THE AUSTRALIAN MONEY MARKET AND THE OPERATIONS OF THE RESERVE BANK OF AUSTRALIA: A COMPARATIVE ANALYSIS

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I. Introduction

This paper provides a comparative analysis of monetary policy in Australia and the United States. It concentrates on the day-to-day conduct of policy and on the influence that the structure of overnight money markets has on the transmission of monetary policy through open market operations. The regulatory structure of any market affects the behavior of agents who trade in that market and, therefore, can also influence the results of government actions. In particular, the efficiency of monetary control may depend on the rules and institutional arrangements that characterize a country's overnight money market. The analysis indicates that there are significant institutional differences between the Australian and United States money markets and that these differences are important in determining the relative efficiency of monetary control under different operating procedures.

There are three major elements that differ between the United States and the Australian money markets. One is the nature of reserve requirements, while another involves the lending procedures used by the respective central banks. The third is that certain money market dealers bank at the Reserve Bank of Australia rather than with private banks. These differences affect monetary control. Further, the interaction between the structure of the money market and monetary control is influenced by use of the interest rate as the instrument of monetary policy in both countries.

To compare the overnight money markets, it is essential to define terminology and explain their structure. This is done in Section II. Since the structure of the U.S. money market is relatively familiar and is examined in depth elsewhere, the discussion will focus primarily on Australia.[1] Section III presents the mechanics of open market operations in Australia and describes the operating procedures of the Reserve Bank of Australia. Based on this description, a theoretical model examining the efficiency of monetary control is explored in Section IV. A brief summary is given in Section V.

II. The Official Money Market in Australia

Overview

This section describes the structure of the official money market in Australia. It also examines the roles of the major participants—dealers, trading banks, and the Reserve Bank—and describes how funds are distributed among them. Various similarities and differences between this market and the U.S. federal funds market are highlighted. A basic comparison in terminology is summarized in Table I, while the major institutional differences are summarized in Table II.

Market Structure

The official money market in Australia is basically analogous to the U.S. federal funds market. It allocates funds that receive same-day credit in

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[1] For a detailed treatment of the U.S. money market, see Cook and Rowe (1986). In particular the article by Goodfriend and Whelpley makes an in-depth study of the federal funds and overnight RP market.

Table I

TERMINOLOGY

	Australia	United States
Market for funds receiving same-day credit in accounts held with central bank	Official money market	Federal funds market
Institutions that deal directly with the central bank	Authorized dealers and occasionally trading banks	Primary dealers, some of which are banks
Inventory of same-day funds	Bank loans to dealers	Excess reserves
Reserves held at central account	Statutory reserve deposits (SRD) and exchange settlement funds	Reserve bank balance
Methods of central bank lending	Rediscounting of government securities and lender-of-last-resort loans (LLR) to authorized dealers	Discount window borrowing

accounts held by trading banks and dealers at the Reserve Bank of Australia. These accounts, which are used for clearing funds, are called exchange settlement accounts. Australia also has an unofficial money market that handles all money market transactions in which banks do not receive same-day credit in their exchange settlement accounts.

In short, Australia has two types of funds. The first consists of same-day funds or exchange settlement funds that accrue to exchange settlement accounts at the Reserve Bank. These include direct dealings with the Reserve Bank, transactions with authorized dealers, and yesterday's check clearings. Funds of the second type are those transferred by bank checks. These are next-day funds because checks presented against banks in Australia are cleared through the Australian Clearing House and do not affect the exchange settlement accounts of banks until the following morning.

Participants in the Official Money Market

Dealers Dealers play a pivotal role in the daily functioning of the official money market. For one thing, the Reserve Bank deals almost exclusively with authorized dealers so that, with the exception of rediscounting, all movements in same-day funds are initiated through the accounts of dealers at the Reserve Bank of Australia. Another reason relates to the timing convention for debiting and crediting the exchange settlement accounts of dealers. These accounts are credited and debited on a same-day basis which gives dealers the central role in distributing exchange settlement funds throughout the banking system. The interbank market also plays a role, but it is only through transactions with dealers that systemwide shortages or excesses can be transferred from one day to the next. That official money market dealers bank at the Reserve Bank of Australia and that their transactions receive same-day credit are the key features distinguishing the Australian from the U.S. money markets.

The timing convention of crediting exchange settlement accounts of dealers on the same day allows the banking system to transfer same-day funds from one day to the next through the use of interday float. This is done by holding a stock of loans with dealers. Because transactions with dealers receive same-day credit while checkable funds take one day to clear, loans to official money market dealers occupy a special place in the operation of the official money market. If the banking system as a whole has insufficient exchange settlement funds, it can call in loans to dealers. (Note that dealers cannot make loans to banks.) The banking system gets immediate credit on this transaction and the transaction also leaves dealers short of same-day funds. Unlike banks, however, dealers can sell a government security to the nonbank public and receive same-day funds. Although dealers receive same-day funds, the check written to the dealer will not be cleared until tomorrow and will not affect the balances in the banking system's exchange settlement accounts until then. Essentially, the timing convention allows the banking system to make use of float (that is, cash items in the process of collection) by transferring exchange settlement funds through time. This also implies that

Table II

MAJOR CHARACTERISTICS OF OVERNIGHT MONEY MARKETS FOR RESERVABLE FUNDS

Australia	United States
Reserve Requirements	
Current reserve requirements are based on last month's deposits and are therefore lagged. These requirements are held in a special account called a statutory reserve deposit account (SRD) and earn a below-market rate of interest.	Reserve requirements in the United States are almost contemporaneous. Required reserves for a two-week maintenance period ending on a Wednesday are based on deposits for the two-week period ending on a Monday.
Clearing Balances	
Balances held at the Reserve Bank for the purpose of clearing checks are called exchange settlement funds. The exchange settlement account pays no interest and can not be negative at the end of the day.	Banks clear funds through their reserve account at the Fed. This account can not have a negative balance at the end of the day.
Dealers	
There are 9 authorized dealers in Australia. They bank at the Reserve Bank of Australia.	There are 37 primary dealers in the United States, some of which are banks. Nonbank dealers do not bank with the Fed.
Central Bank Lending	
There are two forms of lending, one is to authorized dealers through a line of credit and is referred to as a lender-of-last-resort loan (LLR). The other is through rediscounting government securities (CGS). This is not technically a loan, but is analytically equivalent to a loan over the securities' remaining maturity. Both means of acquiring funds usually involve rates that are above market rates.	The Fed lends money to banks through its discount window. These loans are typically made at a subsidized rate and therefore involve some sort of rationing process.

bank loans to dealers are a source of same-day liquidity to the banking system and serve the same purpose as excess reserves do in the United States.

Trading Banks Trading banks in Australia are banks that are authorized to clear checks. Nonbanks are allowed only indirect access to the check clearing system either by holding accounts with trading banks or by having an agency arrangement with a trading bank. For understanding the workings of the official market, however, there is no loss in assuming that all checks are issued by trading banks.

The important regulations that affect bank behavior in the official market are the structure of reserve requirements, access to rediscounting (discussed later), and the same-day availability of funds lent to dealers. Banks maintain required reserves in a special account called a statutory reserve deposit account (SRD). These reserves are based on last month's deposits and earn a below-market rate of interest, implying that the SRD requirement acts as a tax on the banking system. For check clearing purposes banks also maintain an exchange settlement account whose balance cannot be negative at the end of the day. This is equivalent to requiring that banks meet their reserve requirement on a day-to-day basis.

In the United States, banks need only meet their reserve requirements on average and, therefore, have some flexibility in determining the profile of their required reserve balances. In Australia, flexibility arises through the use of float produced by the differential timing in debiting and crediting the accounts of dealers and banks.

The Reserve Bank of Australia The monetary policy of the Reserve Bank of Australia is conducted through its exchange settlement position with the banking system. To influence the cash position of the banking system the Reserve Bank actively uses open market operations consisting of outright purchases and sales of government securities and repurchase and reverse repurchase agreements. As with most central banks that essentially use an interest rate instrument, the volume of trading is many times the actual change in portfolios. For example, in 1985/86 the Reserve Bank's gross purchases amounted to approximately $29.7 billion while its gross sales were approximately $28.4 billion, yielding only a small net increase in its portfolio. The same type of financial churning typifies U.S. experience. As documented by Friedman (1982) and by Levin and Meulendyke (1982), the Federal Reserve made gross transactions on its own account of $393 billion while only adding $4.5 billion to its portfolio.

Open market operations in Australia are almost exclusively implemented through transactions with authorized dealers, although in unusual circumstances the Reserve Bank may transact directly with banks. Unlike open market operations conducted by the Fed, those carried out by the Reserve Bank of Australia do not supply same-day funds to the banking system. This is a direct result of dealers banking with the Reserve Bank. In the United States the Fed's purchase of a security from a dealer immediately provides the dealer's bank with reserves. By contrast, in Australia the dealer receives funds immediately but the banking system only acquires funds on the next day when the dealer's check clears.

Most of the open market operations in Australia are defensive. That is, in order to maintain a desired interest rate the central bank attempts to offset flows of funds that, by affecting the cash position of trading banks, would otherwise cause rates to move. For conditions that are deemed to be short-term or seasonal, repurchase agreements are frequently employed, while outright purchases and sales are more often used to offset longer-term market conditions that do not accord with desired policy.

Central Bank Lending

Another major way for the banking system in Australia to acquire exchange settlement funds is through loans from the central bank. These funds can reach the banking system in two distinct ways. One, called a lender-of-last-resort loan (LLR), is indirect and occurs through a line of credit extended to authorized dealers. The other is through the rediscounting of specific Treasury notes at the Reserve Bank.[2] Rediscounting is not a loan. However, it is analytically equivalent to borrowing at the effective rediscount rate (defined below) for the remaining term of the security rediscounted.

Lender-of-last-resort loans are made with a term of 7-10 days. The minimum term is seven days with dealers having the prerogative of choosing which day they will repay the loan (as long as it is repaid by the tenth day). The rate on lender-of-last-resort loans is usually above going market rates. However, since dealers can always acquire same-day funds by borrowing from nonbanks, dealers will borrow only if overnight rates are expected to rise to the level of the lender-of-last-resort loan rate. Also, since market rates fluctuate, the LLR rate is adjusted frequently. Because an LLR loan is for a minimum term of seven days, the decision to borrow depends not only on current market rates but on expected market rates over the term of the loan.

With respect to the rediscounting of government securities, the Reserve Bank stands ready to purchase securities at a price P, determined by

$$P = 100\ (1 - nr/365)$$

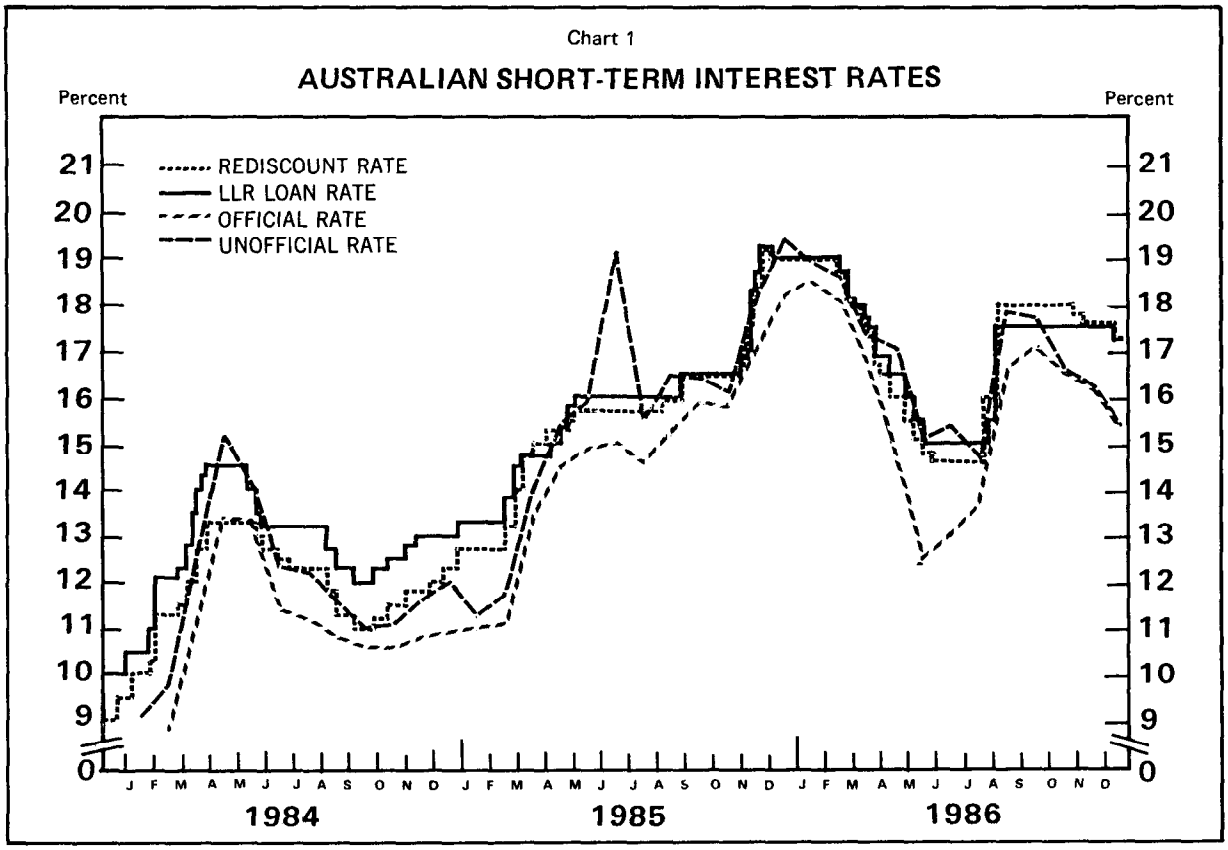
where r is the rediscount rate and n is the number of days to maturity on the note. As Poole (1981) points out, this procedure produces an effective rediscount rate of r^*, commonly known as the "give-up yield," given by

$$r^* = (365/n)\ ((100 - P)/P) = r\ [1 - nr/365]^{-1}.$$

This formula states that the effective rediscount rate r^* is larger than the discount rate r and varies inversely with the number of days n to maturity on the rediscounted note. Like the LLR rate, the rediscount rate is usually above the market rate. The pattern of money market rates is shown in Chart 1.

Borrowing and rediscounting behavior by banks and dealers is depicted in Charts 2a and 2b and in Table III. The data show (1) that large volumes of rediscounting usually occur when unofficial market rates slightly exceed the rediscount rate, but (2) that the rediscount rate is usually above official market rates. The behavior of lender-of-last-resort loans is also similar with dealers borrowing when rates are expected to rise above the LLR rate. These lending methods differ significantly from the operation of the

[2] The rediscount facility is available to any noteholder but is primarily used by banks and authorized dealers.



discount window in the United States.[3] In the United States, discount window loans are usually made at a subsidized rate. Therefore, controlling their volume involves some sort of nonprice rationing. Since rediscounting involves a penalty rate and excess same-day funds are allowed to earn market rates of interest through loans to dealers, the central bank lending facilities in Australia are quantitatively less important than those in the United States. Also, bank loans to dealers in Australia are proportionately greater than excess reserve holdings in the United States. A large

[3] A detailed analytical treatment of the discount window can be found in Goodfriend (1983).

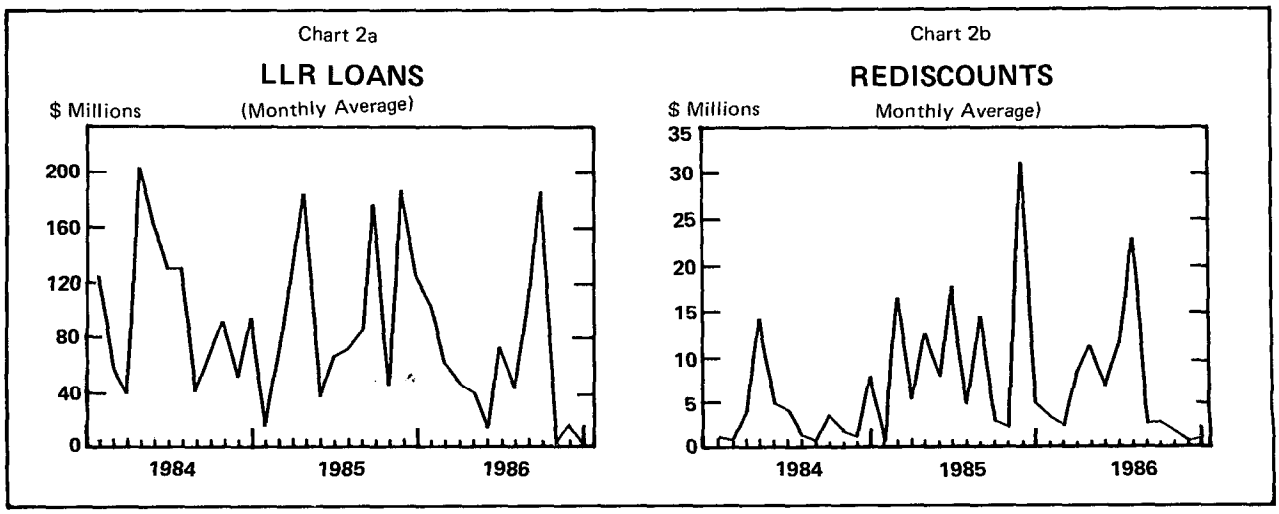


Table III

INSTANCES OF LARGE REDISCOUNTINGS FROM THE RESERVE BANK (1986)

Date	Rediscounts	Rediscount Rate	Official Market Rate	Unofficial Market Rate
1/17/86	63	19.0	18.7	19.0
3/11/86	115	18.0	17.5	17.9
4/8/86	85	16.5	16.3	17.8
6/10/86	83	14.6	14.1	15.4
1/16/87	110	14.6	12.4	16.0

quantity of these loans implies that a substantial draining of reserves would be required in order to induce banks in Australia to use the rediscount facility.

Although the use of rediscounting and LLR facilities may not be as great as discount window use in the United States, they still strongly influence the behavior of banks and dealers. Since these facilities represent a cost of acquiring same-day funds, the rediscount rate and the rate on LLR loans play an important role in determining the supply of bank loans to dealers and the demand for short-term funds by dealers. In essence, the penalty rate charged for same-day funds represents the cost of being caught short of those funds and will therefore be an important determinant for banks in deciding how much of an inventory of same-day funds they should maintain.

III. The Operating Policy of the Reserve Bank of Australia

Before investigating the general operating strategy of the Reserve Bank of Australia, it is necessary to look at the mechanics of an open market operation. Doing so will help to clarify the important information contained in the level of bank loans to dealers, information similar to that communicated by the level of discount window borrowing in the United States.

Open Market Operations

The mechanics of open market operations can best be illustrated by means of a numerical example. Suppose that the exchange settlement accounts of banks have a zero balance and that banks have loans outstanding with dealers of $900 million. Also, assume that taxes of $600 million are being paid by the public to the Treasury. At approximately 9:30 a.m. the Reserve Bank announces the system's opening cash figure resulting from the previous day's check clearings. In this example the figure is zero. At the same time, the Bank also indicates its dealing intentions.

As mentioned, banks' loans to dealers represent an inventory of same-day funds available to the banking system. The greater this inventory the lower the probability that banks will be forced to rediscount government securities. Although banks are not short of exchange settlement funds today, they are aware that tax payments will be leaving the system and, as a result, they will have a cash deficit of $600 million tomorrow morning. Reserves leave the system because the Treasury keeps all of its accounts with the Reserve Bank. Under the assumptions in this example, banks have enough loans outstanding with dealers to cover the shortfall, but the resulting loss in dealer loans would certainly be greater than banks desire at the existing interest rate. Therefore, individual banks will try to acquire next-day funds by bidding for deposits or selling securities to dealers or nonbanks and rates will rise. While any one bank can acquire funds in this manner, the system as a whole can only acquire funds (1) if the Reserve Bank provides accommodation by buying securities from dealers, (2) if dealers finance the purchase of securities through central bank borrowings, or (3) if someone uses the rediscount facility of the Reserve Bank.

If the Reserve Bank does not desire any upward pressure on rates, it can add funds today and allow the system to transfer the funds from today to tomorrow. The banks and dealers will make such transfers because exchange settlement funds do not earn interest. For example, suppose the Reserve Bank buys $300 million in repurchase agreements from authorized dealers. Dealers' exchange settlement accounts will be up $300 million, augmenting their ability to purchase interest-earning securities from nonbanks (or banks) either outright or under repurchase agreements.

Because dealers' accounts are debited (or credited) on the same day, their exchange settlement funds will now be square. Nonbanks will deposit the dealers' checks with a bank and the funds will be credited to the banking system's exchange settlement accounts on the next day. Therefore, although the accounts of dealers and banks at the Reserve Bank will not change as a result of the open market operation, float will increase by $300 million, as will deposits held with the banking system. In effect, the $300 million has spilled over to the next day so that banks will only have to reduce the net amount of

loans with dealers by $300 million rather than $600 million. In this case, the rise in the interest rate will be lessened.

It should also be noted that if the Reserve Bank does not provide additional funds on the day that tax payments leave the banking system, bank loans to dealers will continue to decline. As a result of the tax payment, banks have been forced either to reduce their loans to dealers by $300 million or to rediscount $300 million of securities. As long as the effective rediscount rate is above market rates, banks will call in dealer loans. Calling in a dealer loan results in $300 million being credited to the banking system's exchange settlement accounts. The exchange settlement accounts of dealers are now deficient by $300 million. Dealers must either take out an LLR loan or sell securities from their portfolio. The sale of securities results in immediate credit to the dealers' exchange settlement account even though the check will not be presented against the banking system until tomorrow. Float is, therefore, negative and the system has essentially borrowed money from the next day. On the next day the check clears and the banking system is once again short $300 million and deposits have declined by $300 million. The process will continue until banks' loans to dealers have been driven to zero. At this point, arbitrage implies that the official market rate will have reached the effective rediscount rate.

This transmission mechanism is quite different from that in the United States. In the above example, there has been no change in balances held at the Reserve Bank, since exchange settlement accounts are virtually zero-balance accounts. There is negative float, but the change in the portfolios of dealers and the banking system can be many times the initial $300 million withdrawal of funds. In the United States, under lagged reserve requirements, there would be a once-and-for-all decline in free reserves (excess reserves minus borrowed reserves) without any need for continuing adjustments. The monetary base in the United States would have changed by $300 million and the federal funds rate would have adjusted. In Australia, the $300 million shortfall appears to set off a continual adjustment process without any continuing changes in the monetary base. This process occurs because loans to dealers change and these loans represent an inventory of funds that allow the banking system to postpone rediscounting. In the absence of any subsequent actions by the Reserve Bank, banks eventually must rediscount to keep their exchange settlement account from becoming negative. In U.S. terminology, holding loans with dealers is analogous to banks postponing the need to satisfy reserve requirements with non-interest-bearing reserves.

There is also a similarity between excess reserves in the United States and bank loans to dealers in Australia. Both assets represent a source of same-day funds. In Australia, the greater the spread between the effective rediscount rate and the overnight interest rate, the greater the penalty of being caught short of same-day funds. As a result, banks will make more loans to dealers when the overnight rate is low. For given expectations of future open market operations, there will be a strong relationship between the amount of dealer loans and overnight rates.

Although the preceding example emphasized the difference in the transition path of bank balance sheet items in Australia and the United States, the steady-state equilibrium will be the same. At some point, say with a reserve requirement of 10 percent and no currency drain, a $300 million contraction of central bank liabilities will lead to a $3 billion decline in bank deposits, a corresponding $300 million fall in required reserves, and a $2.7 billion decline in bank assets. In order for the U.S. system to follow a transition path similar to that followed in Australia, the Federal Reserve would have to vary nonborrowed reserves so that excess reserves followed a qualitatively similar path to dealer loans in Australia. The bizarre nature of such a policy is one reason that the Reserve Bank of Australia does not sit on the sidelines for any extended period of time. Protracted contractions and expansions of bank loans to dealers are not usually allowed to occur.

The above example also highlights a particular feature of Reserve Bank behavior that does not seem to be fully appreciated. Specifically, maintaining the current level of short-term interest rates does not imply that the Bank should merely offset daily injections of funds into the system. Since bank behavior in bidding for funds depends on the expected flows of cash over subsequent days, the Reserve Bank's operations must also recognize likely flows of cash in the future. Otherwise, needless variations in interest rates would arise. Therefore, to ascertain whether the Reserve Bank is seeking to move market rates requires a detailed examination not only of conditions existing on the current day but conditions that are liable to arise in the near future.

The one-day lag between transactions that provide exchange settlement funds to banks reduces forecasting errors since banks start each day with a known cash position. If interbank settlement were on a same-day basis, the Reserve Bank would have

difficulty forecasting banks' needs for cash and this could lead to larger swings in overnight interest rates. Of course there is always the possibility that banks would just hold additional loans with dealers. However, an optimal inventory strategy would not cover all contingencies. Also, the ability to borrow and lend across days allows the system to adjust more gradually to movements, especially temporary ones, in settlement funds. Given that the Reserve Bank is averse to sharp swings in interest rates, this is a desirable characteristic. In the United States, the regulation that banks only need to meet their reserve requirements on average has much the same effect.

Although the accounting procedures in Australia provide the system with some ability to adjust to temporary reserve pressures without significant movements in rates, a concerted effort by the central bank to move rates will result in a gradual and continued change in loans to dealers. In the case of a tightening in policy, dealers will be forced to seek funds by borrowing from nonbanks or selling securities. These actions place upward pressure on rates. Eventually, the necessary exchange settlement funds can only come from two sources, lender-of-last-resort loans to dealers and the rediscounting of government securities.

Reserve Bank Policy

The major aim of the Reserve Bank's domestic market operations is to maintain the official market interest rate at a level consistent with the objectives of monetary policy. This type of policy, which uses the interest rate as an operating instrument, has been implemented since the floating of the exchange rate in December 1983. Note, however, that while the Reserve Bank uses an interest rate instrument, it does not peg the rate. Rather, its policy is similar to that of the Fed. The Reserve Bank basically tries to maintain interest rates within some desired band. Fluctuations within this band are tolerated while movements outside the band indicate a change in policy. Band widths vary, but are probably on the order of 100-200 basis points.

The daily volatility of both the official rate in Australia and the federal funds rate in the United States are displayed in Tables IV and V. The measure of volatility is the average squared first difference in daily rates. Table IV displays this measure for selective sample periods chosen so as to remove the contaminating influence of a general policy-induced trend in rates. Table V reports monthly averages. The message of the two tables is the same. Both central banks allow daily rates to fluctuate and the amount of fluctuation is roughly similar. Australian rates showed more volatility in 1984, but that may have been due to a learning process on the part of the Reserve Bank staff. Currently, daily rate movements are on the order of 20-60 basis points in each country. The figures on daily volatility coupled with the large amount of financial churning in each central bank's portfolio constitutes strong evidence that both monetary authorities are using the interest rate as an instrument, but that the interest rate is allowed a certain amount of flexibility.

As a practical matter, one would like to know how the monetary authority is able to obtain a desired average value for the interest rate and yet allow for daily fluctuations. One would also like to know the economic effects of this type of policy as compared to a policy of adhering to an adjustable interest rate peg. In Australia, policy is achieved by targeting bank loans to authorized dealers, while in the United States the Fed targets the level of borrowed reserves. As shown below, both policies are essentially an indirect interest rate instrument (see also McCallum and Hoehn (1983) and Dotsey (1987a,b)). In practice, however, if hitting the targeted level of loans to dealers forces the interest rate outside its prescribed band, then the target is readjusted. The result is a discontinuity in policy. Loans to dealers are

Table IV

VOLATILITY IN THE DAILY OFFICAL RATE AND THE DAILY FEDERAL FUNDS RATE

(Measured by the average squared first difference of daily rates over selected sample periods)

Australian Official Rate			
July 2, 1984	—	Feb. 19, 1985	.72
Feb. 20, 1985	—	Apr. 1, 1985	.40
Apr. 2, 1985	—	Apr. 30, 1985	.04
May 1, 1985	—	Nov. 11, 1985	.30
Nov. 12, 1985	—	Feb. 24, 1986	.14
Feb. 25, 1986	—	Apr. 28, 1986	.44
Apr. 29, 1986	—	Jul. 28, 1986	.53
Jul. 29, 1986	—	Oct. 30, 1986	.11
Oct. 31, 1986	—	Dec. 30, 1986	.03
U.S. Federal Funds Rate			
Oct. 8, 1979	—	Jan. 31, 1983	.61
Feb. 1, 1983	—	Feb. 29, 1984	.08
Mar. 1, 1984	—	Dec. 31, 1984	.18
Jan. 1, 1985	—	Jan. 30, 1987	.25

Table V

VOLATILITY IN THE DAILY OFFICIAL RATE AND THE DAILY FEDERAL FUNDS RATE

(Measured by the monthly average squared first difference of daily rates)

	Australian Official Rate			U.S. Federal Funds Rate						
	1984	1985	1986	1980	1981	1982	1983	1984	1985	1986
Jan.	3.10	.24	.04	.38	1.03	.27	.28	.06	.06	.03
Feb.	2.97	1.78	.08	1.59	.87	.45	.04	.02	.06	.01
Mar.	1.58	.34	.23	.56	.30	.37	.14	.13	.11	.07
Apr.	1.16	.10	.74	2.24	.60	.66	.17	.23	.06	.05
May	.64	.16	.91	1.24	1.07	.17	.02	.21	.05	.01
Jun.	2.54	.73	.24	.54	1.11	.07	.16	.12	.05	.05
Jul.	.52	.50	.33	.18	1.21	.23	.04	.09	.10	.04
Aug.	.68	.17	.29	.37	.72	.15	.02	.04	.06	.01
Sep.	.85	.25	.03	.29	.42	.36	.09	.14	.08	.05
Oct.	.47	.04	.02	.43	.54	.19	.06	.55	.09	.06
Nov.	.50	.33	.04	.73	.24	.05	.02	.05	.17	.18
Dec.	.72	.12	.03	1.55	.11	.14	.13	.20	1.18	3.38
Average of monthly squared deviations										
	1.31	.40	.25	.85	.69	.26	.10	.15	.17	.33

only used as a guide when the interest rate produced by the procedure remains within specified bounds. The same is true of a borrowed reserve target in the United States.

Modeling this type of policy discontinuity would not be easy. Nevertheless, one can model the procedures that span it. These include an interest rate instrument that is varied only periodically and a policy of targeting either loans to dealers (Australia) or discount window borrowing (U.S.). A model of those procedures may tell us something about the effectiveness of monetary control.

IV. The Economic Model

Overview

The purpose of this section is to consider the effectiveness of two different operating procedures for controlling money. Given that the Reserve Bank employs lagged reserve requirements, the basic instrument of monetary control must be the official market rate. With lagged reserve requirements, today's required reserves are based on last period's deposits and there is no way for current policy to affect history. The control of the money stock must, therefore, be accomplished through the interest rate. This rate can be used directly as an instrument or indirectly through the targeting of bank loans to dealers. Although actual policy does not exactly conform to either method, these methods seem to span policy. Therefore, an investigation of the effects that market structure has on the monetary-control powers of a direct versus an indirect interest rate instrument should reveal information regarding the effectiveness of actual policy. That different results are obtained for the United States and Australia shows that market structure is relevant when analyzing the efficiency of monetary policy.

The Market for Reserves

Capturing the major attributes of the Australian money market in an analytically tractable manner requires a degree of abstraction. It is, therefore, important to isolate the key features that characterize the market for reserves. These features include (1) the presence of lagged reserve requirements, (2) the requirement that exchange settlement accounts be nonnegative, and (3) the intertemporal decisions involved in rediscounting, lender-of-last-resort loans, and bank loans to dealers. The intertemporal nature of bank behavior can be illustrated by assuming that the average maturity of a rediscounted

security is two periods of a week each. Similarly, central bank loans to dealers are assumed to be for two periods. One may also wish to think of the reserve maintenance period as being two periods in length, although this is not crucial. It will be evident that, for the two alternative operating procedures analyzed, the particular reserve accounting regime is irrelevant.

The Demand for Money

The intuition behind the results concerning the effectiveness of monetary control (as measured by the squared deviation of money from its target value) can be understood without a detailed description of the economy.[4] Since monetary control is being examined, it will be necessary to discuss the demand for money.

The real demand for money is assumed to be positively related to income and negatively related to the nominal interest rate. When output is high, individuals tend to spend more. The resulting increase in their transactions requirements implies that more real money balances are desired. Conversely, as nominal interest rates rise the opportunity cost of holding money balances increases and individuals economize on their money holdings. The demand for money also depends on a stochastic element that may be thought of as representing unobserved changes in transactions costs brought about by innovations in cash management procedures. This random element is assumed to show some persistence and for simplicity is characterized by an AR1 process. That is, the shock to money demand, x_t, is equal to $\varrho x_{t-1} + v_t$, where $0 < \varrho < 1$, and v_t is white noise. This means that any current disturbance to the demand for money will also affect the future demand for money, although the effect will dampen over time. Some element of persistence is needed to make interesting the comparison between targeting loans to dealers in Australia (borrowed reserves in the United States) and an interest rate instrument. Otherwise, an interest rate instrument would trivially dominate the loans-to-dealer target (and similarly a borrowed reserve target in the United States) as a means of controlling money (see McCallum and Hoehn (1983) and Dotsey (1987a, b)). An AR1 process for the money demand shock represents the simplest way of incorporating persistence and allows the analysis to proceed at an intuitive level.[5]

[4] For a detailed presentation see McCallum and Hoehn (1983) or Dotsey (1987a, b). The model used represents a closed economy. Extending the result to open economy would be of interest but the basic mechanism that drives the results does not seem to be sensitive to such an extension.

[5] A degree of permanence could be modeled for the other variables without affecting the qualitative results.

An Interest Rate Instrument

One basic means for controlling money is a policy of directly using the interest rate. The efficiency of this policy is measured by the expected squared deviation of money from its target, m_t^*. The targeted level of money could arise from some complicated feedback mechanism on past and expected values of various economic variables that are chosen to satisfy broader policy objectives. However, the actual choice of m_t^* is not crucial (see McCallum and Hoehn (1983)), and for simplicity it is assumed that the targeted level of money is a constant.

In order to use an interest rate instrument, the Reserve Bank would peg the current interest rate at a level that will produce an expected value of money equal to m_t^*. Graphically, the demand for money can be drawn as a negatively sloped curve with respect to the interest rate. This is depicted in Figure (1a), where m_t^e is the expected demand for money based on past information that includes observations on last period's economic disturbances. The Reserve Bank then chooses the interest rate r_t^* that it anticipates will equate current money demand with its targeted value.

If the economy does not encounter any shocks, then the demand for money will exactly equal its target. Disturbances, however, will generally occur. For example, the demand for money could be unexpectedly high or there could be a shock to aggregate supply that would affect income and consequently the demand for money. The dashed lines in Figure (1b) reflect two possible demands for money that could occur in the presence of unanticipated economic disturbances. If the demand for money were unexpectedly high, then actual money would be m_t^h and the Reserve Bank would miss its target. Similarly, if money demand were lower than anticipated, actual money would end up lower than the target.

Pegging the interest rate therefore does not produce perfect period-by-period control of the money stock. However, since the errors in controlling money are not systematic, the high and low misses will cancel out over a long enough period. The same is true when the variable targeted is loans to dealers. Thus, in comparing the effectiveness of the two operating procedures, one needs to examine the relative variability in money's deviation from target.

Targeting Bank Loans to Dealers

Alternatively, the Reserve Bank could attempt to achieve a desired level of money by aiming at a desired level of bank loans to dealers. As mentioned, this variable indicates the amount of same-day funds available to banks. For simplicity, it will be assumed that bank loans to dealers are supply-

Figure 1a

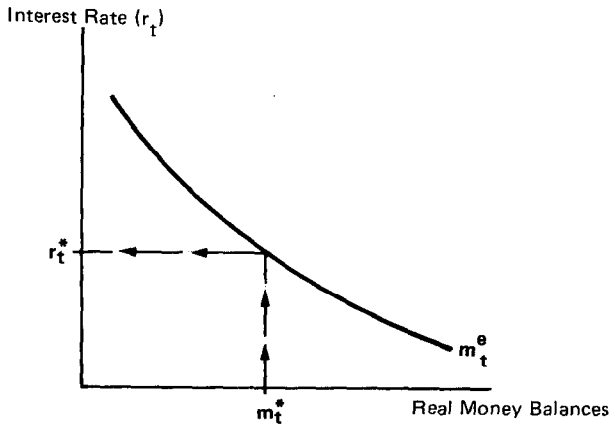


Figure 1b

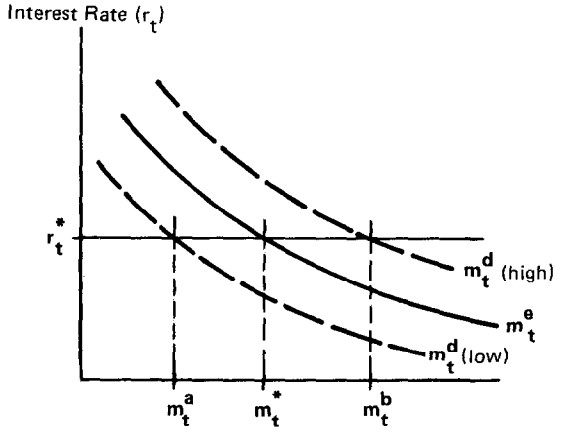


Figure 2a

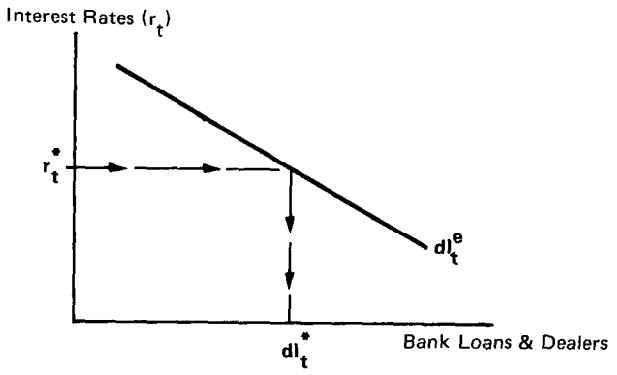
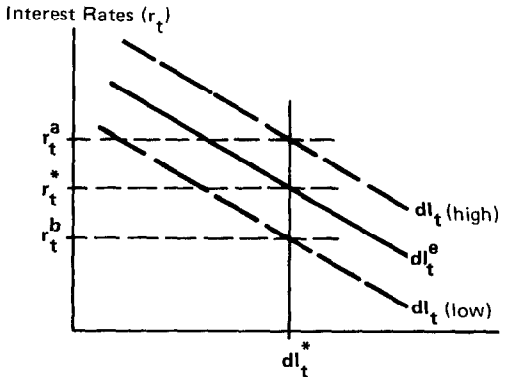


Figure 2b



determined with dealers accepting any amount of loans at the going rate. Banks hold loans with dealers because funds in exchange settlement accounts do not earn interest. The inventory of same-day funds will be based on the cost of running short. Specifically, if a bank must rediscount a two-period security in order to obtain exchange settlement funds, the cost is the effective rediscount rate minus the expected yield on the security rediscounted. In order to avoid this cost, banks will have a well-defined demand for an inventory of same-day funds. These funds are acquired by making loans to official money market dealers. As market rates rise to the level of the effective rediscount rate, there is no longer any advantage to holding loans with dealers since rediscounting no longer involves a penalty. Therefore, the supply of dealer loans is indirectly related to the offical market rate.

Under lagged reserve requirements the procedure of targeting banks' loans to dealers amounts to an indirect interest rate instrument, as does targeting borrowed reserves in the United States. This can be seen by examining Figure (2a). Figure (2a) represents the anticipated supply of loans, dl^e, as an inverse function of the interest rate. As interest rates rise and approach the effective rediscount rate, the penalty associated with rediscounting declines. There is, therefore, less reason for holding same-day funds with dealers.

How should the Reserve Bank choose a target for dealer loans, dl_t^*, given that it is interested in achieving a quantity of money equal to m_t^*? As in the case of an interest peg, the Reserve Bank must choose r_t^* in exactly the same manner. Then, given r_t^*, it will choose dl_t^* at a level that it anticipates will be consistent with r_t^*. If there are no economic disturbances, using open market operations to induce banks' loans to dealers to equal dl_t^* will result in an interest rate of r_t^* and money demand equal to m_t^*. It is in this sense that using a reserve instrument amounts to using an indirect interest rate target.

Now assume that the supply of bank loans to dealers is also affected by a random component, and that no other random disturbance impinges on the economy in the current period. In this case, the actual supply of loans could be depicted by either of the dashed lines in Figure (2b). For the case in which the supply is unexpectedly high, maintaining the reserve target at dl_t^* results in an interest rate of r_t^a and money demand of m_t^a. With no disturbances to money demand, aggregate supply, or aggregate demand, the Reserve Bank would still miss its monetary target. The targeting of bank loans to dealers would be unambiguously worse than using the interest rate directly if there were no persistence in the economy.[6]

To see how persistence can potentially alter the analysis, one can examine the case of a positive money demand disturbance. Individual banks will perceive part of this disturbance by observing movements in the interest rate and an increase in money balances in its depositors' accounts which are positively correlated with aggregate movements in money. Because the money demand disturbance shows persistence, banks realize that next period's demand for money will be high and the next period's interest rate will have to rise if the Reserve Bank expects to achieve its monetary target. An expected rise in the interest rate will lessen the expected opportunity cost of rediscounting securities with maturities of two periods and longer and will, therefore, affect this period's supply of bank loans to dealers. Given the structure of the Australian market for reserves, the supply of loans will decline and today's interest rate will fall. The fall in the interest rate will work to further increase the money balances held by the public and exacerbate the deviation of money from target. This means that using bank loans to dealers is unambiguously worse than an interest rate instrument for controlling money in Australia.

The preceding analysis implies that, from the standpoint of monetary control, targeting bank loans to dealers is likely to be inferior to an interest rate target in Australia. The practical importance of this finding is that the Reserve Bank of Australia should be more concerned with the interest rate than with bank loans to dealers. When applied to the United States the results may be different. This difference occurs because discount window borrowing is generally subsidized and thus must be rationed in some way.[7] Banks attempt to take advantage of their borrowing privilege when rates are expected to be high. In the case of a partially perceived positive money demand disturbance, banks in the United States (as in Australia) expect that next period's interest rate will rise. Assuming an unchanged borrowing (discount) rate, they therefore attempt to postpone borrowing today with the result that a higher funds rate is required to induce them to borrow the targeted amount. This higher funds rate reduces the quantity of money demanded and causes the actual level of money to be closer to target than it would be under an interest rate instrument. Targeting borrowed reserves can, therefore, improve monetary control if the demand for borrowing is not too volatile.[8]

V. Summary

This paper presents a comparison between operating procedures and money market institutional arrangements in Australia and the United States. The conclusion is that, although the central banks of both countries use similar operating procedures, differences in institutional structure affect the relative efficiency of policy. The most important institutional differences are the administration of central bank lending and the fact that official money market dealers bank at the Reserve Bank. The use of lagged reserve requirements in Australia as opposed to contemporaneous reserve requirements is not an important difference under current operating procedures. The use of an interest rate instrument, either directly or indirectly, makes the reserve accounting regime irrelevant. Other aspects of the money market such as different rules for satisfying reserve requirements in Australia and the United States are likely to take on more importance under contemporaneous reserve requirements and reserve targeting.

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[6] Another necessary condition for a reserves instrument to potentially outperform an interest rate instrument is heterogeneity of information among agents (see Dotsey (1987a)).

[7] For more detail see Goodfriend (1983).

[8] For a more complete treatment see Dotsey (1987a).

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