve requirements and interest rate volatility may be related comes from both casual observation and empirical studies. When the Federal Reserve cut reserve requirements at the end of 1990, for example, the volatility of the federal funds rate rose sharply for several weeks (Feinman). And, more recently, as sweep accounts have further reduced reserve balances, intraday volatility in the federal funds market appears to have risen moderately (Bennett and Hilton).

Previous empirical studies have examined the connection between reserve requirements and

interest rate volatility by comparing volatility across countries with different levels of reserve requirements. For example, Kasman compared volatility of overnight rates in Switzerland, the UK, Canada, the United States, Germany, and Japan from 1988 to 1991. Kasman found a positive relationship between low reserve requirements and higher volatility across these countries. Specifically, volatility was higher in countries with low and nonbinding reserve requirements (the UK and Switzerland) than in countries with high levels of reserve requirements (Japan and Germany). Kasman also noted an uptrend in volatility in Canada and the United States, two countries where the level of reserve balances was declining. Ayuso, Haldane, and Restoy found a similar relationship in comparing volatility in the UK, Germany, France, and Spain from 1988 to 1993. Both studies also found evidence that volatility in the overnight market was transmitted to longer term rates in some of the countries examined.

Recent data for Canada, the UK, and New Zealand, however, suggest that the relationship between reserve requirements and interest rate volatility is not as clear cut. In all three countries, volatility was higher on average than in the United States over the 1990-96 period, as shown on the left side of Chart 3. But, a closer look at annual averages over this period shows that volatility in the three countries dropped sharply toward the end of the period. Indeed, during 1996, all three countries experienced lower interest rate volatility than the United States. These results suggest that interest rate volatility depends on factors other than reserve requirements and indicate a need to reexamine the linkage between reserve requirements and volatility.<sup>28</sup>

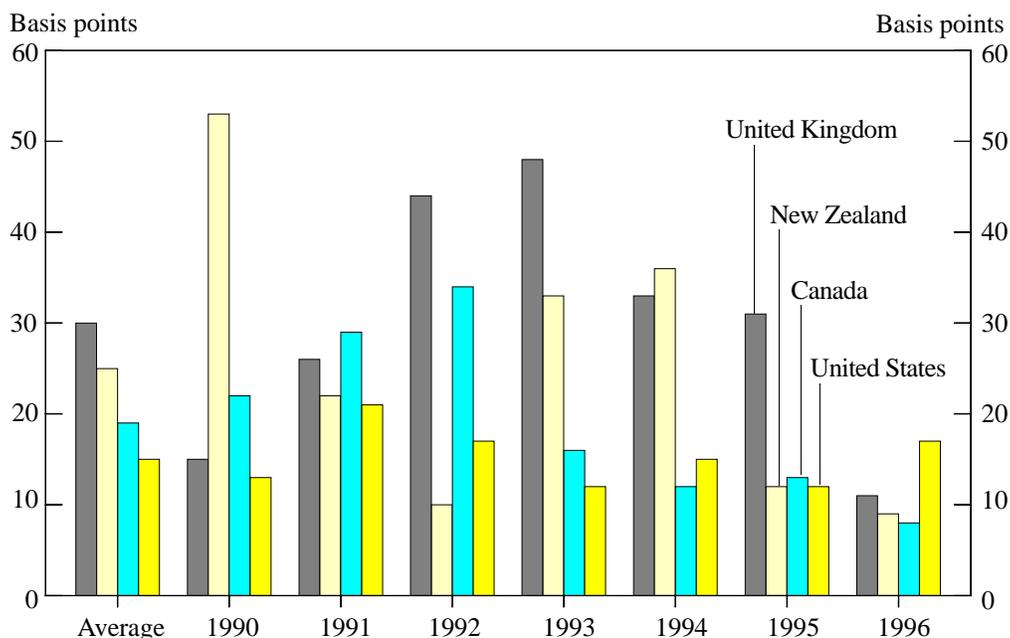
#### *The reserve requirement/volatility connection*

Interest rate volatility arises in the overnight

Chart 3

## INTEREST RATE VOLATILITY

Mean absolute deviation from 30-day centered moving average of daily rates



Source: Board of Governors of the Federal Reserve System, Bank of Canada, Bank of England, Reserve Bank of New Zealand.

market as institutions attempt to meet reserve requirements or settlement balance requirements by trying to fund account deficiencies or dispose of account surpluses. Generally speaking, the amount of volatility depends on two factors: the size of the surplus/shortage for the system and the institutional mechanisms for providing or removing liquidity from the system.<sup>29</sup>

The size of a daily surplus or shortage in the settlement system depends, in large part, on the central bank's ability to estimate settlement bank demand for settlement balances. For example, if the central bank underestimates the demand for settlement balances on a given day, it will tend to supply too few balances and short-term rates

will tend to rise as institutions attempt to obtain additional balances.

The level of reserve requirements may influence volatility to the extent that it affects the central bank's ability to estimate the demand for central bank balances. If there is no uncertainty in demand, reserve requirements will have no implications for volatility. To see this point, consider two regimes: one in which there is a binding reserve requirement that must be met on a daily basis and a second in which there is no reserve requirement but institutions must hold a nonnegative daily settlement balance. Without uncertainty, a given reserve deficiency will have the same implications as a settlement balance

deficiency of the same magnitude. That is, it does not matter whether a \$10 million shortage results from a \$10 million reserve deficiency that must be funded that day or a \$10 million settlement balance deficiency that must be funded that day.

If demand is uncertain, however, reserve requirements may affect volatility to the extent that they make it easier for the central bank to forecast demand. As discussed earlier, the determinants of the demand for reserve balances are likely to be different from the determinants of the demand for settlement balances. Reserve requirements may reduce volatility if they improve the central bank's ability to forecast the size of a daily surplus or shortage of central bank balances. Conversely, the removal of reserve requirements could lead to increased interest rate volatility if the central bank has more difficulty in forecasting the demand for settlement balances.<sup>30</sup>

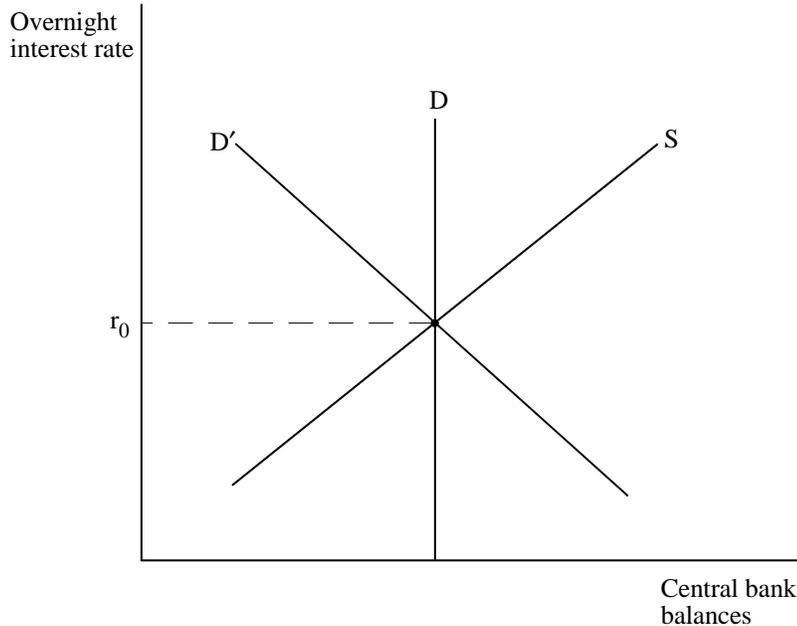
The second factor affecting volatility is the set of mechanisms that a central bank adopts for resolving daily deficiencies or surpluses in central bank balances. Generally speaking, these mechanisms affect volatility by altering the interest sensitivity of the demand for or supply of central bank balances.

One way of reducing daily liquidity pressures and lowering volatility is to introduce averaging of balance requirements over a period of time. Averaging reduces volatility to the extent that it allows an institution to spread a daily surplus or deficiency over time. For example, instead of purchasing funds in the market to fund a daily deficiency, under averaging, an institution can offset the deficiency by holding a surplus in the future. The implications of averaging for volatility are illustrated in Figure 2. In the absence of averaging, the demand for central bank balances is likely to be

insensitive to interest rates as shown by the vertical demand curve  $D$ . In contrast, a system of averaging has the general effect of making the demand for central bank balances more interest sensitive  $D'$ . With a flatter demand curve, errors in forecasting demand or supply have a smaller impact on interest rates and volatility is reduced.<sup>31</sup> In considering the role of averaging, it is important to recognize that averaging can be used either with reserve requirements, as in the United States, or without reserve requirements, as in Canada. Thus, the benefits of averaging in reducing interest rate volatility can be obtained independently of the existence of reserve requirements.<sup>32</sup>

Interest rate volatility will also depend on how central banks provide liquidity through open market operations and through discount or lending facilities. The structure of open market and lending facilities will determine the slope of the supply curve for central bank balances shown in Figure 3. If restrictions are placed on the ability of a settlement institution to access these facilities, the supply curve will tend to be steeper  $S$ , resulting in greater interest rate volatility for errors in forecasting the demand for balances or nonpolicy factors affecting supply. Alternatively, if the central bank provides or absorbs funds on demand, the price charged will set a ceiling or floor on the overnight rate because institutions would not be likely to borrow at a higher price or lend at a lower price than that set by the central bank. Thus, for example, the central bank could set a lending rate that was somewhat higher than that paid on settlement balances, resulting in a band or corridor in which the overnight rate would fluctuate as shown in Figure 4.<sup>33</sup> In the limiting case, if the central bank were to provide or absorb funds at a single rate, the supply curve would be horizontal  $S'$ , as shown in Figure 3, and interest rate volatility would be eliminated.

Figure 2



### *Explaining volatility*

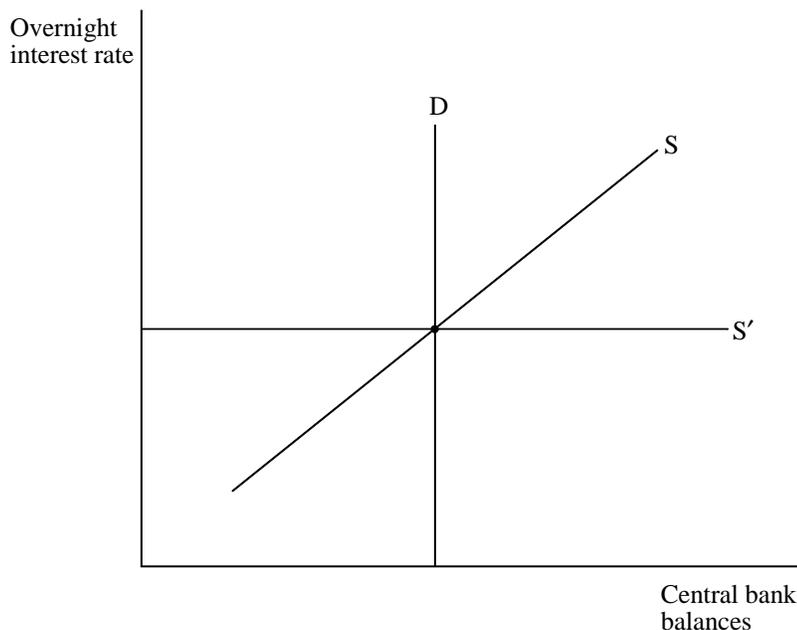
This framework can be used to explain some of the stylized facts about interest rate volatility in Canada, the UK, and New Zealand described above. Indeed, in all three countries, the observed behavior of volatility appears to be more closely related to the mechanism for providing liquidity than on the absence of reserve requirements.

As discussed above, the elimination of reserve requirements could lead to greater interest rate volatility if the demand for settlement balances is more difficult to forecast than the demand for reserves. This could be a significant factor in situations in which the central bank must monitor a large number of institutions or, perhaps, in a period of transition to a regime of lower reserve

requirements. It is not clear that this is an important factor in Canada, the UK, and New Zealand, however, because of the relatively small number of settlement institutions in these three countries.<sup>34</sup>

A more important factor behind the behavior of volatility in these three countries may be the institutional structures for providing liquidity. The low level of volatility in Canada, for example, is likely due to a combination of the averaging system for settlement balances and the operating bands for the overnight rate. As discussed earlier, in Canada, direct clearers do not have to meet a daily settlement balance requirement but are permitted to average daily surpluses and deficiencies over a 30-day period. This procedure has the effect of alleviating daily

Figure 3



liquidity pressures and reducing volatility by making the demand for settlement balances more interest sensitive. The use of an operating band for the overnight rate also reduces volatility in Canada. Under the current operating procedures, the Bank of Canada uses open market operations in the form of repurchase agreements to provide or absorb liquidity when the overnight rate threatens to move outside of the operating band.

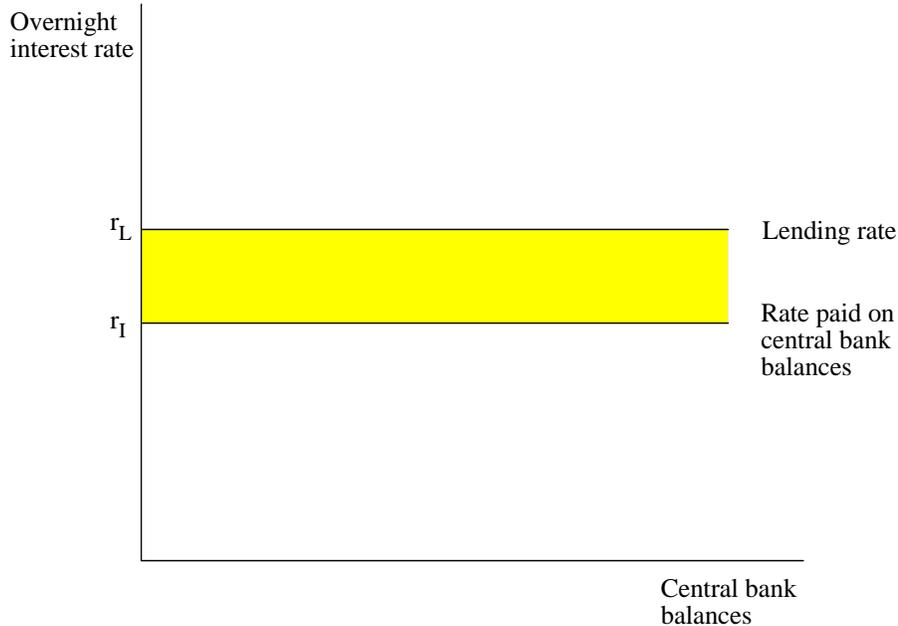
Interest rate volatility will continue to be limited under the new operating procedures to be implemented later this year in Canada when the LVTs system is in place. In this new framework, averaging will be eliminated. However, volatility will be limited by the new operating band, whose bounds will be determined by the rates at which settlement institutions can finance end-

of-day deficiencies or earn interest on settlement balances.<sup>35</sup>

Differences in liquidity mechanisms may also explain why interest rate volatility has been somewhat higher in the UK and New Zealand than in Canada. Both the UK and New Zealand have daily settlement balance requirements and do not use averaging to limit volatility. In addition, neither country has formal interest rate operating bands. In this environment, volatility depends largely on the terms that the central bank sets for providing additional liquidity.

As discussed above, access to additional liquidity from the central bank in both the United Kingdom and in New Zealand has been influenced by restrictions on the types of assets that

Figure 4



are acceptable to the central bank and the supplies of these assets (UK and New Zealand) as well as on the range of acceptable counterparties (UK). One reason that volatility has fallen recently in both the United Kingdom and New Zealand may be that the mechanism for providing liquidity has become more flexible. The Bank of England has made a number of changes in recent years to broaden the range of assets acceptable in transactions and has expanded the range of counterparties. The Reserve Bank of New Zealand has also undertaken institutional reforms in the money markets aimed at relieving liquidity pressures.<sup>36</sup> By improving money market liquidity, these institutional changes in the United Kingdom and New Zealand may have contributed to reduced interest rate volatility.

#### IV. IMPLICATIONS FOR THE UNITED STATES

The experience of Canada, the United Kingdom, and New Zealand shows that monetary policy can be conducted without the use of reserve requirements and that interest rate volatility can be managed by appropriate mechanisms for providing liquidity. In the United States, a continued decline in reserve balances could result in increased interest rate volatility. If greater interest rate volatility became an impediment to monetary policy, the Federal Reserve would have two policy options: take actions to restore the effectiveness of reserve requirements or adapt to a world of lower reserve requirements by altering liquidity mechanisms to reduce interest rate volatility.

### *Will volatility rise?*

As discussed in our previous article, the United States has not yet experienced a sustained increase in interest rate volatility as reserve balances have declined (Sellon and Weiner). Volatility rose sharply, but only temporarily, after the Federal Reserve lowered reserve requirements in 1990.<sup>37</sup> And, despite the growing use of sweep accounts, there is evidence of only a moderate increase in volatility in recent years (Bennett and Hilton).

There are two reasons for believing that volatility could rise, however, if reserve balances continue to decline. First, the nature of balances held by depository institutions at the Federal Reserve is gradually changing to reflect an increased demand for payments needs rather than reserve needs. To the extent that the demand for Federal Reserve balances held for clearing and settlement purposes is more variable and more difficult to forecast than the demand for reserve balances, interest rate volatility may rise.<sup>38</sup>

A second reason for expecting increased volatility results from the way that reserve requirement averaging is currently structured in the United States. Under current averaging procedures, a fall in reserve balances tends to reduce the benefits of averaging. This occurs because depository institutions are currently discouraged from having daily account overdrafts by high fees and by administrative counseling. As a result, a decline in reserve balances effectively reduces the size of a reserve balance deficiency that an institution can incur and use to offset reserve surpluses during the averaging period. For example, an institution facing an unexpected surplus early in the averaging period may not be able to incur enough reserve deficiencies later in the period to offset the surplus without being overdrawn at some point later in the period. In this situation, an institution experiencing a large

surplus has an incentive to sell these funds rather than hold them, resulting in downward pressure on interest rates.<sup>39</sup> Because of the restrictiveness of current policy on daily overdrafts, a fall in reserve balances effectively reduces the benefits of averaging and reduces the interest sensitivity of reserve demand. And, as illustrated in Figure 2, a reduced interest sensitivity of demand tends to increase interest rate volatility.

### *Policy options*

Faced with the potential for higher interest rate volatility as reserve balances fall, the Federal Reserve has two general strategies it could pursue if it wishes to reduce volatility. One option is to make regulatory changes that would stem or even reverse the erosion of reserve balances. A second option is to adapt to a world of lower reserve balances by making institutional changes similar to those used in Canada, the UK, and New Zealand so as to manage interest rate volatility.

*Maintain reserve requirements.* As noted earlier, the recent decline in reserve balances in the United States is largely due to banks' use of sweep accounts designed to reduce required reserves and lower the cost of reserve requirements. The most straightforward solution to this problem would be for the Federal Reserve to pay interest on reserve balances.<sup>40</sup> Paying interest on reserves would offset the cost of holding idle balances at the Federal Reserve and would reduce the incentive to avoid reserve requirements. As a result, payment of interest on reserves would likely stop and, perhaps, reverse the recent erosion in reserve balances.

While the Federal Reserve has long supported the payment of interest on reserves, it does not currently have the legal authority to do so (Feinman). Over the years, the main obstacle to payment of interest on reserve balances has been the

budgetary impact of the potential loss of Treasury revenue. This revenue loss would occur because part of the earnings on the Federal Reserve System's security portfolio would be paid to depository institutions holding reserve balances rather than being transferred to the Treasury.

Without paying interest on reserves, the Federal Reserve is likely to have only limited ability to stem the erosion in reserve balances. Conceptually, one stopgap measure might be to amend Regulation D to prohibit the use of sweep accounts or to limit their use. If the objective of this measure is to limit volatility, outright prohibition may be too extreme, as it appears that monetary policy is not impaired by the current level of reserve balances. Thus, balancing the cost of the reserve tax on depository institutions against monetary policy efficiency would suggest that actions to limit further erosion of reserve balances may be preferable to mandating higher levels.

A second approach to stem the decline in reserve balances might be to reduce the ability of depository institutions to use vault cash to meet reserve requirements. Currently, depository institutions can use 100 percent of their vault cash to satisfy reserve requirements. Reducing the proportion of vault cash that counts for reserve purposes would force institutions to hold higher reserve balances at the Federal Reserve. The Federal Reserve has altered the eligibility of vault cash in the past (Feinman). For example, in 1917, the Federal Reserve removed the eligibility of vault cash to be used to satisfy reserve requirements. Then, in 1959, the eligibility of vault cash was restored in an attempt to lower the reserve tax to prevent member banks from leaving the Federal Reserve System.<sup>41</sup>

Although both of these methods could be temporarily successful in increasing or maintaining

reserve balances, they are unlikely to provide a permanent solution. Indeed, the recent development of sweep accounts should not be seen as an isolated event but as merely the latest method used by depository institutions to evade the reserve requirement tax. Thus, without the payment of interest on reserve balances, institutions are likely to continue to have an incentive to invent new methods of avoiding the reserve tax and so undermine the effectiveness of reserve requirements.

*Adapt to lower reserve requirements.* The other option open to the Federal Reserve is to adapt to a world of low and declining reserve balances by taking actions to limit increased interest rate volatility. One way to do this is to enhance the benefits of reserve averaging. As noted above, under the current institutional structure of reserve requirements in the United States, lower reserve balances reduce the interest sensitivity of reserve demand and undermine the benefits of averaging in lowering interest rate volatility. One solution to this problem is to expand the averaging period or the reserve carryover provision to allow reserve deficiencies and surpluses to be spread over a longer time span.<sup>42</sup> A somewhat more radical approach would be to change System policy on daily overdrafts to allow institutions the flexibility to include end-of-day overdrafts in the averaging process.<sup>43</sup> In terms of the model presented above, these institutional changes would have the effect of increasing the interest sensitivity of reserve demand and could offset the impact of the decline in reserve balances.

The Federal Reserve could also limit interest rate volatility by altering its procedures for supplying liquidity. One approach would be to alter the frequency of reserve provision through open market operations. Normally, the trading desk at the Federal Reserve Bank of New York conducts one open market operation per day. In contrast,

the Bank of England has three regularly scheduled times at which it can conduct open market operations during the day. This structure gives the Bank of England flexibility in adjusting to revised estimates of the size of the daily settlement balance need and helps reduce rate volatility. Similarly, the Bank of Canada, under its current operating procedures, can conduct open market operations during the day to maintain the overnight rate within its operating band.

An alternative way of increasing the flexibility of mechanisms for supplying liquidity is to change the structure of the discount window. Traditionally, the discount window has served as the primary safety valve for depository institutions to adjust to reserve imbalances. However, the stabilizing function of the discount window has diminished in recent years as depository institutions have become increasingly reluctant to borrow, perhaps because such borrowing from the Federal Reserve is viewed as an indication of an institution's financial condition. This increased reluctance to borrow means that depository institutions are more likely to fund a reserve shortfall in the market rather than relying on discount window borrowing.

A number of reform proposals for the discount window have been advanced over the years.<sup>44</sup> Of these proposals, the most promising way of reducing interest rate volatility appears to be the replacement of the current system with a Lombard-type framework, such as that used in Germany. In this framework, the discount rate would be set at a penalty rate and administrative restrictions on borrowing would be removed. Interest rate volatility would be limited because institutions would turn to the discount window to meet a system shortage of central bank balances. In this type of system, the discount rate would effectively set a ceiling on the overnight rate as in Figure 4 above.<sup>45</sup>

At the same time, restructuring the discount window would not limit downward movement in the overnight rate. Thus, to reduce the range of variation of the overnight rate, a separate liquidity absorption mechanism would be needed either in the form of a standing offer to purchase excess balances at a fixed rate or an explicit payment of interest on these balances.<sup>46</sup> The rate paid on these balances would serve as a floor on the overnight rate, as shown in Figure 4. If the Federal Reserve were to use both of these mechanisms, the resulting system would be similar to the Canadian system, where a band for the overnight rate serves to limit interest rate volatility.

## V. SUMMARY AND CONCLUSIONS

The sharp decline in reserve balances in the United States in recent years has raised concerns about the effectiveness of monetary policy in a low reserves environment. Conceptually, two monetary policy issues arise in a system in which reserve requirements are not binding on depository institutions. First, when the demand for central bank balances arises from payments needs rather than from reserve requirements, changes in the structure of the payments system may become an important factor in the design of monetary policy operating procedures. Second, as reserve requirements decline, short-term interest rate volatility could increase either if the demand for central bank balances becomes more difficult to forecast or if the interest sensitivity of this demand is reduced.

While these two issues are important conceptually, it is not clear how important or relevant they are in practice. To assess their practical importance, this article examined the experience of Canada, the United Kingdom, and New Zealand, three countries that have conducted monetary policy without reserve requirements for a number of years. The experience of these

countries underscores the connection between the structure of the payments system and monetary policy in a world without reserve requirements. In all three countries, recent changes in the payments system have had implications for monetary policy operating procedures. At the same time, however, the experience of these three countries suggests that there need be little connection between the absence of reserve requirements and the degree of short-term interest rate volatility. Rather, the volatility observed in these countries appears to depend more on institutional arrangements for providing and absorbing liquidity than on the absence of reserve requirements.

If reserve balances continue to decline in the United States, short-term interest rate volatility could increase due to the declining effectiveness of current reserve averaging procedures and,

perhaps, to increased difficulty in forecasting the demand for reserve and settlement balances. If rising volatility becomes a policy concern, the Federal Reserve has two options. One approach is for the Federal Reserve to pay interest on reserve balances. Paying interest on reserves would offset the cost of holding idle balances at the Federal Reserve and would reduce the incentive to avoid reserve requirements. As a result, payment of interest on reserves would likely stop and, perhaps, reverse the recent erosion in reserve balances. The second approach is to adapt to a world of low reserve balances by altering the institutional framework for providing and absorbing liquidity. If the Federal Reserve chooses this second option, it may benefit from the experience of countries that have already adapted to a world without reserve requirements.

## ENDNOTES

<sup>1</sup> While reserve requirements typically apply to demand or transactions accounts, savings accounts and other short-term bank liabilities may also be subject to reserve requirements. In the United States, the basic structure of reserve requirements is set out in the Monetary Control Act of 1980, and the Federal Reserve's authority to adjust reserve requirements is limited by this legislation. Depository institutions in the United States currently face a 10 percent reserve requirement on transactions account balances in excess of \$49.3 million and a 3 percent requirement on transactions balances of \$0 to \$49.3 million. There is an exemption for smaller institutions set out in the Garn-St. Germain Depository Institutions Act of 1982 that limits the amount of transactions balances subject to the 3 percent requirement. Currently, there are no reserve requirements on nonpersonal time deposits or eurocurrency liabilities.

<sup>2</sup> In the United States, reserves are maintained over a two-week period based on the level of transactions deposits also averaged over a two-week period. Additionally, in the United States, depository institutions are allowed to carry over part of a reserve deficiency or surplus into the next maintenance period.

<sup>3</sup> In a "sweep" arrangement, funds are automatically

transferred from reservable deposit accounts, such as demand deposits and other checkable deposits, to nonreservable accounts, such as money market deposit accounts. Such a transfer lowers the deposit base for the calculation of reserve requirements. The use of sweep accounts by banks began modestly in 1994 but has increased considerably since the spring of 1995.

<sup>4</sup> In both systems, the demand for central bank balances will also be influenced by the opportunity cost of holding these balances. This opportunity cost is influenced both by alternative earning opportunities for central bank balances and by price incentives set by the central bank for balance excesses and deficiencies. For further discussion, see Clinton (1997).

<sup>5</sup> In the United States, as required reserve balances have fallen, many depository institutions have found that their remaining reserve balances at the Federal Reserve are no longer sufficient for handling payments needs. As a result, many institutions have increased their holding of so-called "clearing balances" to handle their payments needs (Sellon and Weiner). However, unlike reserve balances, which depend on the level of deposits, the demand for clearing balances depends on an institution's use of Federal Reserve

priced services (Stevens). As a result, this demand is likely to be behaviorally different from the demand for reserves.

<sup>6</sup> Another example is the shift by many countries from payments systems based on net settlement to real time gross settlement systems. In net settlement systems, interbank settlement is generally made on a net basis at the end of a business day. In a real time gross settlement system, each transaction is settled separately during the day. Thus, net settlement systems generally require that institutions hold smaller balances than in gross settlement systems. As a result, a change in the method of settlement of interbank transactions may affect the demand for settlement balances.

<sup>7</sup> Formally, the Bank of Canada uses a “monetary conditions index” (MCI) as their operational target. The MCI is a combination of a short-term interest rate and the exchange rate; for details, see Freedman.

<sup>8</sup> The central bank must also be able to forecast nonpolicy factors affecting the supply of settlement balances. For further discussion, see Sellon and Weiner.

<sup>9</sup> Prior to the elimination of reserve requirements, the Bank of Canada limited access to lending by administrative restrictions similar to those applying to use of the Federal Reserve’s discount window. Borrowing was also discouraged by a rising marginal cost based on the frequency of borrowing. With the elimination of reserve requirements, administrative restrictions were removed and borrowing from the Bank of Canada is now based purely on cost considerations.

<sup>10</sup> Because institutions pay the Bank Rate on a daily deficit and then must hold an offsetting positive balance later in the averaging period, the cost of an overdraft is approximately twice the Bank Rate.

<sup>11</sup> For more discussion of these operations, see Clinton and Fetting.

<sup>12</sup> Such a transfer of government balances, termed the “drawdown/redeposit mechanism,” is performed at the end of the day and, by itself, would not be sufficient to keep the overnight rate within the operating band during the day.

<sup>13</sup> For more details, see Clinton (1991).

<sup>14</sup> Some small-dollar, paper-based transactions will continue to settle retroactively. For discussion, see Bank of Canada.

<sup>15</sup> Repurchase agreements will be used as a means of indicating a target rate within the operating band. For more details, see Clinton (1997).

<sup>16</sup> In anticipation of moving to the new framework, in February 1996, the Bank of Canada set the Bank Rate at the upper limit of the current operating range for the overnight rate. Previously, the Bank Rate was tied to the 3-month Treasury bill rate.

<sup>17</sup> Dealing rates for eligible bills are established for four maturity bands ranging from 1-14 days to 64-91 days.

<sup>18</sup> Liquidity strains following the ERM crisis in 1992 caused the Bank of England to evaluate its methods for providing money market liquidity (King).

<sup>19</sup> Eligible bills are commercial bills of exchange accepted by a bank whose acceptances are eligible for discount at the Bank of England. For more details, see Bank of England (1997).

<sup>20</sup> In addition, under the new arrangements, the Bank of England operates over a narrower range of maturities and, on average, at a shorter maturity.

<sup>21</sup> This type of intraday repurchase facility is less necessary in Canada because the LVTS is a net settlement system and so requires less intraday liquidity.

<sup>22</sup> Reserve Bank bills are discount securities, similar to Treasury bills, issued by the Reserve Bank. Their sole purpose is to be used in transactions with the Reserve Bank. These bills have an original maturity of 63 days and can be discounted on demand at the Reserve Bank to obtain settlement cash if they have 28 or fewer remaining days to maturity. The rate on these transactions is reset daily at a penalty margin of 90 basis points above market rates for other short-term securities. For more details, see Huxford and Reddell.

<sup>23</sup> The settlement cash rate is set daily at a margin 300 basis points below the seven-day cash rate. Interest is paid only on the first \$20 million in each bank’s settlement account. This restriction was put in place to reduce interest rate volatility and to prevent banks from attempting to manipulate short-term rates by accumulating a large settlement cash position and forcing competitors to resort to the discount window.

<sup>24</sup> The Reserve Bank can also change monetary policy by altering the supply of Reserve Bank bills, the penalty margin, or the rate paid on settlement cash. For more details, see Huxford and Reddell.

<sup>25</sup> For a discussion of these changes, see Reserve Bank of New Zealand.

<sup>26</sup> For a detailed discussion of the payments system changes in New Zealand and associated changes in monetary policy operations, see Tait.

<sup>27</sup> As this article was being prepared, the Reserve Bank had published a discussion paper outlining possible changes but had not taken action on this proposal.

<sup>28</sup> While a comparison of volatility across countries is illustrative, it can mask country-specific factors. For example, some of the volatility early in the period in the Canadian overnight rate probably reflects the fact that the Bank of Canada, at that time, was focusing more on the 3-month rate than on the overnight rate. Similarly, the Bank of England has traditionally influenced rates at a variety of short-term maturities rather than focusing exclusively on the overnight rate. In addition, all three countries are open economies where exchange rate stability may be as important as interest rate volatility. In some instances, greater interest rate volatility may result from attempts to reduce exchange rate variability. Also, changes in volatility may result from changes in the institutional structure of financial markets. For example, the decline in volatility in the UK in 1996 coincides with the introduction of an open gilt repo market which may have made it easier for institutions without bill holdings to redistribute liquidity among themselves. Nevertheless, the recent low level of volatility in the overnight rate in all three countries is noteworthy in countering the claim that low reserve requirements are associated with higher interest rate volatility.

<sup>29</sup> Independent of the size of a system surplus or shortage, volatility may also depend partly on the distribution of settlement balances among settlement banks and on the existence of market power exerted by institutions. A discussion of these issues is beyond the scope of this article.

<sup>30</sup> Note that the relevance of this effect is an empirical issue whose importance may vary by country depending on the institutional structure of the settlement system.

<sup>31</sup> In practice, the effect of averaging on demand is likely to be considerably more complicated than shown in this figure. For example, on the last day of an averaging period, there may be no further opportunity to carry forward surpluses or deficiencies so that the demand curve is vertical. Also, institutions may find it difficult to work off large imbalances occurring early in the period so that the benefits of averaging are attenuated. For a discussion of these and related issues, see Borio.

<sup>32</sup> This point is sometimes unclear in discussions of reserve requirements and volatility where a comparison is made

between a system of positive reserve requirements with averaging and a system of zero reserve requirements without averaging. Volatility may be lower in the first system, not because of the existence of reserve requirements, but because of averaging. The central bank's policies with regard to end-of-day overdrafts may also affect volatility. It should be noted that to implement averaging in a system without reserve requirements, the central bank must permit end-of-day overdrafts (collateralized) in order for there to be something to be averaged over time. For a more detailed discussion of averaging, see Bindseil.

<sup>33</sup> How the overnight rate would be determined within this band is difficult to illustrate as it would depend on institutional factors, such as the distribution of settlement balances among settlement banks and central bank operations to provide or absorb liquidity during the day.

<sup>34</sup> Canada has 12 bank and nonbank direct clearers, the UK has 15 clearing banks, and New Zealand has 11 banks with settlement accounts at the Reserve Bank of New Zealand.

<sup>35</sup> Then, as now, clearing institutions will have a strong incentive to target a zero settlement balance.

<sup>36</sup> In 1991, several changes were made to improve the functioning of the interbank market. These changes included a decrease in the size of the discount margin, an increase in the supply of Reserve Bank bills coupled with a reduction in their initial term to maturity, a reduction in the cash target, and other institutional changes.

<sup>37</sup> In December 1990, the Federal Reserve eliminated the 3 percent reserve requirement on nontransaction accounts, an action which reduced required reserves by about one-third (Feinman).

<sup>38</sup> Clouse and Elmendorf provide some evidence that the variability of shocks to balances held only for clearing and settlement purposes may be greater than the variability of shocks to required operating balances (required reserve balances and required clearing balances). As discussed in our previous article, one likely reason interest rate volatility has not increased as required reserve balances have declined is that some depository institutions have established required clearing balances as a partial offset. However, future growth of these accounts is likely to be limited by their structure. Clearing accounts pay implicit interest in the form of offsets to the cost of Federal Reserve payments services and, hence, are primarily attractive to those institutions who make extensive use of these services. However, many institutions appear to have reached the maximum size of clearing balances warranted by their use

of Federal Reserve services (Bennett and Hilton). In addition, institutions who do not use Federal Reserve services are unlikely to open clearing accounts to offset a decline in reserve balances.

<sup>39</sup> Similarly, with low reserve balances an institution is more likely to face the possibility of a daily overdraft and so is more likely to seek to fund an actual or prospective deficiency by bidding for funds that day.

<sup>40</sup> For additional discussion of issues connected with paying interest on reserves, see Weiner (1985) and Hilton, Gerdts, and Robinson. It should be noted some analysts have argued that, even with payment of interest on reserves, a system of positive reserve requirements may be less efficient than a system without reserve requirements (King).

<sup>41</sup> Membership in the Federal Reserve System has always been voluntary for state-chartered banks. Prior to the passage of the Monetary Control Act of 1980, only member banks were subject to reserve requirements. Thus, state-chartered member banks could avoid the reserve requirement tax by giving up their Federal Reserve membership and did so in increasing numbers in the 1970s. Many national banks also switched to state charters in order to avoid reserve requirements. The Monetary Control Act ended this practice by making all depository institutions subject to reserve requirements regardless of membership status.

<sup>42</sup> For a detailed discussion of the pros and cons of this approach, see Meulendyke and Tulpan.

<sup>43</sup> As discussed above, under current procedures, institutions with a surplus position early in a reserve maintenance position have an incentive to sell these reserves rather than hold them. This incentive occurs because the ability to offset the surplus later in the averaging period is limited by their ability to incur reserve deficiencies and the amount of these deficiencies has been reduced by the decline in reserve balances. Permitting daily overdrafts would allow the institution to incur larger deficiencies later in the averaging period to offset the surplus. For a more detailed discussion of this alternative, see Anderson and Riela.

<sup>44</sup> For a detailed discussion of these alternatives, see Wenninger.

<sup>45</sup> Even with the removal of administrative restrictions on borrowing, a reluctance to borrow from the Federal Reserve could still be a problem in this system. With a reluctance to borrow, while the discount window might limit volatility, the discount rate would not cap overnight rates since some institutions would be willing to pay a higher price for balances obtained in the market. Some additional potential complications to the use of a Lombard facility should also be noted. One issue is whether all administrative restrictions, even for troubled institutions, could or should be removed. There are also logistical questions in a country with as many depository institutions as the United States.

<sup>46</sup> Either of these options would likely require legislative authorization.

## REFERENCES

- Anderson, Donald, and Gina Riela. 1993. "Collateralized Overnight Overdrafts," Federal Reserve Bank of New York, *Reduced Reserve Requirements: Alternatives for the Conduct of Monetary Policy and Reserve Management*, April, pp. 239-48.
- Ayuso, J., A.G. Haldane, and F. Restoy. 1994. "Volatility Transmission Along the Money Market Yield Curve," Bank of Spain, Working Paper 9403.
- Bank of England. 1997. *Reform of the Bank of England's Operations in the Sterling Money Markets*, February.
- \_\_\_\_\_. 1994. "The Development of a UK Real-Time Gross Settlement System," *Bank of England Quarterly Bulletin*, May, pp. 163-68.
- Bindseil, Ulrich. 1997. "Reserve Requirements and Economic Stabilization," Deutsche Bundesbank, Economic Research Group, Discussion Paper 1/97, January.
- Borio, Claudio E.V. 1997. "Monetary Policy Operating Procedures in Industrialized Countries," Bank for International Settlements, Working Paper 40, March.
- Bank of Canada. 1996. "A Proposed Framework for the Implementation of Monetary Policy in the Large Value Transfer System Environment," Discussion Paper 2, Ottawa, March.
- Bank of Japan. 1995. "Reserve Requirement Systems and Their Recent Reforms in Major Industrialized Countries: A Comparative Perspective," *Quarterly Bulletin*, May, pp. 54-75.
- Bennett, Paul, and Spence Hilton. 1997. "Falling Reserve Balances and the Federal Funds Rate," Federal Reserve Bank of New York, *Current Issues in Economics and*

- Finance*, April.
- Clinton, Kevin. 1997. "Implementation of Monetary Policy in a Regime with Zero Reserve Requirements," Bank of Canada, Working Paper 97-8, April.
- \_\_\_\_\_. 1991. "Bank of Canada Cash Management: the Main Technique for Implementing Monetary Policy," Bank of Canada, *Bank of Canada Review*, January. Reprinted in Bank of Canada, *The Transmission of Monetary Policy in Canada*, 1996, pp. 36-49.
- \_\_\_\_\_. and Kevin Fetting. 1989. "Buy-back Techniques in the Conduct of Monetary Policy," *Bank of Canada Review*, July. Reprinted in Bank of Canada, *The Transmission of Monetary Policy in Canada*, 1996, pp. 51-60.
- Clouse, James, and Douglas Elmendorf. 1997. "Declining Required Reserves and the Volatility of the Federal Funds Rate." Board of Governors of the Federal Reserve System, Mimeo. June.
- Dale, Spencer, and Marco Rossi. 1996. "A Market for Intra-day Funds: Does It Have Implications for Monetary Policy?" Bank of England, Working Paper no. 46, March.
- Evans, Lewis, Arthur Grimes, and Bryce Wilkinson with David Teece. 1996. "Economic Reform in New Zealand 1985-95: the Pursuit of Efficiency," *Journal of Economic Literature*, December, pp. 1856-1902.
- Feinman, Joshua N. 1993. "Reserve Requirements: History, Current Practice, and Potential Reform," *Federal Reserve Bulletin*, June, pp. 569-89.
- Freedman, Charles. 1996. "The Use of Indicators and of the Monetary Conditions Index in Canada," *The Transmission of Monetary Policy in Canada*, Bank of Canada, pp. 67-79.
- Hilton, Spence, Ari Cohen, and Roxann Robinson. 1993. "Paying Interest on Reserves," Federal Reserve Bank of New York, *Reduced Reserve Requirements: Alternatives for the Conduct of Monetary Policy and Reserve Management*, April, pp. 63-108.
- Huxford, Julie, and Michael Reddell. 1996. "Implementing Monetary Policy in New Zealand," Reserve Bank of New Zealand, *Reserve Bank Bulletin*, December.
- Kasman, Bruce. 1993. "A Comparison of Monetary Policy Operating Procedures in Six Industrialized Countries," Federal Reserve Bank of New York, *Reduced Reserve Requirements: Alternatives for the Conduct of Monetary Policy and Reserve Management*, April, pp. 15-62.
- King, Mervyn. 1994. "Monetary Policy Instruments: The UK Experience," Bank of England, *Quarterly Bulletin*, August, pp. 268-76.
- Meulendyke, Ann-Marie, and Ted Tulpan. 1993. "Expanded Reserve Maintenance Periods and Increased Carryover Limits," Federal Reserve Bank of New York, *Reduced Reserve Requirements: Alternatives for the Conduct of Monetary Policy and Reserve Management*, April, pp. 169-206.
- Montador, Bruce. 1995. "The Implementation of Monetary Policy in Canada," *Canadian Public Policy*, March. Reprinted in Bank of Canada, *The Transmission of Monetary Policy in Canada*, 1996, pp. 19-33.
- Reserve Bank of New Zealand. 1997. *Monetary Policy Implementation and Signaling*, Discussion Document, March.
- Sellon, Gordon H., and Stuart E. Weiner. 1996. "Monetary Policy Without Reserve Requirements: Analytical Issues," Federal Reserve Bank of Kansas City, *Economic Review*, Fourth Quarter, pp. 5-24.
- Stevens, E. J. 1993. "Required Clearing Balances," Federal Reserve Bank of Cleveland, *Economic Review*, Fourth Quarter, pp. 2-14.
- Tait, John. 1995. "Monetary Policy and Liquidity Management After the Introduction of Real Time Gross Settlement," Reserve Bank of New Zealand, *Reserve Bank Bulletin*, December.
- Weiner, Stuart E. 1992. "The Changing Role of Reserve Requirements in Monetary Policy," Federal Reserve Bank of Kansas City, *Economic Review*, Fourth Quarter, pp. 45-63.
- \_\_\_\_\_. 1985. "Payment of Interest on Reserves," Federal Reserve Bank of Kansas City, *Economic Review*, January.
- Wenninger, John. 1993. "Alternative Approaches to Discount Window Lending," Federal Reserve Bank of New York, *Reduced Reserve Requirements: Alternatives for the Conduct of Monetary Policy and Reserve Management*, April, pp. 137-68.