

**THE IMPLEMENTATION OF MONETARY  
POLICY IN AUSTRALIA**

**AN EXAMINATION OF INTEREST RATE  
TARGETING AND THE ENDOGENEITY OF  
LIQUIDITY**

**By**

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For future researchers and students embarking on further study, all too often the reason for study seems to be one of accreditation as opposed to original thinking, debate and enquiry. The latter sometimes gets lost but should always be the finality to any journey in academia.

Finally, my sincere gratitude goes to my wife, Rebecca O'Hara, for her ongoing support and encouragement throughout the many years of university study. I dedicate this thesis to, my late father, Francis Leo O'Hara.

## **Authentication of Thesis**

I, Liam Justin O'Hara, acknowledge that this thesis contains no material which has been accepted for the award of any other degree or diploma and that, to the best of my knowledge and belief, the thesis contains no material previously published or written by another person, except when due reference is made in the text of the thesis.

Signature of Applicant

**LIAM JUSTIN O'HARA**

## **Abstract**

The essence of this thesis is to examine the economics of interest rate targeting and the endogeneity of liquidity within the day-to-day implementation of monetary policy in Australia. In contrast to proponents of an exogenous money supply, this thesis provides a technical account of the operating procedures and institutional settlement framework surrounding the implementation process, and more generally the dynamics of the broader money and financial markets. The thesis also incorporates an examination of the Reserve Bank literature, and current and historic time series data. A contribution to the literature is provided in terms of a balance between theory and the more technical aspects to the implementation of monetary policy. Contributions to the literature are provided by the findings presented within chapters two and three.

Chapter two provides an examination of the relationship between the Reserve Bank and the banking system in the determination of the system-wide supply and demand for liquidity. The main findings of chapter two suggest that the supply of system-wide liquidity fully accommodates the demand for system-wide liquidity in order to maintain stability in the Reserve Bank's official short-term interest rate target. Manipulation in the supply of system-wide liquidity in the banking system is not required to move official short-term interest rates. OMO fully accommodates the demand for system-wide liquidity regardless of the level of end of day cash balances the banking system desires to hold in their ES accounts with the Reserve Bank. As to maintain stability in official short-term interest rates, the supply of system-wide liquidity becomes endogenously determined by the demand for system-wide liquidity. Chapter two provides a detailed, technical, and holistic account for understanding the endogenous nature of OMO within the broader market for short-term funds.

Chapter three provides an examination of the relationship between commercial banks during the inter-bank RTGS day. The main findings of chapter three suggest that the Reserve Bank is able to move official short-term interest rates through the use of pre-determined interest rates bands that pay 25 basis points either side of the official inter-bank cash rate target. Changes to this interest rate band simultaneously move official short-term interest rates and reinforce a new target rate announced by the Reserve Bank. Movements in official short-term interest rates are not a consequence of the manipulation to the supply of liquidity. Rather, commercial banks determine the demand for liquidity and the Reserve Bank fully accommodates their demand via an intra-day and an overnight repurchase agreement facility. Thus, at every stage of the settlement process, the supply of liquidity fully accommodates the demand for liquidity but at a cost influenced and set directly by the Reserve Bank.

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## CHAPTER ONE

# **I**ntroduction and literature survey

### **1.1 Aim**

The theory of an exogenous money supply, coupled with the money multiplier, has invariably dominated economic theory as the founding model explaining the creation of money and the manipulation of its supply. Money multipliers explicitly command authority as results of their mathematical niceties in modelling the theory that central banks exogenously control their own liabilities so as to manipulate broader monetary aggregates. One unfortunate consequence of the money multiplier approach is its inability to portray a realistic depiction of actual operating procedures involved within the implementation of monetary policy, and the institutional settlement framework of sophisticated financial markets, in which monetary policy depends.

In recent years, central banks, post-Keynesian economists, and financial market economists have critiqued money multipliers for a more insightful understanding into the implementation of monetary policy. In practice, central banks fully accommodate the demand for central bank money within the daily settlement process. Accommodation is affected on two distinct levels: 1. settlement between the central bank and the aggregate banking system and; 2. inter-bank settlement. Central banks fully accommodate, ex-post, the supply with the demand for central bank issued money in order to influence and directly control a cost of funds to the banking system. While the quantity of central bank money becomes an endogenous variable, central banks, as a monopoly supplier of liquidity, can influence and directly control the interest

rate/s at which their own liabilities are supplied during the daily settlement process. In essence, central banks must supply their own liabilities on demand if they are to facilitate not only a well functioning settlement process but also to manage a cost of funds to the banking system. Goodhart (2004) explains these obvious practical realities:

...simple observation of the way that central banks and money markets actually behaved would reveal that this was the exact reversal of the truth. The process started with the Central Bank determining its official short-term interest rate, in pursuit of its current policy objectives. The demand for bank borrowing, at the chosen policy rate, was the main determinate of the growth of monetary aggregates. Given  $M$ , the multiplier worked effectively in reverse, to determine the amount of base money that the authorities had to make available to the banking system to sustain their initially chosen interest rate (p.3).

Macfarlane (1984) notes exactly the same faults with the money multiplier approach:

When the dust has settled and statistics collected, it will be seen that there is a reasonable relationship between the cash base ... and bank deposits. It is this relationship that has traditionally been referred to as the multiplier between money base and money supply, but as the forgoing suggests, causality between the two variables is a complicated process and not a mechanical one, as estimated equations for the multiplier would imply. The main channel of causality thus runs from interest rates to deposit growth and then to cash or bank reserves. The multiplier shows a simple supply relationship but that is because it leaves out the chain of causality (p. 116)

The quantity of central bank issued money is demand determined by the settlement demands of the banking system and is therefore endogenous to the settlement process and the broader money/financial markets. Central banks can not restrict the supply of their own liabilities but they can affect the cost of funds within this settlement process. This thesis examines the Australian case for these arguments with respect to the endogeneity of central bank liquidity and the determination of official short-term interest rates. A critical component of this examination is the institutional settlement framework in which the implementation of monetary policy depends.

A technical appreciation of the actual operating procedures employed by the Reserve Bank of Australia [Reserve Bank], within the daily settlement process, becomes the critical component to understanding the endogeneity of liquidity and how official short term interest rates are determined. Technical operating procedures also emphasize the critical institutional settlement framework underpinning the implementation of monetary policy process and the functionality of the broader money/financial markets.

To achieve this outcome, an analysis and examination was required of the operating procedures and institutional settlement frameworks underpinning the implementation of monetary policy in Australia. The success of monetary policy is a depended relationship between operational procedures, employed by the Reserve bank, and the institutional settlement framework in financial markets. As a result, Australia's operating procedures, and institutional settlement framework, provides a deeper clarity into the endogenous nature of liquidity and the determination of short-term interest rates.

## **1.2 Statement of problems and motivation for research**

Academic theory and research has depicted, and over represented, monetary theory and practice in terms of a relationship between the money base, the quantity of broader money supply, and the determination of short-term interest rates. Undergraduate textbooks have further perpetuated the notion that central banks exogenously control the money base, as depicted by the LM curve<sup>1</sup>, in order to control broader monetary aggregates. Manipulation in the monetary base leads to further changes in broader monetary aggregates via the limiting parameters of the money multiplier. An exogenous money supply not only

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<sup>1</sup> See, for example, HALL, R., and J. TAYLOR (1997): *Macroeconomics, 5th Ed.* New York: Norton, ABEL, A., and B. BERNANKE (1995): *Macroeconomics, 2nd Ed.* Reading, MA: Adison-Wesley, and MANKIW, N. (1997): *Macroeconomics, 3rd Ed.* New York: Worth.

misrepresents how monetary policy is actually implemented but it also becomes highly restrictive, misleading, and even confusing when trying to reconcile traditional approaches with current operating procedures and the institutional settlement framework surrounding or underpinning the implementation process.

While exogenous money proponents misrepresent the workings of the banking system and financial markets, examinations of interest rate targeting can fail to provide an all encompassing account of operating procedures, the institutional settlement framework, and the interconnections with the broader money and financial markets, critical omissions for understanding the endogeneity of liquidity and the determination of official short-term interest rates. Rogers and Neil (1994), for example, highlight the choice of instrument under the control of the Reserve Bank but they fail to provide a thorough examination into the operating procedures and institutional settlement framework underpinning the implementation process:

The Reserve Bank can only control either the money stock or control interest rates; it can not control both. If the Reserve Bank controls the money stock, the money supply is exogenous and interest rates become endogenously determined by the interaction between the demand for, and the supply of ... [liquidity]. However, if the Reserve Bank controls interest rates, interest rates are exogenous and the money supply becomes endogenously determined by the demand for money at the Reserve Bank's chosen rate of interest (p. 260).<sup>2</sup>

The actual daily operating procedures involved in determining interest rates are a critical component for not only appreciating the endogeneity of liquidity and the determination of short-term interest rates but also dispelling previously considered perceptions on the implementation of monetary policy: Borio (1997) notes that the pitfalls of not examining operating procedures:

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<sup>2</sup> In fact, Rogers and Neil (1994) provide a more sophisticated account than most on the implementation of monetary policy in Australia during that time. However, their analysis is also misleading. As chapter two examines, the Reserve Bank need not manipulate the quantity of liquidity to move short-term interest rates, nor do they 'exogenously' control the interest rate in the securities market in order to induce AMMDs out of liquidity and into securities.

... breeds the perception that operating procedures can be taken for granted. ...it encourages the view that operating procedures are of no consequence. The way in which policy is implemented can have significant implications for the organization and functioning of broader money markets. ...it risks giving rise to potential misconceptions among parts of the academic profession...[that] include the view that the monetary base is the key concept in the determination of interest rates; that reserve requirements are necessary, or predominantly used, for monetary control; that the marginal demand for bank reserves can be thought of as a function of the volume of deposits; or that the central bank controls interest rates by mechanically supplying a certain volume of funds to meet a generally well-behaved demand for monetary base or bank reserves. ... [Alas] a proper understanding of operating procedures could throw light on its source, changing characteristics and reach in the wake of the profound changes taking place in the financial environment (p. 9-10).

Operating procedures and the institutional settlement framework are difficult fields of enquiry. This is largely due to the closed nature of the market and participants within this market. Accordingly, errors, omissions, and misrepresentation of the facts are always likely outcomes. The implementation of monetary policy is not static in practice, unlike the depiction of the money multiplier. Rather, it is dynamic and continuously changing as financial markets and technology develops, requiring fresh examinations.

### **1.3 Brief literature survey**

There are two main approaches to examining the policy options available to central banks. The first approach is to assume the money supply is the instrument of control and exogenously determined by the central bank. Short-term interest rates are a residual outcome of this process. Moreover, the money multiplier represents the parameters to which the central bank manipulates the money supply. Alternatively, the money supply can be considered as an endogenously determined variable where the money supply is determined by the demand for money and credit. Within this view, the central bank

relinquishes control of the money supply and determines a level of short-term interest rates, thus fully accommodating the demand for liquidity.

### **1.3.1 Exogenous or vertical money and the money multiplier identity**

Underlying the exogenous money approach is the belief that the money supply can be decomposed into two parts, the exogenous input by the central bank and the endogenous reaction of commercial banks and the non-bank public (Brunner, K. 1973). The money multiplier identity illustrates the mathematical principles on which the approach to exogenous money is founded (Friedman, M. and A. Schwartz 1963) and; (Cagan, P. 1965). A money multiplier identity can be derived by knowing the endogenous reaction of the money supply and the exogenous input into the money supply process. Mathematically, the money supply (M) is defined as currency (C), held by the non-bank public, and total bank deposits (D):

$$M = C + D \tag{1.1}$$

The money base, also broadly known as ‘high-powered money’, (B) is defined as currency on issue (C) and reserves (R) held by the banking system with the central bank:

$$B = C + R \tag{1.2}$$

Dividing equation 1.1 by 1.2 we find that the money supply becomes some function of the money base:

$$M/B = (C + D) / (C + R) \tag{1.3}$$

Rearranging 1.3 to solve for the money supply:

$$M = [(C + D) / (C + R)]B \tag{1.4}$$

and, dividing the denominator and numerator on the right hand side by (D):

$$M = [(C + D)/D / (C + R)/D]B \quad (1.5)$$

the money multiplier is derived:

$$\begin{aligned} M &= [(c + 1) / (c + q)]B \\ &= mB \end{aligned} \quad (1.6)$$

where,  $c = C/D$  is the currency to deposit ratio,  $q = R/D$  is the reserve to deposit ratio and  $m = (c + 1)/(c + q)$  is the money multiplier. Reserves (R) can be further defined as required reserves (RR) and excess reserves (ER) of the banking system. Accordingly, equation 1.6 is transformed as follows:

$$\begin{aligned} M &= [(c + 1) / (rr + er)]B \\ &= mB \end{aligned} \quad (1.7)$$

where (rr) is the required reserve ratio and (er) is the excess reserve ratio. The demand for money base is found by rearranging equation 1.6 to form:

$$B = cM/(c+1) + qM/(c+1)^3 \quad (1.8)$$

The first term on the left hand side of equation 1.8 becomes  $cD$  and the second term  $qD$ . Hence,  $C = cD$  and  $R = qD$  represent the demand for money base by the non-bank public and commercial banks, respectively. If the demand for liquidity is unpredictable, commercial banks would need to convert additional deposits into currency and reserves. An exogenous money supply does not cater for unstable demands for base money. Where central banks fail to accommodate the demand for base money, interest rates would rise to counteract the demand for base money by forcing the non-bank public to substitute an interest bearing deposit account for their calls on base money. Interest rates become a residual of the banking system's ability to meet monetary base limits

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<sup>3</sup> For a detailed examination of the supply and demand for base money see, for example, VISSER, H. (1974): *The Quantity of Money*. London: Martin Robertson and Company Limited., and TASLIM, M., and A. CHOWDHURY (1995): *Macroeconomic Analysis for Australian Students*. Sydney: Prentice Hall.

imposed by the central bank (Palley, T. 1996). Recently, Goodfriend (1997) describes the interconnections between the supply and demand for money as the tool of monetary policy:

The theory of money demand implies that control of the money supply is necessary and sufficient to control the trend of inflation...money demand may be thought of as the fulcrum by which a central bank controls inflation, and the money supply may be thought of as the lever by which it does so (p. 9).

Exogenous money proponents typically hold strong views that the money supply is determined in this hierarchical process. Such a process begins with the banking system maintaining special accounts with the central bank. The central bank then supplies fixed quantities of reserves, through the instruments of open market purchases and sales. A portfolio shift is initiated by the banking system where, in the short-run, the supply and demand for base money moves interest rates as commercial banks compete to adjust their disequilibrium position in light of exogenous changes in their accounts. In the long-run, the banking system has little choice but to re-balance their deposit liabilities relative to the manipulation in the supply of base money.

Anderson (1967) and Jordan (1969) describe the money supply process as a long-run equilibrium. The banking system and the non-bank public compete for a limited amount of base money with the entire process culminating in a long-run equilibrium where all base money is allocated, fully and efficiently, between the two competing sources of  $C + R$ . Thus, the money multiplier does not only depict causation but, moreover, it becomes an identity for defining the creation, destruction and manipulation of the supply of money in light of a stable, predictable, and even controllable demand for money base function.

### **1.3.2 Endogenous or Horizontal money and short-term interest rates**

Alternatively, the second approach assumes the money supply is endogenously determined and the central bank engineers a short-term interest rate. The endogenous money approach is far more encapsulating. For example, Keynes (1936) viewed money as a link with the past and present, and between the present and the future. Accordingly, uncertainty becomes an important precondition for the existence of money and thus its supply and demand.

The crucial argument to proponents of endogenous money is that money and credit are demand determined magnitudes, and cannot be studied without respect to a country's institutional frameworks and the historical settings that have existed and evolved over time.<sup>4</sup> Therefore, according to Eichner and Kregel (1975), Moore (1988), and Graziani (1989), money and credit cannot be viewed as an exogenous variable, in the orthodox analysis, rather as a result of 'animal spirits'. Entrepreneurs meet the level of effective demand for their output and must meet this demand with additional finance. Arestis (1996), comments on the arrangements between the production and monetary sectors:

The Central Bank Administers the level of the discount and commercial banks administer their lending and deposit rates (given banks' uncertain assessment of risk and value of collateral). At this level and structure of interest rates, banks stand ready to provide whatever loans the entrepreneurs' requirements for credit entail, so long as they are in their prearranged credit limits. An increase in the demand for credit leads to an increase in its supply, and thus an increase in the existing money stock, without necessitating a change in interest rates, unless the Central Bank varies its administered rate, changes of which influence directly changes in administered interest rates via a mark up process. It is the rate of interest that is the control instrument of monetary policy (p. 120)

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<sup>4</sup> For an interesting discussion on endogenous money, refer to: CHICK, V. (1994): "Lost and Found: Some History of Endogenous Money," Unknown conference source,13.

Dow and Dow (1989), and Wray (1990) debate the degree to which the banking system is willing to increase the money supply through loan creation. This view combines both liquidity preference theory and endogenous money by arguing that since commercial banks have complex portfolio choices, they have their own internal liquidity preference. Commercial banks' liquidity preference influences the amount of loans it makes available and, thus, when commercial banks run-down their liquidity they require an additional liquidity premium to expand their loan portfolio to the non-bank public.

Hence, irrespective of the interest rate set by the central bank, commercial banks ration credit when their liquidity preference dictates it. Minsky (1982, 1986), and Chick (1986, 1989, 2002) highlight the risks associated with an endogenous money supply. Sophisticated banking and financial systems heighten the degrees of speculation and risk taking. Consequently, financial fragility of the banking, financial, and production sectors are heightened particularly in bad economic times. Commercial banks can try to re-establish their desired liquidity preference in light of these problems and thus contribute to their own down turn, and the down turn of the economy through debt deflation.

Kaldor (1982), and Moore (2003) reverse causality of the money supply process to the following simply but effective expression:

$$\Delta C \rightarrow \Delta M \rightarrow \Delta B \quad (1.9)$$

Expression 1.9 reverses causation of the money supply by stating that the demand for credit leads to a change in the money supply which, in turn leads to changes in the money base. In the latter case, central banks are more concerned that there is a continuous and growing demand for their own liabilities. Without a demand for their own liabilities, central banks fail to determine a cost of funds to the banking system, and a lender of last resort.

Accordingly, the traditional demand for liquidity or the monetary base,  $C = cD$  and  $R = qD$ , is also restrictive and misleading. The predicability, or unpredictability, of the demand for liquidity or the money base becomes less relevant (Walsh, C. 1998). The demand for money must incorporate the creation of new deposits as well as existing deposits. Since the demand for money is determined endogenously, the demand for money is always willingly demanded.

An endogenous money supply has profound implications. No longer are short-term interest rates a residual outcome of the demand and supply for base money. Rather the private sector creates money through credit creation and the central bank fully accommodates the demand for its own liabilities at a cost influenced or directly set by them.

## **1.4 Methodology**

An examination is undertaken by way of a study into the operating procedures and institutional settlement framework employed by the Reserve Bank. Operating procedures are critical in examining the endogeneity of liquidity and the mechanics of the determination of official short-term interest rates. Operating procedures and the institutional settlement framework can be categorised into three broad areas of investigation: the relationship between the Reserve Bank and the banking system in the settlement process; the relationship between commercial banks in the inter-bank settlement process and; the structures, instruments, processes, and financial system architecture employed by the Reserve bank within these settlement processes.

Operating procedures provide the foundation for examining the endogeneity of liquidity, and the determination of short-term interest rates. Chapter two and three provide the basis for the methodology and associated findings. In

arriving at these findings, strong use of the Reserve Bank literature were drawn upon, to not only provide relevant evidence for the arguments presented but, to highlight the current views and opinions of the Reserve Bank itself with respect to the implementation of monetary policy.

Moreover, the content of the thesis is original, technical, and analytical. The thesis examines a number of sub-components necessary to appreciate the broader dynamics within the money market, and how money markets are constructed around these operating procedures and the current institutional settlement framework. The thesis examines both current and historical time series data in support of the arguments presented. The availability of such data has been a critical component of the examination and findings presented within the thesis.

What's important to the content and findings presented within the thesis is a clearer understanding of just how contemporary monetary policy is implemented in Australia. In order to convey this knowledge, the thesis incorporates a detailed examination of the structures, instruments, processes, and financial system architecture within the settlement process itself. Since the Reserve bank fully accommodates the demand for liquidity within the settlement process, the settlement process must be the relevant starting point for examining the endogeneity of liquidity and the determination of short-term interest rates.

## **1.5 Findings**

Chapter two examines the role of open market operations [OMO] in the stability of short-term interest rates and endogeneity of system-wide exchange settlement [ES] liquidity. The supply of system-wide liquidity fully

accommodates the system-wide demand for liquidity. The findings suggest that the Reserve Bank does not manipulate the system-wide supply of liquidity in order to move official short-term interest rates to its target rate. Similar findings are provided by Bell and Wray (2003) with respect to the Federal Funds market in the United States of America:

...the Fed does not keep reserves scarce to hit its target, and it need not drain reserves to raise the target. ...Rather, the central bank announces a target and supplies (horizontally) the quantity of reserves banks want/require. Given that demand for reserves is highly interest inelastic, there is very little relationship between the fed funds rate target and the quantity of reserves required/desired. (p. 269)

In Critique of Taylor's (2001) paper, Mosler (2002) comments:

Taylor goes on to state that today "when the FOMC (Federal Open Market Committee) publicly announces changes in its funds rate target, the market reacts very quickly and sometimes without any immediate open market purchases or sales" This thought is better stated by eliminating the word "sometimes", as it is virtually always the case (p. 420).

Goodhart (2002) notes similar paradoxes with respect to OMO in the United Kingdom:

Open market operations, bearing down on the reserve base of the banking system, was the means to this end, but both the institution form of the operation exercise (e.g. the design of the weekly treasury bill tender and the access of the system to direct central bank lending) and the quantitative day-to-day decisions on the operations themselves, were invariably designed with a view towards making the central bank's chosen key short-term rate effective in determining the set of other shorter-term market rates, and *not* in order to achieve any predetermined level of monetary base (p.15)

What's more important to the Reserve Bank is not the quantity of money base but rather that the banking system has a demand for liquidity to settle obligations with itself. The system-wide demand for liquidity is the sum of the banking systems' liquidity to settle obligations with the Reserve Bank plus the banking systems' end of day liquidity position with the Reserve Bank.

Deviations in the demand or supply of system-wide liquidity are quickly counter-acted in the opposite direction, and roughly the same magnitude, via the use of OMO. OMO is designed to fully accommodate the demand for system-wide liquidity in order to maintain stability in short-term interest rates and neither as a tool to manipulate the money supply or, as the findings suggest, the Reserve Bank's official short-term interest rate/s. Mosler (2002) again finds similar evidence:

The thought process leading to construction of that type of model demonstrates a lack of understanding of the dynamics behind actual policy implementation. The New York Trading Desk can readily meet the federal funds target mandated by the FOMC (Federal Open Market Committee) without professor Taylor's (or anyone else's) reaction function. The target is an interest rate, so the New York Trading desk need only respond to changes in that interest rate. If the federal funds rate trades above its target, for example, it is a simple matter to make funds available at the appropriate interest rate for member banks to borrow on an as-needed basis. There is no functional value to knowing how much the banks need in advance. The Fed can always readily supply, and indeed must supply, any quantity of \$US reserves the banks demand at the going rate, or the federal funds rate will not be on target. Payment is notional and effected by simply crediting member bank reserve accounts. There is no inherent constraint on the quantity as the target is the interest rate and the quantity necessarily floats to meet bank demands, so the Fed has no need to "be prepared" for any quantity demanded (p. 421)

Time series data into dynamics of OMO, in maintaining official short-term interest rates, reveals many interesting facts. The quantity of liquidity which the banking system actually demands, in their ES account with the Reserve Bank, is not the anchor of monetary policy. The banking system determines the quantity of end of day balances not the Reserve Bank. In a system where liquidity fully accommodates the settlement process, end of day cash balance are neither significant in their magnitude nor in their settlement use. Thus, on an operational basis, the banking system can, in theory, demand a zero-non-negative end of day cash balance.

Finally the instruments of OMO are also interesting in their own right. The Reserve Bank does not limit itself to risk-free Commonwealth Government Securities [CGS] but has adapted to dealing in a range of public and private sector securities among a broad range of participants, both commercial bank and non-bank financial institutions [NBFI]. The short term money market is highly competitive in the sense that NBFI, and potentially any large non-bank corporation, can borrow funds at market interest rates as opposed to commercial bank facilities.

OMO is just one small but significant section of the short-term money market. Repurchase agreements have account for over 96% of the total turnover in domestic OMO, in recent years. Their calculations and terms become a critical component to understanding the endogenous or accommodating nature of OMO.

Chapters three examines the role of pre-determined interest rate bands in moving short-term interest rates, the payment and settlement system architecture, and the endogeneity of ES liquidity in a Real Time Gross Settlement System [RTGS]. This chapter examines the payment and settlement system in unprecedented detail to provide an analysis of the demand for liquidity during the inter-bank RTGS day. Again the Reserve Bank does not need to restrict the quantity of liquidity to move official short-term interest rates to their target rate. Instead the Reserve Bank pays 25 basis points either side of the target rate on surplus and deficit ES account positions.

Commercial banks obtain intra-day liquidity, on demand, through an intra-day repurchase agreement facility with the Reserve Bank. Intra-day repurchase agreements fully accommodate the daily inter-bank RTGS day. A commercial bank with surplus funds, above that required to unwind intra-day repurchase agreements by the close of the inter-bank RTGS day, would lend surplus liquidity to deficit commercial banks in the inter-bank cash market at, or

around, the target rate. Likewise, a commercial bank in deficit, below the amount required for unwinding intra-day repurchase agreements, and unable to borrow from a surplus commercial bank as needed, converts intra-day repurchase agreements into an overnight repurchase agreement with the Reserve Bank at 25 basis points<sup>5</sup> above the target rate. Findings into the inter-bank RTGS day suggest that ES liquidity is always provided on demand at interest rates influenced or directly determined by the Reserve Bank. Wray (1998) observes very similar operating procedures of the Bank of Canada:

The Canadian Central Bank ... requires direct clearing banks to hold balances with the Central Bank for clearing purposes. They earn interest of 50 basis points below the overnight bank rate (equivalent to the discount rate in the US) on positive balances, and are charged the bank rate on deficits. The Bank of Canada sets a target range for the overnight market rate, which has a ceiling of the bank rate and a floor equal to the bank rate less 50 basis points. The reserve target is for bank settlement balances to equal zero on average (positive balances by some banks are to be offset by deficits of others). A pre settlement period of half an hour is supposed to allow each direct clearer time to lend or borrow reserves to reach a zero settlement balance by the end of each business day (p. 105).

These findings highlight the fact that the quantity of liquidity does indeed float to meet commercial bank demand for inter-bank RTGS transactions without the Reserve Bank jeopardising its official short-term interest rate target. The relationship between the findings in chapter two and three is best described by Lewis and Mizen (2000) with respect to their examination of the how monetary policy is implemented in most western countries

The central bank occupies a special position in every national money market. It is primarily through the market for call money that a central bank's operations impinge upon the financial markets as it seeks to control short-term interest rates. The market serves as an automatically regulator when the system as a whole is in balance and as a means of regulating rates when the authorities seek to alter the general level of

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<sup>5</sup> A basis point is equal to 1% of 1% or 0.01% (0.0001). On Financial Markets, a basis point is the smallest increment in the change in interest rates and yields in the securities markets.

interest rates. Interbank settlements are the lever. Daily payments made to banks and their customers result (ultimately in the case of net end of day settlement, immediately with real time guaranteed settlement) in transfers of funds between banks, and these are made with 'cash', that is balances which banks hold in operational accounts at the central bank. In the absence of transactions undertaken by the central bank or its clients, especially the government, the settling-up would sum to zero, and through the money market the banks with net inflows of funds could be induced to lend to those with net outflows. When there are transactions involving the central bank, including those on its own account in the markets, the commercial banks can be left with an overall cash deficit or surplus at final settlement. As the source of cash reserves, the central bank is in a strong position to affect financial conditions (p. 346).

OMO, intra-day repurchase agreements, and overnight repurchase agreement facilities ensure the supply of liquidity accommodates the demand for settlement obligations both between the banking system and the Reserve bank, and in the inter-bank settlement process. While OMO maintains stability in the Reserve Bank's official short-term interest rate/s, a pre-determined interest rate band of 25 basis points either side of the target rate serves to move official short-term interest rates to their new target level. These facilities react endogenously to the settlement demands of the banking system but at a cost influenced or set directly by the Reserve Bank. Without full accommodation, the banking system is unable to settle obligations as they arise, and the Reserve Bank fails to target a cost of funds to the banking system.

## **1.6 Thesis structure**

Chapter two examines the role of OMO in the stability of short-term interest rates and endogeneity of system-wide ES liquidity. The thesis examines the purpose of OMO in fully accommodating the demand for system-wide liquidity over a 10 year time period. Accordingly, the market structure prior to the introduction of RTGS is examined to provide a clearer insight into the endogeneity of liquidity during the unique operating procedures employed by

the Reserve Bank, at that time. Chapter two proceeds to examine the principles of OMO with the support of recent time series data. Finally, chapter two provides a detailed examination of the instruments, terms, and calculations of repurchase agreements within the OMO process.

Chapters three examines the role of interest rate bands in moving short-term interest rates, the payment and settlement system architecture, and the endogeneity of ES liquidity in a RTGS system. Chapter three provides a detailed and technical examination of how the RTGS system settles payment instructions across commercial banks' ES accounts. The thesis then proceeds to examine commercial banks' internal liquidity management operations for their own business and their non-bank clients. Intra-day and overnight repurchase agreement facilities are examined to show that the Reserve Bank fully accommodates the demand for liquidity during the inter-bank RTGS day. Finally, the thesis examines the role of predetermined interest rate bands in moving the Reserve Bank's official short-term interest rate.

Encompassed within chapters two and three are detailed introductions to the chapters' purpose and content. Both chapters complement the central theme and findings presented overall, as outlined by their specific titles. Chapter two and three provides original insight into the more technical aspects surrounding the implementation of monetary policy in Australia. Chapter four provides a brief summary of the purpose, examination, and findings of the thesis.

## CHAPTER TWO

# **The role of open market operations in the stability of short-term interest rates and the endogeneity of system-wide exchange settlement liquidity<sup>6</sup>**

### **2.1 Introduction**

The Reserve Bank influences the cost of final settlement within the daily settlement process. As the monopoly supplier of cash or ES funds<sup>7</sup> to the banking system<sup>8</sup>, the Reserve Bank can determine interest rates on which the banking system obtains cash for final settlement. It is this daily base cost of final settlement that affects all other short-term interest rates. The supply of cash is determined by the final settlement demands of the banking system rather than by a legal reserve requirement. As a non-restricted quantity, the supply of cash is fully accommodated, by the Reserve Bank through various facilities, to meet the banking system's demand for final settlement obligations but at a cost influenced and directly controlled by the Reserve Bank. Appreciably, it is for this reason that the Reserve Bank regards the quantity of cash supplied to the banking system as an endogenously determined variable.

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<sup>6</sup> Note: The author acknowledges the Reserve Bank of Australia for their ongoing assistance in providing current and historical time series data. Conversations with Mr James Whitelaw - domestic markets department - have been appreciated. Information presented in this chapter are the views of the author and do not necessarily represent the views or/and position of the Reserve Bank of Australia.

<sup>7</sup> Liquidity and Cash are inter-changeable. The Reserve bank bestows cash status on the liabilities it produces: Cash = Money base = Currency + ES funds. Chapter three examines that part of cash, ES cash, associated with the Reserve Bank's OMO. I prefer to use the word liquidity because the money base represents a stock where as accommodating the system-wide demand for liquidity is variable and not necessarily encapsulated in the money base statistic.

<sup>8</sup> Banking system refers to the aggregate banking systems ES account position. As a monopoly supplier of ES cash, only the Reserve Bank can meet the banking system's aggregate or system-wide demand for cash: System-wide supply/demand for cash = the banking system's end-of-day or overnight cash balances + the banking system's cash settlement obligations with the Reserve Bank.

It is worth noting Campbell's (1998b) statement and position on this matter:

Traditional textbook discussions of the operations of monetary policy focus on the quantity of money. In this model, the transmission mechanism works through either changing banks' reserve requirements or using open market operations to change the money base, which is essentially liabilities of the central bank. Changes in the money base, operating through the money multiplier, were designed to influence growth in the money supply, which in turn influenced interest rates and, ultimately, economic activity. It is important to recognise that operating procedures for monetary policy in Australia – or in any country for that matter – do not conform to this traditional model. There are no reserve requirements on banks in Australia; their demand for central bank funds comes from their need for settlement balances, not reserve requirements. The Reserve Bank's operations focus on establishing a price at which these funds are made available, rather than on the quantity of liquid funds – i.e. they operate to affect the cash rate, not the money base (p. 1-2)

In recent years, the Reserve Bank has reiterated this crucial point and the terminology has been very clear. Campbell (1998a) comments that an official inter-bank cash rate is:

...the only genuine barometer of the effectiveness of the Reserve Bank's market operations, since these operations are aimed at maintaining stability in the [inter-bank] cash rate – not achieving a particular level of ES [balances] (p. 56)

Again, the Reserve Bank (2003b) notes this point, with emphasis:

The Reserve bank has no prescribed target for the level of settlement balances [cash], supplying whatever amount is needed to keep the cash rate near the target (p. 4).

Whilst the Reserve Bank is the monopoly supplier of cash, the quantity of cash is actually demand determined by the final settlement demands of the banking system; thus endogenous to the settlement process, and the financial markets, but at interest rates determined exogenously by the Reserve Bank. The supply of cash accommodates the demand for cash via three main market based facilities: 1. OMO is an aggregate tool designed to ensure the system-wide

supply of cash fully accommodates the banking system's system-wide demand for cash at the official short-term inter-bank cash rate; 2. Intra-day cash allows commercial banks, and the banking system generally, access to large quantities of cash to settle intra-day inter-bank settlement obligations and; 3. Borrowing cash overnight from the Reserve Bank assists commercial banks, and the banking system generally, to complete settlement at a cost set directly by the Reserve Bank. Chapter Two examines OMO in the provision of aggregate or system-wide cash and its role in stabilising short-term interest rates.

## **2.2 Historic and contemporary OMO**

OMO, the process used by the central bank to influence the system-wide cash position of the banking system is not essential to move the Reserve Bank's official short-term cash rate: the official inter-bank cash rate. Historically, it was presumed that the role of OMO, under an interest rate targeting regime, was to provide a degree of cash pressure in order to move the official short-term inter-bank cash rate. The misinterpretation that OMO actually moves the inter-bank cash rate derives largely from traditional text-book theory that propounds an exogenous money supply where the role of OMO was to adjust the banking system's system-wide cash position in order to control its credit creating capabilities, and where, as a consequence, movements in short-term interest rates were the residual outcome of this process.

However, OMO has evolved to maintain stability in the short-term interest rates, not to move it. An excess supply of system-wide cash will place downward pressure on short-term interest rates as the banking-system cannot rid an excess supply of cash unless demand simultaneously increases within the banking system. Likewise, an excess demand for system-wide cash will place upward pressure on short-term interest rates as the banking system cannot alleviate excess demand for cash, unless the supply increases through

OMO. In maintaining stability in short-term interest rates, OMO ensures that the system-wide supply of cash fully accommodates the system-wide demand for cash at the official inter-bank cash rate target. While OMO ensures the system-wide supply and demand for cash are equated, they do not ensure that the cash is evenly distributed. Commercial banks play a critical role in redistributing cash in the inter-bank cash market between those with debits and those with credits to their ES account.

More specifically, OMO are designed to offset exogenous cash pressures which add or subtract from the stock of end of day or overnight cash demanded by the banking system. Studying the stock of end of day balances demanded by the banking system with the Reserve Bank, on an overnight basis, becomes irrelevant to objectives of the operating procedures themselves. Only an aggregate excess supply or demand will place pressure on the official short-term inter-bank cash rate, regardless of the daily quantity demanded as end of day cash balances. Adding to this, the banking system currently holds miniscule and decreasing quantities of end of day cash; this represents a significant reduction in its functionality as the main source of final settlement cash.

Finally, the static nature of the traditional textbook models further fails to encompass the evolving nature of the instruments used in the open market process. The Reserve Bank, as with many western central banks, does not limit itself to risk-free Government securities but has progressively moved to purchase both public and private sector securities under repurchase agreement. Repurchase agreements, not outright purchases and sales, account for well over 96% of the total turnover in domestic OMO in recent years; unfortunately, the nature of these repurchase agreements has rarely been examined by economics and finance academics.

Chapter two examines the role of OMO in the provision of system-wide cash. The short term inter-bank cash rate is maintained by equating, or fully accommodating, the demand and supply for system-wide cash, i.e., it is not used as a disequilibrium tool to move the inter-bank cash rate. This is mainly due to the banking system having direct recourse, as a final resort, to a borrowing facility at the Reserve Bank at a pre-determined interest rate. Hence, the Reserve Bank had always fully accommodated the demand for cash. An examination, spanning 10 years of daily time-series data from 1993 to 2004, on cash interest rates and cash quantities indicates no well-defined daily relationship between the quantity of cash and cash interest rates.

Encompassed with this examination are the institutional dynamics of the broader cash market, hitherto little understood. Furthermore, an historical examination of OMO over the past 10 years highlights the fact that the Reserve Bank has fully accommodated the demand for cash in order to maintain cash interest rates at their target levels, and the settlement system functional. The examination proceeds to investigate the principles of OMO, why they are necessary, and what determines their volume. Chapter two, also, examines repurchase agreements, their associated calculations, dealing arrangements, and their own interest rates and terms.

### **2.3 The overnight cash market and cash interest rates**

The broader dynamics of the overnight cash market provides the key to understanding financial markets and short-term interest rates. The Reserve Bank influences the overnight interest rate at which commercial banks borrow final settlement cash. The Reserve Bank can ensure the system-wide supply of cash is sufficient, but leave it to commercial banks to trade away surplus or deficit positions amongst themselves. On any given day, a commercial bank is uncertain as to its borrowing or lending requirements, since this is a function of

the financial activities on the day and in previous days, i.e., the distribution of final settlement demands are unknown and unevenly distributed as a result of their own and their non-bank client activities. Consequently, commercial banks price their cost of funds, at the margin, from the daily interest rates paid on overnight borrowed funds in the inter-bank cash market. Within this system, commercial banks can enter the overnight market to redistribute cash resulting from the daily in-flows/out-flows of their ES account at a cost influenced or set directly by the central bank.

### **2.3.1 NBFIs: adding depth to the overnight market**

While the Reserve Bank influences overnight interest rates within the banking system, borrowing and lending is endogenously determined by the demand for credit. Commercial banks, NBFIs - merchant and investment banks, finance companies, money market corporations, building societies and credit unions - play a critical role in the borrowed funds market, adding considerable depth to it. Their main activity is to lend to the non-financial sector over varying maturities and yields. To support their lending activities, NBFIs fund themselves by borrowing in the overnight money market at market interest rates, mainly from corporations and large businesses.

#### **2.3.1.1 A market not just for commercial banks**

A NBFI can enter the short term money market under a repurchase agreement, on an unsecured basis, and by, simply, issuing commercial bills of exchange on behalf of themselves or their clients. A NBFI may have 2 billion dollars recalled daily and will re-enter the overnight market to borrow a further 2 billion from alternative clients with surplus funds. However, they are in the

process of intermediation by borrowing overnight at-call funds to support their lending to the non-financial sector, and/or investing in a portfolio of market instruments.

Alternatively, both commercial banks and non-bank financial institutions can assist their high net-worth clients by issuing commercial bills of exchange. Both institutions, simply, discount the commercial bill of exchange at prevailing market interest rates, provide the discounted value to their clients, and on-sell the instrument to the financial markets, charging their client a small fee or margin for arranging finance and taking on default risk. Surplus funds accumulated, on a daily basis, are re-invested in market securities or parked in an 11 am deposit account with their respective commercial bank/s.

Thus a short-term money market primarily facilitates the intermediation [borrowing and lending] process, not necessarily the arbitrage of relative interest rates, by allowing commercial banks and NBFIs readily available access to borrowed funds at market interest rates to support the demand for finance. Critically, while the process of borrowing and lending funds creates new monetary liabilities and new instruments of finance, and is not restricted to commercial banks, the process can only serve to redistribute cash within the banking system.

### **2.3.2 The banking system**

Commercial banks are not only deposit-taking but also deposit creating institutions. They can fund themselves with deposits but must stand ready, on a daily basis, to convert deposits into cash. The liquidity of the banking system is cash, not bank deposits. The Reserve Bank can ensure cash is distributed to the banking system however, commercial banks play a critical role by re-distributing cash among borrowers and lenders. Shanmugam et al (1992)

describes the inter-bank market as “fickle” (p. 145), limited to those with ES accounts while lending commercial banks would not desire excessive inter-bank cash exposures relative to their overall asset portfolio. While limits exist, under an interest rate target regime, the inter-bank cash market becomes a reliable source of funds within the settlement process. The Reserve bank influences the base cost of funds to the banking system within this settlement process as the sole instrument of monetary policy. Commercial banks also issue market instruments; however, while they do raise funds, market instruments are a portfolio decision and, like deposits, can only serve to redistribute cash within the banking system. Borrowing among commercial banks is a function of the daily distribution of final settlement obligations and commercial banks cannot be certain as to their net-calls for cash.

## **2.4 Historical overview of the cash market in Australia**

Since the establishment of the Reserve Bank in 1959 and until June 12<sup>th</sup> 1996, OMO were not designed to manipulate the quantity of system-wide cash the banking system maintained with the Reserve Bank, but rather the quantity of system-wide cash loans the banking system invested with Authorised Money Market Dealers [AMMDs]. Macfarlane (1984) notes this crucial distinction in the practise of monetary policy by commenting that banks had:

... no need or facility to hold buffer stocks of cash with the Reserve Bank. The funds that banks [held] with authorised dealers [had] some of the characteristics of money base, but they [were] not a liability of the Reserve bank and are not able to be controlled by market operations (p.116).

While OMO could be used to create a degree of cash pressure, their role was primarily defensive; ensuring the banking system's loans with AMMDs remained at a level demanded by the banking system. An announcement to a change in the official cash rate target was enough for cash rates to move

automatically. Thus there was no well defined relationship between cash rates and the quantity of cash loans invested with AMMDs. Consequently, little need arose for OMO to move official cash rates. A shortage of cash in the banking system did not mean cash was unavailable in the final resort. Rogers and Neil (1994) describe the daily lender-of-last resort methods:

...the Reserve Bank always [stood] ready to rediscount [buy back] Treasury Notes of less than 90 days to maturity at a penalty interest rate – the rediscount rate. ...AMMDs [could also] sell CGS to the Reserve Bank under Repurchase Agreements where AMMD[s] agree to repurchase the CGS at a specified future date. The yield of these transactions [was] set by the Reserve Bank, and as with the rediscount rate, contains a penalty element in order to discourage indiscriminate use so that the Reserve Bank's monetary policy objectives are not thwarted (p. 269-270).

In essence, by the very nature of the daily implementation of monetary policy and the operation of ES accounts, cash cannot be exogenously controlled but can be supplied at a cost of funds influenced and set by the Reserve bank. The system-wide demand for cash was a transaction or settlement demand, for commercial banks to pay the Reserve bank, determined by the banking system. A commercial bank's cash loans to an AMMD were simply a depository for the banking system to lend surplus cash at-call and recall loans when the Reserve Bank debited their ES account. If the system-wide demand for cash exceeded its supply, overnight interest rates rose. Likewise, if the system-wide supply exceeded demand, overnight interest rates would fall.

What had been little understood was that an announcement to a change in the target for the cash rates was enough for cash rates to move automatically, while OMO were principally designed to maintain and reinforce cash rates. Whereas the Reserve Bank could ensure cash was plentiful, AMMDs, like the banking system, performed a dynamic and critical role by redistributing cash within the banking system by borrowing and lending in the official and unofficial market (Reserve Bank of Australia 1985, 1990).

### 2.4.1 The official and unofficial overnight market<sup>9</sup>

The official cash market was that part of the short-term money market that dealt in secured same-day cash and was populated by those with ES accounts; namely the Reserve Bank, AMMDs, and the banking system. The unofficial cash market dealt in next-day funds, also known as bank-cheque funds, and was populated by those in the official market and a range of NBFIs who maintained bank accounts with their respective commercial bank/s. AMMDs were a conduit between the Reserve bank and the banking system, effectively straddling both markets to fund their portfolio of short term securities<sup>10</sup>, and thus providing the means to redistribute cash relative to their ES position in the official cash market. Battellino (1990) provides a simplified, but effective, account of their role in both markets:

AMMDs ... deal[t] in two types of funds – ES funds with banks, and bank cheque funds with other market participants. In this way, AMMDs provide a link between what is known as the official money market – i.e. between the Reserve Bank, the AMMDs and the commercial banks – and the rest of the money market, which is often known as the unofficial money market (p. 37)

AMMDs received same-day cash value for transactions in the unofficial market, providing an ability to move cash in and out of the banking system, and across days, relative to their position in the official market<sup>11</sup>. The Reserve bank (1990) comments on their ability to redistribute cash as:

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<sup>9</sup> For a detailed examination of the differences between the official and unofficial cash market: See// TSUNG, S., and B. YUILL (1978): "Short-Term Money Markets Grow Swiftly," in *Australian Monetary Economics*, ed. by K. Davis, and M. Lewis. Sydney: Longman Cheshire.

<sup>10</sup> For a detailed description of the role and activities of the AMMDs: See// RESERVE BANK OF AUSTRALIA (1991): "Authorised Short Term Money Market Dealers," *Reserve Bank of Australia Bulletin*, June, 19-25..

<sup>11</sup> AMMDs position is determined by the ebbs-and-flows in the expected cash position of the banking system. For example, spending by the Commonwealth Government would see a rise in cash and a simultaneous selling of CGS to AMMDs in preceding days. AMMDs would need to borrow cash in the unofficial market to fund the increase in securities; effectively stopping the cash hitting the system.

a mechanism by which on any given day the market can absorb fluctuations in the availability of cash, in effect by bringing cash forward from, or pushing cash into, the following day (p. 10)

Rankin (1992) provides a micro-examination into the behaviour of AMMDs and commercial banks under this system, commenting that both markets created a dynamic or inter-temporal effect:

Banks expecting to receive inflows [respectively pay outflows] of ES funds tomorrow can either wait until tomorrow and lend [respectively borrow] in the ES market then or they can lend [respectively borrow]<sup>12</sup> in the non-ES market today to offset tomorrow's expected flows. In the latter case, the banks are using what is called the "float" – the amount which spills into the ES market tomorrow as a result of transactions today. Banks choice between the two options will be based on a number of factors. One is a comparison of the non-ES rate today and the expected exchange settlement rate tomorrow. More important is the level of ES balances that each bank has – if high, the bank is likely to lend non-ES funds today so as to avoid building ES balances up further; if low, the bank is likely to wait so as to build up its ES balances and lend them in the exchange settlement market tomorrow. Indeed, in the latter case, the bank may even seek to borrow non-ES funds today to add to its surplus tomorrow (p. 3).

Likewise:

Authorised dealers facing a surplus [respectively deficit] today can meet this by repaying loans [respectively borrowing] in either the ES or non-ES markets today. In both cases they will balance their clearing accounts at the Reserve Bank, but each will have a different implication for flows of ES cash tomorrow (p. 3)<sup>13</sup>

The function of the daily official overnight market for commercial banks and AMMDs was to redistribute system-wide cash by borrowing or lending within the banking system to square their ES account, i.e., end the day with a zero non-negative account balance.

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<sup>12</sup> Note: Lending cash includes buying securities under reciprocal repurchase agreement and borrowing cash includes selling securities under repurchase agreement.

<sup>13</sup> For a summary of Rankin's detailed examination of the cash market: See/FELMINGHAM B., and W. COLEMAN (1995): *Money and Finance in the Australian Economy*. Sydney: Irwin.

## 2.5 Historical overview of OMO

Historically, the aggregate or system-wide supply of cash was always determined by the Reserve Bank. Deviations<sup>14</sup> in the supply or demand of system-wide cash in the banking system placed upward or downward pressure on overnight interest rates. Commercial banks would continue to increase or decrease their bid/offer rates for overnight funds, reflecting their realised or expected system-wide cash position with AMMDs.

Carmichael and Harper (1995) provide a detailed exposition of commercial bank behaviour when the demand for system-wide cash exceeded its supply. A net exogenous payment to the Reserve Bank would reduce loans to AMMDs and force commercial banks to bid-up overnight interest rates in the unofficial market to maintain optimal quantities of cash loans with AMMDs. As commercial banks recall loans with AMMDs, they too would simultaneously face negative ES accounts and be forced to bid-up overnight interest rates in the official and unofficial markets to maintain their funding base. In this case, the only way AMMDs could maintain funding, without borrowing from the Reserve Bank initially, would be to bid away non-bank deposits, under repurchase agreement, in the unofficial market.

While each commercial bank and AMMD could obtain more funds in this way for the banking system, and AMMDs, it would only have served to redistribute cash the following morning; albeit with higher short-term cash rates. While the Reserve Bank provides AMMDs same-day cash value for borrowing next-day funds in the unofficial market, on settlement, the following morning, the banking system would be forced to recall more loans with AMMDs to pay the

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<sup>14</sup> Commercial Banks demanded a certain quantity of cash with AMMDs. Deviations to this desired level could precipitate commercial banks to change behaviour (refer to following pages). It should not be confused with an exogenous money supply, rather deviations in the supply or demand of cash which could move interest rates in the official and unofficial market.

Reserve Bank. This process would continue and overnight interest rates would rise as AMMDs and commercial banks bid up overnight interest rates until they became indifferent between borrowing in the market and borrowing from the Reserve Bank.

The Reserve Bank could limit interest rate rises through OMO. In this respect, OMO were the primary refinancing tool of the banking system before borrowing directly from the Reserve Bank, and were primarily used to maintain stability in the short-term cash rates. In the unofficial market, short-term cash rates moved in anticipation of the future expected deviations to the banking system's cash loans with AMMDs. Consequently, OMO were also forward looking. Dotsey (1987) explains:

... maintaining the current level of short term interest rates does not imply that the [Reserve] bank should merely offset daily injections of funds into the system. Since bank behaviour in bidding for [and selling] funds depends on the expected flows of cash over subsequent days, the Reserve Bank's operations must also recognise likely flows of cash in the future (p. 9).

MacFarlane (1986) describes the defensive nature of OMO and the behaviour of commercial banks when cash is expected to be abundant.

If we know that there will be two or three days of heavy inflow of cash into the system, we have to ask whether the bank can afford to wait until cash has hit the system and then mop it up or whether it is better to act before the cash has arrived. What normally happens is that banks and other participants in the short term money market will see that their cash position is going to become flush over the coming few days and so they will stop bidding for funds in the unofficial market and become willing to lend. Thus, in the unofficial market, conditions will ease in anticipation of these funds. When the inflow arrives, if the bank merely sells securities to match it, this will have limited effectiveness. Banks will have received the cash, lent it to authorised dealers and the Reserve bank's sales of securities will merely ensure that the dealers acquire assets to match the increase in their loans from banks, rather than reduce their borrowings from other lenders in the unofficial market. It will keep authorised dealers bidding for funds, but it will not stop banks from

becoming more cashed up, i.e. having more loans to dealers [or ES funds] (p. 10).

Dotsey (1987) also notes that while commercial banks could have demanded more loans with AMMDs it would not have been an “optimal inventory strategy” (p.10). If the system-wide supply exceeds demand, the banking system would need to begin offering lower interest rates in the unofficial market to shed any daily excess supply of cash. On settlement, the commercial banks may stop bidding for cash in the inter-bank cash market and invest increasing amounts of cash with AMMDs. In turn, AMMDs would become cashed up and would need to push these funds in the unofficial market by quoting lower offer rates to NBFIs and commercial banks in the unofficial market. Theoretically, excess supply or demand for system-wide cash would have moved cash interest rates however, a disequilibrium in the cash market was not an operational prerequisite for moving cash rates to a new cash rate target.

### **2.5.1 Times series data: cash quantities and official cash rates**

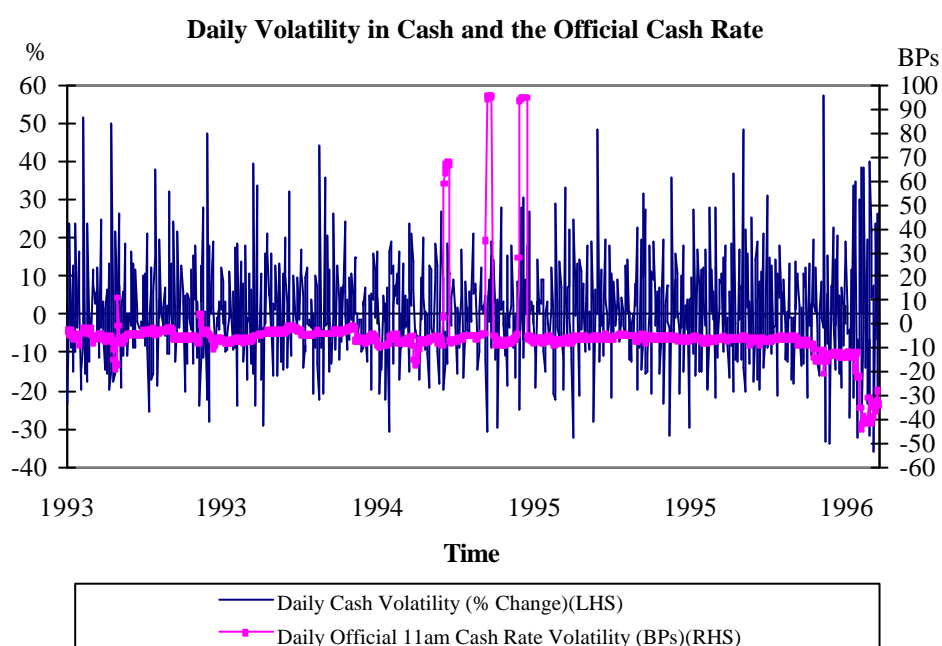
Carew (1978) describes the nature of the cash markets and the type of interest rates traded. AMMDs in the official cash market funded themselves primarily by raising 11am cash, where funds were invested, renegotiated or recalled prior to 11am, from commercial banks and other non-bank clients.<sup>15</sup> Commercial banks and NBFIs in the unofficial market funded themselves by borrowing 11am and 24 hour at-call funds. Commercial banks could also fund daily deficit ES positions by borrowing in the inter-bank cash market on an unsecured basis. It was, however, the official cash rate that the Reserve Bank influenced which in turn fed into the unofficial and inter-bank cash rates.

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<sup>15</sup> For a statistical profile of the quantities of cash borrowed by AMMDs from both commercial banks and non-bank clients: See//FOSTER, R. (1996): "Australian Economic Statistics: 1949-50 to 1994-95," *Reserve Bank of Australia*, Occasional Paper No. 08.

A sample of the data on commercial banks' cash balances with AMMD against the official 11am cash rate from 1993 to 1996 is provided in Figure 2.1. Evidently, the daily volatility in the official 11am cash rate was insignificant relative to the daily volatility in system-wide cash.

Figure 2.1



Source 1 McMillan and Martin (1993) and the Reserve Bank of Australia

The short-run daily deviation in system-wide cash averaged, in absolute terms, 25 percentage points while most cash rates observations have deviated by less than 10 basis points from the official cash rate targets. Regardless of the announced target cash rate, the daily quantity of system-wide cash invested with AMMDs had been quite volatile and there appears to be no well-defined relationship between the official cash rate and the daily quantities of cash with AMMDs.

Rankin (1992) has also observed similar observations. Having announced a new target cash rate:

there may be little need in practise for the [Reserve] Bank to buy or sell CGS to add pressure for the cash rate to move close to the new target (p. 13).

There are a number of explanations for this contradiction between theory and practise. One possible explanation would have been that commercial banks and AMMDs were aware that the Reserve Bank, being a monopoly supplier of cash, could force cash rates up or down if they did not automatically move to the new, announced, cash rate target, i.e., it was futile to deviate too much from the official cash rate target, particularly given other fixed cost parameters, i.e., borrowing from the Reserve Bank at penalty interest rates.

Furthermore, having announced a target cash rate, the banking system was prepared to experience large daily volatility in their cash holdings with AMMD, without placing pressure on cash rates, because they were aware that the Reserve Bank would correct any imbalance, in the long run, over proceeding days and weeks to maintain stability in their announced cash rate target. In fact the three year net injection of cash was just 0.8%,<sup>16</sup> indicating that, while the daily deviations in system-wide cash can be large, over the long-run the quantity of system-wide cash remains relatively stable.

In essence, the relationship between the daily quantities of system-wide cash with AMMD and short-term cash rates was an unpredictable one. Dotsey (1987) concludes:

The relationship between banks' loans to [AMMDs] and interest rates [provided] the Reserve Bank with a useful indication of how market operations will affect rates. However at times there can be a conflict between the signals provided by bank's loans to [AMMDs] and the interest rate. The Reserve Bank appears to regard the interest rate as the more reliable guide for market operations (p. 15).

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<sup>16</sup> This simply states that while the quantity of system-wide liquidity with AMMD may vary considerably from on a daily basis, over time the quantity of system-wide cash has only deviated by 0.8% around the average.

The remaining sections of chapter two examines the role of OMO in stabilising the Reserve Bank's official short-term inter-bank cash rate, and the endogeneity of system-wide cash since the commencement of RTGS on the 22<sup>nd</sup> June 1998 to 31 December 2004.

## **2.6 Maintaining stability in the official short-term inter-bank cash rate: determining the supply and demand for system-wide cash**

OMO determines the supply of system-wide cash to accommodate the banking system's demand for system-wide cash to maintain stability in the inter-bank cash rate. OMO ensures, through a competitive market allocation, the aggregate banking system has sufficient cash available, on a daily basis, to accommodate their final settlement obligations with the Reserve Bank, and their demand for end of day cash balances. Mathematically, the daily system-wide demand for cash equals: 1. The final settlement obligations between the Reserve Bank and the banking system plus 2. The aggregate demand for end of day cash balances. While OMO equates the system-wide supply and demand for cash, commercial banks play a critical role in the inter-bank cash market by redistributing cash between deficit or surplus commercial banks.

### **2.6.1 OMO: principles of accommodation**

OMO ensures that the banking system is not left in a surplus or deficit system-wide cash position resulting from certain exogenous factors. The Reserve Bank (2001b) provides an examination of these exogenous factors. Firstly, the system-wide supply of cash is a function of the Government's fiscal position:

In a world where the Reserve bank was undertaking no open market operations, the amount of cash that underpins the market [ES funds, or what the academics call 'high powered money'] would depend on the

Governments fiscal balance, and it is not hard to see that this would be likely to result in monetary instability. Any government deficits not financed by an exactly coincident issue of debt to the public...would mean a rise in cash and a fall in interest rates. Similarly, a surplus not exactly matched by debt retirement would lead to shrinkage of the amount of cash and an escalation of interest rates (p. 15-16).

Mismatches in the government's daily net-spending add or subtracts from the system-wide supply of cash in the banking system. A budget deficit results in positive net-spending today, adding system-wide cash to the banking system, placing downward pressure on the inter-bank cash rate. In forthcoming days, the system-wide supply of cash in the banking system will be reduced, placing upward pressure on the inter-bank cash rate, as financial markets purchase new government securities. In the short-run, the Reserve Bank would undertake an open market sale followed by an open market purchase in the following days.

A budget surplus results in negative net spending today, subtracting system-wide cash from the banking system, placing upward pressure on the inter-bank cash rate. In forthcoming days, the Government could repurchase existing debt, increasing the system-wide cash position of the banking system, placing downward pressure on the inter-bank cash rate. In the short-run, the Reserve Bank would need an open market purchase followed by an open market sale of securities in the following days.<sup>17</sup>

Secondly, where the Government has zero outstanding debt, consistent budget surpluses would subtract system-wide cash from the banking system. OMO is required, at least in the short-run, due to mismatches in government spending

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<sup>17</sup> Due to the mismatches in spending and receipts, the Reserve Bank stills needs to provide daily short-term finances to assist the Government. This is not printing money in the old sense but rather borrowing through an "overdraft facility" from the Reserve Bank only for temporary mismatches at interest rates above market interest rates. For an historical account of Government borrowing arrangements: See//RESERVE BANK OF AUSTRALIA (1993): "The Separation of Debt Management and Monetary Policy," *Reserve Bank of Australia Bulletin*, November, 1-5. What is of concern is the daily net-effect on the system-wide supply of cash in the cash market. For information on the Reserve Bank's cash management operations: See//RESERVE BANK OF AUSTRALIA (2000): "Implications for the Reserve Bank's Liquidity Management Operations of Changes in Commonwealth Government Cash Flows," *Reserve Bank of Australia Bulletin*, August, 50-5.

and revenues regardless of whether the government has existing outstanding debt. In the long-run these exogenous mismatches in the governments' fiscal position may even-out as a function of the economic climate and cycle. Thirdly, the continuous demand for currency requires accommodation through OMO:

Even with the fiscal position in balance, the system could be destabilised by changes in the public's demand for currency. Because the public's demand for currency expands with the growth of the economy, it could only be accommodated in this regime by some other source of cash such as provided by Reserve bank open market operations (p. 16).

Finally, the Reserve Bank's own operations require further intervention. When previous open market instruments mature, they either add or subtract to the supply of system-wide cash in the banking system, prompting further open market purchases or sales. The daily net-exogenous affects of all these variables are encapsulated in the opening system cash position of the banking system.

## **2.6.2 The opening system cash position**

The daily opening system cash position determines the scale of open market operations on any given day. The system cash position is the estimated autonomous net-change to the system-wide supply of cash to the banking system resulting from the above exogenous variables outside the Reserve bank's control.<sup>18</sup>

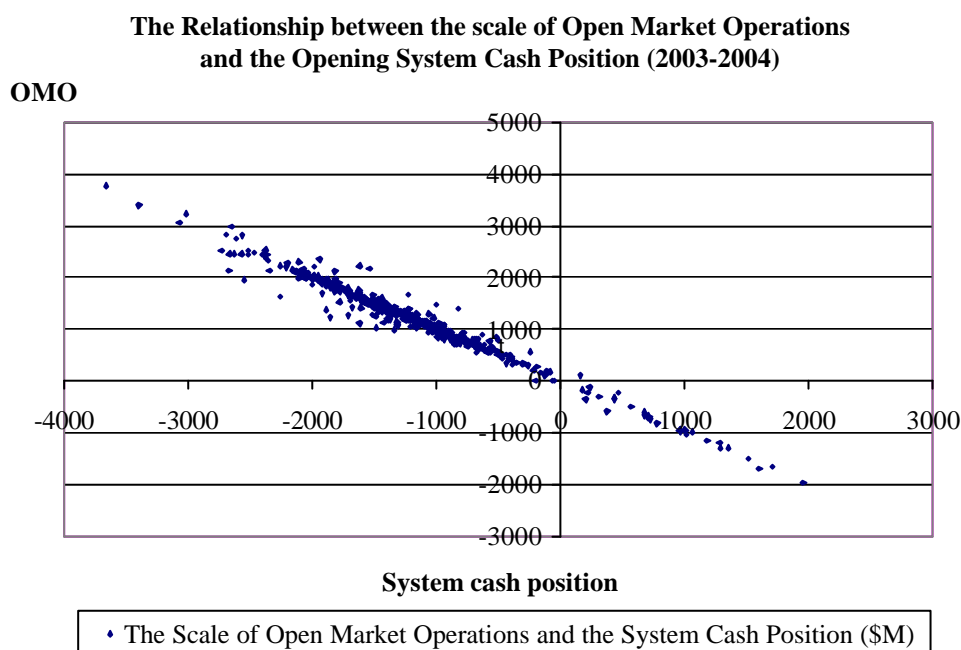
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<sup>18</sup> Again, do not get confused between an exogenous money supply (controlled by the Reserve Bank) and exogenous or autonomous change in the supply of, or for that matter demand for, cash (outside the Reserve Bank's control). The former is about control of the monetary base, the latter about accommodating the demand for system-wide cash.

### 2.6.2.1 Time series data: opening system cash position data

A sample of the data for the opening system cash position for 2003-2004 is provided in Figure 2.2. A positive change in the opening system cash position results in the system-wide supply of cash exceeding the demand for system-wide cash. A negative change in the opening system cash position results in the system-wide demand for cash exceeding the system-wide supply of cash.

Figure 2.2



Source: Reserve Bank of Australia

Figure 2.2 also highlights the effectiveness of OMO in offsetting, in the opposite direction and roughly equal magnitude, the opening system cash position and hence fully accommodating the demand for system-wide cash, thus maintaining stability in the inter-bank cash rate. The accuracy in offsetting the opening system cash position is provided by the regression results based on data presented in Figure 2.2.

### 2.6.2.1.1 Regression results

The evidence clearly indicates that OMO are undertaken on a scale that counteracts and fully accommodates the daily net-exogenous effects influencing the supply of cash in the banking system. How effective have these operations become? Applying a simple linear regression function of the form:

$$E(Y / X_t) = \hat{Y}_t = \hat{b}_1 + \hat{b}_2 X_t \quad (2.1)$$

To the sample data observations observed in Figure 2, we find

$$\hat{Y}_t = 19.173_1 - 0.9838_2 X_t \quad (2.2)$$

Equation (2.2) shows that the  $\hat{b}_2$  coefficient is extremely close to 1, indicating that the effectiveness of OMO is almost exactly off setting the system cash position with the same magnitude. The accuracy of the Reserve Bank's operations is also indicated by the coefficient of determination:

$$R^2 = 0.9859 \quad (2.3)$$

Equation (2.3) measures the goodness of fit indicating, in this case, that most of the observations are explained by the linear regression function. Not surprisingly,  $\hat{Y}_t$  has to be explained solely by  $X_t$  as only one independent variable, the system cash position, warrants OMO. More specifically, the opening system cash position is the expected shock to the banking system's end of day cash position.

### 2.6.3 The demand for overnight or end of day cash

Commercial banks determine the quantity of overnight cash demanded as end of day balances in their ES account. Large and consistent deviations in the

supply of end of day cash balances from the level demanded by the banking system as end of day balances can lead to an excess supply or demand, as a result of the opening system cash position, for end of day cash, thus movements in the inter-bank cash rate. The Reserve bank (2003b) describes the likely effect of OMO inability to meet the banking system's demand for end of day cash balances.

If these operations lead to too high a level of balances, account holders [those holding exchange settlement accounts] will seek to lend excess funds to other institutions, usually on an overnight and unsecured basis. As a result, the cash rate would come under downward pressure moving away from target. Conversely, if too few balances are supplied the cash rate would come under upward pressure (p. 1).

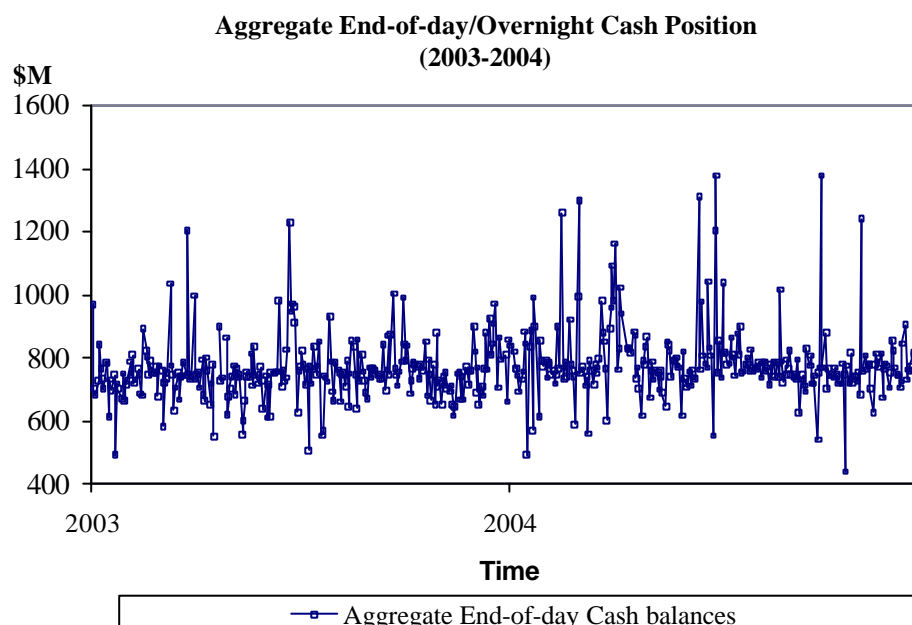
The quantity demanded as end of day cash balances is endogenously determined by the banking system. More importantly, the daily stock or quantity of end of day balances demanded by the banking system, on an overnight basis, is irrelevant to appreciating what exactly is happening. OMO accommodates the daily supply of system-wide cash in order to accommodate the daily demand for end of day cash balances, regardless of the level/s of end of day cash balances demanded by the banking system, which could be zero non-negative end of day cash balances.

### **2.6.3.1 Time series data: overnight/end-of-day cash balances**

A sample of the data on end of day cash balances for 2003-2004 is provided in Figure 2.3. The data highlights the effectiveness of OMO in offsetting deviations to end of day cash balances resulting from the opening system cash position. Figure 2.3 also highlights the small quantities of cash demanded by the banking system during this time, averaging a daily 774 million dollars. Campbell (1998a) offers an explanation to the declining quantities of end of day balances:

... First the market players involved with Real time Gross settlement have adapted well to operating in the new environment [i.e. Moving from a purely multilateral net deferred system to a RTGS system]; and second, participants have reasonable confidence about the availability of cash near the interest rate announced by the Reserve Bank as its policy target (p. 57).

Figure 2.3



Source 2 Reserve Bank of Australia (2004)

In fact, the demand for end of day cash balances is a daily variable not a constant. Commercial banks set their own daily demand for end of day cash and quantities could reside anywhere from a few billion dollars to zero non negative end of day cash balances. As long as commercial banks can obtain cash in the inter-bank cash market, initiate final settlement, and end the day with a non-negative ES account, zero balances are permitted. Figure 2.3 also highlights deviations to the quantity of end of day cash by several million dollars from the previous settlement day. Deviations of these magnitudes are insignificant to the total cash position of the banking system.

As long as the banking system is willing to demand slightly greater or lesser quantities of these balances, on a daily basis, pressure on the inter-bank cash rate would be negligible.

Yet another interesting observation is the difference in the quantity of cash demanded, on a daily basis, post-AMMDs. Average system-wide cash demanded with AMMDs were 3.8 billion dollars, or some five times the average value of cash demanded as end of day cash balances with the Reserve Bank in 2003-2004. The reduced functionality of end of day balances reflects the new and distinct operating procedures in a RTGS system. Today, the end of day cash balance is, purely, a function of liquidity preferences.

#### **2.6.4 Further evidence: end-of-day cash and the inter-bank cash rate**

Irrespective of the quantity of cash demanded by the banking system, OMO fully accommodates the demand for system-wide cash. Rankin (1995) explains this process.

From day to day, there will be no clear-cut link between the amount of cash in the system and the level of the cash rate. If demand for cash rises...the Reserve Bank will conduct operations to ensure that supply also rises – the amount of cash will rise, but cash rates will not change. Likewise, if demand falls, the Reserve Bank's operations will produce a fall in the amount of cash but again there would be no change in the cash rate. (p. 35-36)

With this said, OMO can provide a degree of tightness or looseness to reinforce the official inter-bank cash rate. This is not essential. The inter-bank cash rate moves simultaneously with changes in the Reserve Bank's pre-determined interest rate band. An interest rate band sets the interest rate on surplus end of day cash balances and the interest rate associated with borrowing directly from the Reserve bank. Again the Reserve bank (2003b) comments on the inter-bank market structure.

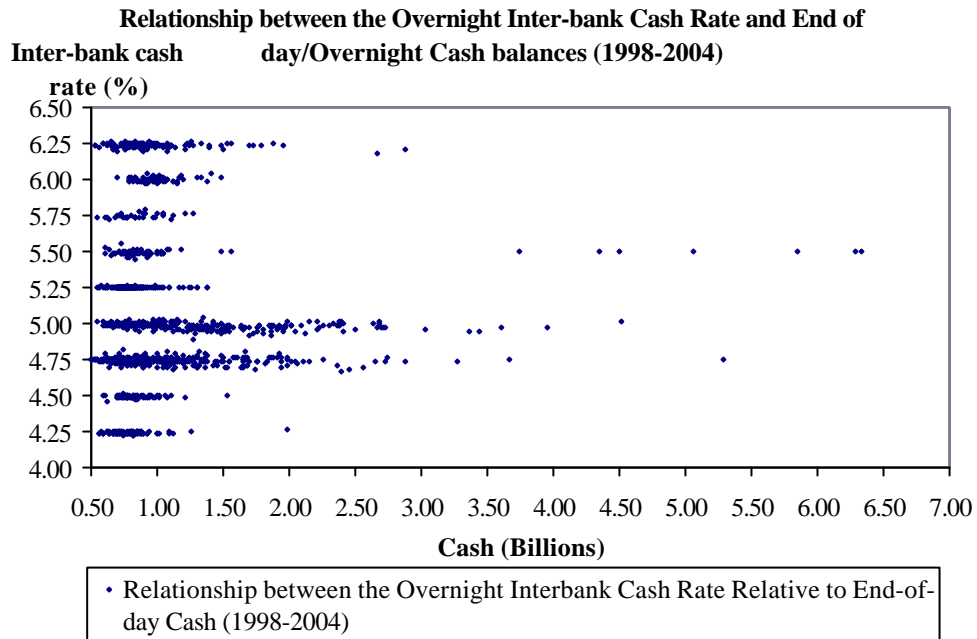
While open market operations are needed to maintain the actual cash rate near the target, they [open market operations] are not needed to ‘move’ the actual cash rate. The expectation that the Reserve bank will ensure that the cash rate is at the target is enough for the rate to shift immediately upon the announcement of a new target. By linking the interest rate paid on exchange settlement balances to the target cash rate, the effective cost of holding these balances does not change with changes in monetary policy. Reflecting this, there is no evidence of a relationship between the level of ES balances and the level of the target cash rate (p. 2)

At present, the Reserve Bank pays 25 basis points below the official inter-bank cash rate target on end of day cash balances. Likewise, the Reserve Bank is prepared to lend cash on demand at 25 basis points above the official cash rate target. Therefore, a commercial bank’s opportunity cost on surplus end of day cash balances is a constant relative to movements in the official inter-bank cash rate target. The operating procedures associated with movements to the official inter-bank cash rate are examined in detail within chapter three.

#### **2.6.4.1 Time series data: overnight/end-of-day cash balances and the inter-bank cash rate**

An examination of the daily end of day cash balances plotted against the official inter-bank cash rate for the period beginning mid 1998 to 2004 is provided in Figure 2.4. Figure 2.4 indicates that the banking system is prepared to demand small and roughly constant quantities of end of day cash balances irrespective of the official inter-bank cash rate. Not only are end of day cash balances interest rate inelastic, as represented by the nine movements in the official inter-bank cash rate over the seven year period, but the functionality of end of day cash balances as a source for final settlement obligations has been significantly reduced.

Figure 2.4



Source 3: Reserve Bank of Australia

Three explanations exist for the declining functionality of end of day cash balances within the settlement process. First, OMO are conducted for same-day settlement to offset, exact, deviations to the end of day cash balance. Secondly, a well functioning inter-bank RTGS system, and inter-bank cash market, ensures commercial banks can borrow or lend large quantities of cash between themselves, and thus avoid the need to demand large end of day cash balances with the Reserve Bank. Finally, the interest rate paid on end of day balances is 25 basis points below the official target rate, representing a constant opportunity cost on any surplus cash.

## 2.7 Instruments of OMO

OMO are primarily implemented under repurchase agreements via public and private sector securities, and outright transactions in public sector securities. Repurchase agreements reduce credit risk among borrowers and lenders of

cash as the transaction is secured using high quality security. Depending on the opening system cash position and/or a change in the demand for end of day cash balances, the Reserve Bank will borrow, lend or remain neutral. Repurchase agreements are bipedal transactions. On the first leg the Reserve bank adds or withdraws system-wide cash and on the second leg the first leg is repaid with interest. Campbell (1998b) explains

Repos involve a holder of securities selling them [for cash], and simultaneously agreeing to repurchase them at a fixed price on a fixed date in the future. Repos are extremely flexible instruments for managing liquidity because their terms can be tailored to suit particular circumstances. Securities of all maturities can be used as collateral in the transaction. So, even long-term bonds can be used to generate short-term liquidity without the holders permanently giving up ownership of their asset (p. 4).

When the Reserve Bank buys or sells securities it pays for them by credits or debits to the ES account of the buyers or sellers commercial bank account. Figure 2.5 examines the significant increase in the use of repurchase agreements in recent years. Between the second half of 1996 to 2004, repurchase agreements have averaged 320 billion dollars or 96% of the total domestic turnover in OMO. Purchases alone peaked in 2001-2002 to exceed 400 billion dollars or some 96% of the total domestic operations. The composition of the Reserve Bank's outstanding stock of repurchase agreements is also interesting. Figure 2.6 examines the composition of the Reserve Bank's outstanding repurchase agreements from 1996 to 2004.

According to the Reserve Bank (2004), prior to 1997, repurchase agreements were conducted solely in CGS. Within the past seven years, the list of eligible open market securities expanded, considerably, to incorporate a range of public and private sector securities. In 1997, semi-government securities [SGS] issued by State and Territory governments were added to the list of eligible securities. The list was further expanded in 2000 and 2001 to include certain AAA-rated supranational securities [SS] and Australian dollar

denominated securities issued offshore by the State and Territory governments, respectively.

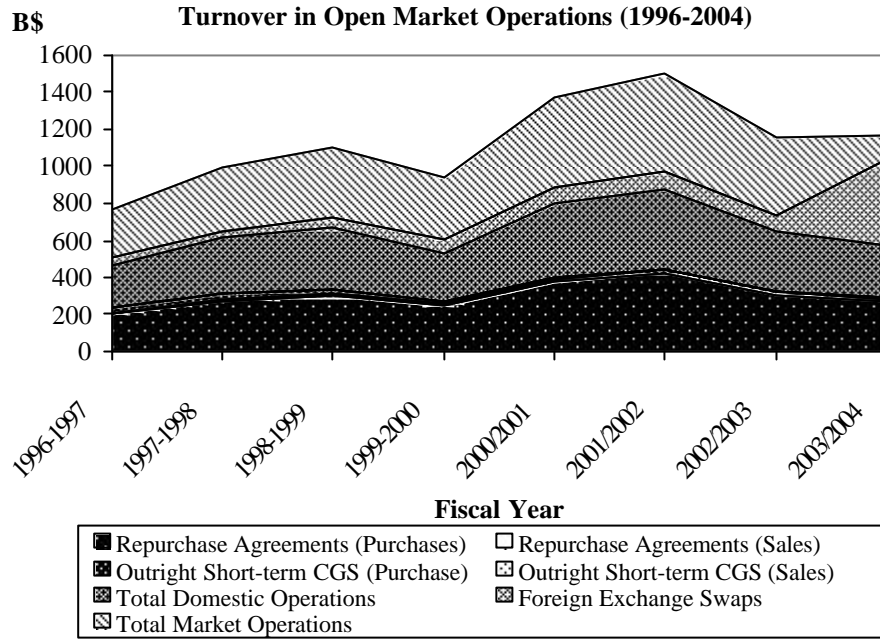
As recently as 2004, the Reserve Bank once again extended the list of eligible open market securities to include private sector financial instruments such as Bank Accepted Bills [BAB] and Negotiable Certificates of Deposit [NCD]. High daily turnover in the over-the-counter [OTC] market, particularly under repurchase agreements, strengthens the Reserve Bank's ability to conduct OMO and thus maintain stability in the official inter-bank cash rate.

Accordingly, the Reserve Bank can purchase or sell securities, in varying quantities, as it pleases and, if necessary, domestic operations can be supplemented with foreign exchange swaps. OMO thus accommodates the demand for system-wide cash and hence stability in the official inter-bank cash rate. As long as this is achieved, the type of securities used to achieve this outcome becomes a secondary consideration. Battellino (1990) comments on this critical aspect to OMO:

From a technical point of view it does not matter what securities the bank deals in, so any change in the securities used would not reduce the effectiveness of the [Reserve] Bank's operations. There are many overseas central banks which do not deal in securities issued by their central governments, but deal in a wide range of private sector securities (p. 44).

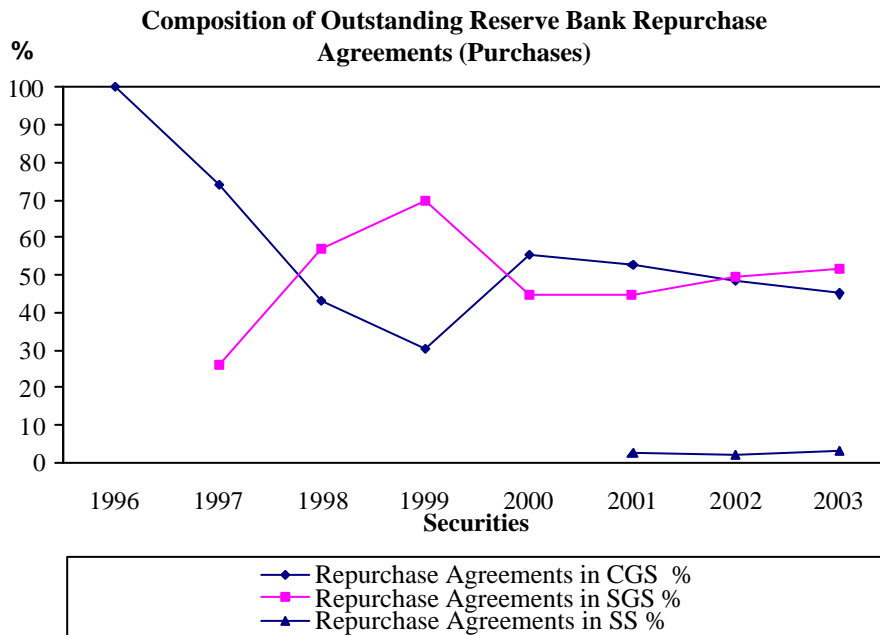
An endogenous money supply where both public and private institutions issue liabilities to the financial markets broadens the range, depth, and effectiveness of its own operations in maintaining stability in the official short-term inter-bank cash rate.

Figure 2.5



Source 4 Reserve Bank (2001a, 2002b, 2003a)

Figure 2.6



Source 5: Reserve Bank of Australian (2003)

### **2.7.1 Short-term repurchase interest rates and maturities**

The Reserve bank is also prepared to deal in range of maturities and interest rates with repurchase agreements. A negative system cash position entails maturities of less than thirty days to maturity, while a positive system cash positions normally entails one month maturities. Terms can be chosen to offset future volatility in the system cash position; buying thirty day securities today to mature in thirty days when the system cash position is expected to be positive. In mid 2002, longer term maturities of ninety and one-hundred-and-eighty day maturities were selected. The Reserve bank does not only accept its preferred terms but accesses all bids and offers for cash relative to the market interest rates in financial markets, risk, and maturities in their dealings..

### **2.7.2 Repurchase agreement methods and calculations**

Carew (1998) describes the dealing process at the Reserve Bank. When lending cash to the market, buying securities, under repurchase agreement the Reserve Bank sorts bids for cash in descending order of yield or interest rate. As a lender of cash in the broad cash market, the Reserve bank wishes to obtain the highest yield possible. When buying cash from the market, selling securities, under repurchase agreements, the Reserve Bank wishes to pay the lowest interest rate possible. Examples are provided on the buying and selling of cash under repurchase agreement. These examples use hypothetical notional values in terms of the repurchase dollar amounts however, the actual interest rates, maturities, and the system cash position values are the actual values on the day in question.

### 2.7.2.1 Buying securities or lending cash under repurchase agreement

On the 7<sup>th</sup> October 2003, the opening system cash position was negative to the value of \$806 million. The Reserve bank injected \$870 million in cash through repurchase agreements using CGS and SGS as security. The weighted average term and repurchase interest rate were 4 days to maturity and 4.76%, respectively. The minimum parcel when lending cash under repurchase agreement is \$20 million. The Reserve bank would contract to buy a security with a face-value of \$100 million that will mature on the 6<sup>th</sup> March 2005. The current market interest rate is 4.78% and the inter-bank cash rate is currently 4.75%.<sup>19</sup> The Reserve bank will lend cash, on the first leg, equal to:

$$T = \frac{100,000,000}{\left(1 + 0.0478 \times \frac{547}{365}\right) \times 1.02} = \$91,485,682.67 \quad (2.4)$$

The face value of the security is discounted using the prevailing market yield-to-maturity with an additional 2% discount as security to the Reserve Bank. On the 11<sup>th</sup> of October 2003 the repurchase agreement matures and cash is repaid to the Reserve bank, in the second leg, equal to:

$$\begin{aligned} T + 4 &= \$91,485,682.67 + \left( \$91,485,682.67 \times \left( \frac{0.0476}{365} \times 4 \right) \right) \\ &= \$91,533,405.61 \end{aligned} \quad (2.5)$$

The second leg, or unwind consideration, is equal to the first leg [\$91,485,682.67] plus four days interest [\$47,722.94] payable to the Reserve bank.

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<sup>19</sup> The values, terms and repurchase interest rates are the actual values for that day. Note: I have used a notional 100 million dollars as typical value, a weighted average interest rate which is very close the bid rates in the market. Moreover the term of the security is purely fictional for discounting purposes.

### 2.7.2.2 Selling securities or borrowing cash under repurchase agreement

On the 27<sup>th</sup> November 2003, the system cash position was positive to the value of \$711 million. The Reserve bank withdraw \$700 million in cash under repurchase agreements using CGS as collateral. The weighted average term and repurchase interest rate was 26 days to maturity and 5.06% respectively. The Reserve Bank would contract to sell CGS with a face value of \$100 million and a maturity date of the 1<sup>st</sup> January 2010. The current market interest rate on CGS for 2010 delivery is 5.5% and the inter-bank cash rate is currently 5.00%. The Reserve bank will borrow cash, on the first leg, equal to:

$$T = \frac{100,000,000}{\left(1 + 0.055 \times \frac{2227}{365}\right)} = \$15,535,319.44 \quad (2.6)$$

The face value of the security is discounted using the prevailing market yield-to-maturity. On the 22<sup>nd</sup> of December 2003, the repurchase agreement matures and cash is repaid to financial markets, in the second leg, equal to:

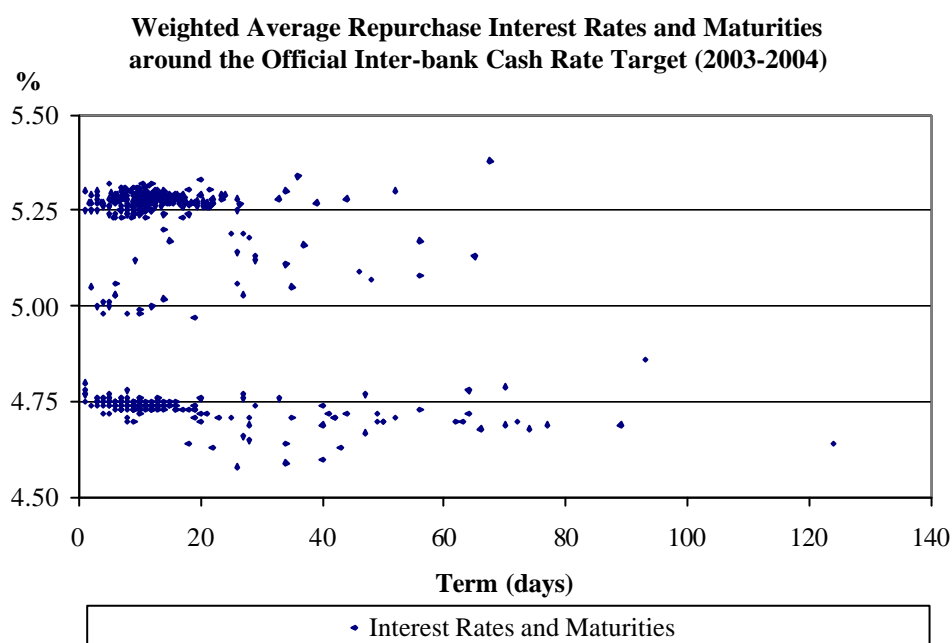
$$\begin{aligned} T+4 &= \$15,535,319.44 + \left( \$15,535,319.44 \times \left( \frac{0.0506}{365} \times 26 \right) \right) \\ &= \$15,591,314.69 \end{aligned} \quad (2.7)$$

The second leg, or unwind consideration, is equal to the first leg [\$15,535,319.44] plus four days interest [\$55,995.25] payable to the financial markets. The actual weighted average repurchase interest rates are currently published by the Reserve Bank. The data provides an excellent insight into the interest rates paid and received by participants, both bank, NBFIs, and potentially any large non-bank corporation, in the daily OMO process.

### 2.7.2.3 Time Series data: weighted-average repurchase cash rates<sup>20</sup>

A sample of the data observations for the weighted average interest rates and terms is provided in Figure 2.7. Data observations indicate that commercial banks and NBFIs borrow and lend funds, with the Reserve Bank, around the announced official inter-bank cash rate target.

Figure 2.7



Source 6: The Reserve Bank of Australia

Evidently, the short term interest rates under repurchase agreements deviate around the official inter-bank cash rate target, as they do in the broader cash market, but generally spreads are within five to ten basis points either side of the official inter-bank cash rate target.

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<sup>20</sup> Where there has been more than one weighted average interest rate and terms associated with different securities and risk, such as CGS and NCD, the average is taken of the two for a given day's dealings.

Principally, the daily supply and demand for funds during the Reserve Bank's OMO will strongly affect the interest rates paid and received by commercial banks, NBFIs, and generally any large corporation that could in principle participate in the Reserve Bank's OMO. Interest rates beyond one-day are determined by the expected future movements in the Reserve Bank's official short-term inter-bank cash rate

Moreover, the objectives of the Reserve Bank and participants are completely different. Participants borrow or lend money market funds to support their own activities, while the Reserve Bank requires enough participation to offset the opening system cash position of the banking system; fully accommodating the demand for system-wide cash and, therefore, maintaining stability in the inter-bank cash rate. Depth in the market for overnight and short-term funds is critical for the success of OMO. The Reserve Bank (1993) thinks of these two aspects as adding depth to the daily cash market while simultaneously assisting the Reserve Bank in maintaining stability in the official short-term inter-bank cash rate:

...the resulting day-to-day flows of liquidity to and from the money market [and, more importantly, among participants in the market] assist the Bank in using its OMOs to influence monetary conditions. These flows underpin the demand for money market cash. This is important as the Bank needs a large and stable demand for money market cash at all times... (p. 5)

## **2.8 Concluding Remarks**

Chapter two examined, from a technical perspective, the role of OMO in stabilising short-term interest rates and the endogeneity of system-wide ES liquidity to the banking system. Findings presented provide a significant technical understanding behind the Reserve Bank's operating procedures pre-

AMMDs and post AMMDs, respectively. Accordingly, while there are many interesting insights examined, the main findings are reiterated.

The supply of system-wide liquidity is actually demand determined, fully accommodating the banking system's demand for system-wide liquidity: the sum of the demand for end of day cash balances plus the demand to settle obligations with the Reserve Bank. OMO fully accommodates the demand for liquidity in order to maintain stability in short-term interest rates and the solvency of the banking system. Thus, the supply of system-wide liquidity is endogenous to the banking system. As a monopoly supplier of system-wide liquidity, the Reserve Bank can actively manage ES accounts in order to accommodate the demand for system-wide liquidity. Otherwise the banking system will find itself either with an excess or shortage of system-wide liquidity to which the banking system cannot, in aggregate, alleviate.

Continually, the quantity of liquidity within the banking system is not the object of monetary policy. Rather, the quantity of end of day liquidity is demand determined and the banking system can demand zero non-negative liquidity balances with the Reserve Bank. Interestingly, the quantity of end of day liquidity is interest inelastic with respect to the official short-term inter-bank cash rate. Rather, the small quantities of liquidity demanded are regarded as a liquidity preference decision, determined by the banking system, irrespective of the official short-term inter-bank cash rate.

A well functioning inter-bank cash market serves to redistribute large quantities of cash reducing the need to demand any significant end of day liquidity balances in their ES account. Moreover, the Reserve Bank pays 25 basis points either side of the official inter-bank cash rate target which, effectively, caps the cost of funds in the banking system. A pre-determined interest rate band not only maintains the opportunity cost on the banking

system's liquidity position, and the certainty of borrowing from the Reserve Bank when in need, but, as chapter three examines, it acts to move the official short term inter-bank cash rate even when commercial banks' demand negligible or zero end of day liquidity balances.

Finally, the broader cash market/money market is not occupied solely by the banking system. NBFIs are actively borrowing funds, and adding depth to the market for borrowed funds. The prospect of borrowing or obtaining finance using market instruments at market interest rates, as opposed to obtaining funds directly through a commercial bank facility, minimises the cost of funds to the borrower. Thus, the banking system does not have a monopoly in the money market. NBFIs, and, for that matter, larger non-bank corporations, can arrange finance by, as chapter three will examine, using the same payment and settlement systems as operated by commercial banks.

The broader money markets can arrange additional finance within the banking system, but it can only serve to redistribute liquidity as inter-bank RTGS transactions are initiated. Accordingly, the instruments of OMO are open in the sense that both bank and non-banks can actively participate. While the market in repurchase agreements is larger than required for OMO, the Reserve Bank does require an active, and deep, market in repurchase agreements, across a range of instruments, if it is to accommodate changes to the system-wide demand and supply of liquidity, as reflected by the system cash position.

Apart from these findings, Chapter two provided perspective, and clarity between theoretical interpretations associated with an exogenous money supply and the practical realities of the endogeneity of liquidity under an interest rate target regime. Finally, Chapter two provides a holistic approach to understand the operating procedures and institutional settlement framework into the implementation of monetary policy within Australia.

## CHAPTER THREE

# **The role of interest rate bands in moving short-term interest rates, the payment and settlement system architecture, and the endogeneity of exchange settlement liquidity in a RTGS system<sup>21</sup>**

### **3.1 Introduction**

Chapter two examined, with the support of time series data, the operating procedures involved in fully accommodating the demand for system-wide cash to the banking system, i.e., accommodating the aggregate banking system's demand for liquidity. Accommodating the system-wide demand for liquidity through OMO, irrespective of the quantity of end of day cash balances demanded by the banking system, maintains stability in the Reserve Bank's official short-term inter-bank cash rate. Chapter three contributes to the examination of operating procedures, with the support additional time series data, and the institutional settlement framework in which monetary policy is implemented. The endogeneity of intra-day and overnight cash<sup>22</sup> borrowings during Australia's inter-bank RTGS day is also examined. The operating procedures employment to influence, and set directly, the level of short-term interest rates during the inter-bank RTGS day are critical components to understanding how a cost of funds is set within the banking system.

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<sup>21</sup> Note: The author acknowledges the Reserve Bank of Australia for their ongoing assistance in providing current and historical time series data. Conversations with of Mr James Whitelaw- domestic markets department- have been appreciated; including provision of detailed papers on the RITS/RTGS system architecture. Information presented in this chapter are the views of the author and do not necessarily represent the views and position of the Reserve Bank of Australia.

<sup>22</sup> Again, liquidity or ES funds is a flow while the money base represents a stock. For example, intra-day liquidity accommodates the demand for inter-bank RTGS payments allowing an injection and withdrawal of liquidity only while the RTGS system is open. Its value is not represented in the money base statistic published by the Reserve Bank.

The Reserve bank implements a change in monetary policy by adjusting its target for the short-term inter-bank cash rate. Again, the Reserve Bank is able to achieve this outcome, not by manipulating the supply of cash but rather, by adjustments to pre-determined interest rate bands applied to commercial banks'<sup>23</sup> ES accounts. The Reserve Bank (2003b) comments on this arrangement:

The Reserve Bank pays interest on balances held in ES accounts at a rate 25 basis points below the target for the cash rate. It is also prepared to provide liquidity [on request] to ES account holders on an overnight secured basis at 25 basis points above the target for the cash rate. These arrangements mean that the cash rate should remain within a range of 25 basis points either side of the target rate except in the most extreme circumstances (p. 2).

Commercial banks will usually transact inter-bank on an overnight and unsecured basis, not to necessarily, borrow funds for final inter-bank RTGS obligations but rather, to re-balance their ES account relative to the options available within the settlement process itself; as reflected by the current pre-determined interest rate band. The application of a pre-determined interest rate band provides a maximum opportunity cost on commercial banks' ES account position during the inter-bank RTGS day, and hence, a mutual incentive to minimise this opportunity cost within the inter-bank cash market.

An inter-bank cash market is simply a market that maximises returns and minimises cost respectively, i.e., as opposed to leaving surplus cash in ES accounts overnight, as end of day cash balances, at 25 basis points below the official inter-bank cash rate target, and, respectively borrowing from the Reserve Bank, at a penalty interest rate, at 25 basis points above the target for the official inter-bank cash rate.

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<sup>23</sup> Commercial banks refer to individual banks with an ES account with the Reserve Bank. Unlike the term "banking system", in chapter two, which refers to the aggregate demand or system-wide cash – sum of demands for overnight cash balances and the demand for settlement obligations between the banking system and the Reserve Bank - the term commercial banks' refer to individual banks' and their settlement obligations among each other i.e., inter-bank.

As examined within chapter two, the banking system ends the day with approximately the same quantity of end of day cash balances in their ES account; a tiny and insignificant quantity of 750 million dollars in aggregate. However, inter-bank RTGS transactions have averaged between 120 to 150 billion dollars a day, with many intra-day inter-bank settlement obligations reaching over a billion dollars each.

With such large inter-bank RTGS transactions, and a minimal demand for end of day cash balances, how do commercial banks meet their intra-day inter-bank RTGS exposure, without precipitating pressure on the short-term inter-bank cash rate? In avoiding volatility in the short-term inter-bank cash rate, and to ensure smooth functionality of settlement within the RTGS system, the Reserve Bank fully accommodates the demand for cash through the use of an intra-day and an overnight repurchase facility. Again, it is crucial to reinforce the general theme to this paper highlighted by Campbell (1998b), cited in chapter three, and Rankin (1995) who explicitly reinforced the notion that the quantity of cash is not the objective of monetary policy:

It is common for textbooks to explain the effect of central bank market operations in terms of their impact on the amount [quantity] of liquid funds [cash] in the banking system. These funds, which are sometimes called 'base money' or by a similar term, are assumed to underpin the money supply process and hence act as a linchpin in the transmission mechanism. It is important to recognise that the transmission mechanism for monetary policy in Australia does not conform to this model. It is true that the Reserve Bank's market operations affect the supply of liquid funds to the banking system, but it is not the amount of funds itself which is of interest to the bank. What the Reserve Bank is interested in is the excess supply or demand for these funds, because that is what determines the level of [the inter-bank] cash rate (p. 35)<sup>24</sup>

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<sup>24</sup> Note: Rankin refers to the plural cash rates when there existed an official and unofficial cash rate. Since the disbandment of the official AMMDs and the introduction of RTGS, the cash rate is the official inter-bank cash rate. Refer to chapter three for a detailed discussion.

The endogeneity of cash is not more apparent than with respect to the intra-day cash facilities. Intra-day cash facilities permit commercial banks to substitute cash for market instruments in order to settle inter-bank RTGS obligations and to unwind these transactions before the inter-bank RTGS day closes. Effectively, the quantity of cash to a commercial bank, and ultimately within the banking system, balloons to accommodate inter-bank RTGS obligations. Commercial banks access intra-day cash through the use of intra-day repurchase agreements with the Reserve Bank, which is provided free of charge. Intra-day repurchase agreements can be entered into, and reversed, at any time during the inter-bank RTGS day. As with OMO, the Reserve Bank can ensure the banking system as a whole can access cash, on demand, but cannot, and does not, ensure that cash is evenly distributed as a result of inter-bank RTGS transactions.

The inter-bank cash market plays a critical role in redistributing cash. As the RTGS day progresses, commercial banks will find their ES account gravitates towards a surplus or deficit position, i.e., above or below the quantity of cash required to reverse intra-day repurchase agreements with the Reserve Bank. While the Reserve Bank will not restrict cash as a final resort, the pre-determined interest rate band provides an incentive for commercial banks to transact in the inter-bank cash market. A commercial bank facing a surplus cash position in their ES account has the option of leaving cash in their ES account, as end of day cash balances, at 25 basis points below the target inter-bank cash rate or lending cash inter-bank, thus receiving the additional 25 basis points. Ditto, a commercial bank facing a deficit position in their ES account has the option of borrowing overnight cash from the Reserve Bank, through an overnight repurchase agreement, at 25 basis points above the target for the inter-bank cash rate or, alternatively, borrowing in the inter-bank cash market and minimising the cost of settlement funds by 25 basis points.

Chapter three examines the role of the Reserve Bank's pre-determined interest rate band in moving the official short-term inter-bank cash rate, since the inter-bank RTGS system was introduced formally on the 22<sup>nd</sup> June 1998 through to the 31<sup>st</sup> December 2004. An appreciable characteristic of the inter-bank RTGS day is an understanding of the functionality of the payment and settlement systems, and the workings of intra-day and overnight repurchase agreements in fully accommodating the demand for inter-bank RTGS transactions. Again, chapter three provides a technical account of the endogeneity of cash during the RTGS day. To achieve this end, a statistical examination is undertaken to encapsulate the central theme of chapter three while further providing the imperative institutional settlement framework of the Australian financial markets.

### **3.2 The inter-bank RTGS system**

RTGS is a major revolution in the Australian inter-bank settlement process. According to the Reserve Bank (1999), the chief aim of a RTGS was to reduce inter-bank settlement risk among commercial banks resulting from their large-value multilateral net deferred settlement exposures. However, the bank for International Settlement [BIS] (1997) provides a more evolutionary account into RTGS, as:

...A gross settlement system in which both processing and final settlement of funds transfer instructions can take place continuously (that is, in real time). As it is a gross settlement system, transfers are settled individually, that is without netting debits against credits. As it is a real time settlement system, the system effects final settlement continuously rather than periodically at pre-specified times provided that a sending bank has sufficient covering balances or credit. Moreover, this settlement process is based on the real time transfer of central bank money. An RTGS system can thus be characterised as a funds transfer system that is able to provide continuous intraday finality for individual transfers (p. 18)

Large value, time critical or otherwise any potential inter-bank payment are settled continuously, and individually, inter-bank as the instruction is received by commercial banks, making any payment final and irrevocable once settlement is complete. Payment obligations, generated by commercial banks and their non-bank clients, are settled in the inter-bank RTGS system. Inter-bank RTGS transactions are performed in the Reserve Bank Information and Transfer system [RITS]: which acts as Australia's RTGS system.

### **3.2.1 RITS/RTGS system architecture**

RITS is Australia's RTGS. RITS was established by the Reserve Bank in 1991 as an electronic depository and settlement system for CGS. As of 22<sup>nd</sup> June 1998, RITS was updated to perform inter-bank RTGS transactions initiated within the key payment systems apparatus<sup>25</sup>. RITS/RTGS provides finality in the payment system by ensuring that any high value or time critical inter-bank settlement obligation is settled as the individual payment instruction is initiated, i.e., in gross value terms (Reserve Bank of Australia 2002c).

RITS provides full automation of all inter-bank RTGS transactions as payment instructions are initiated by commercial banks, and their non-bank clients, through the payment system. Both commercial banks and non-bank members, of these various payment systems, can initiate payment instructions for inter-bank RTGS throughout the day.

However, regardless of who a payment instruction is initiated by, i.e., payments initiated by a commercial bank or a non-bank client, it requires a

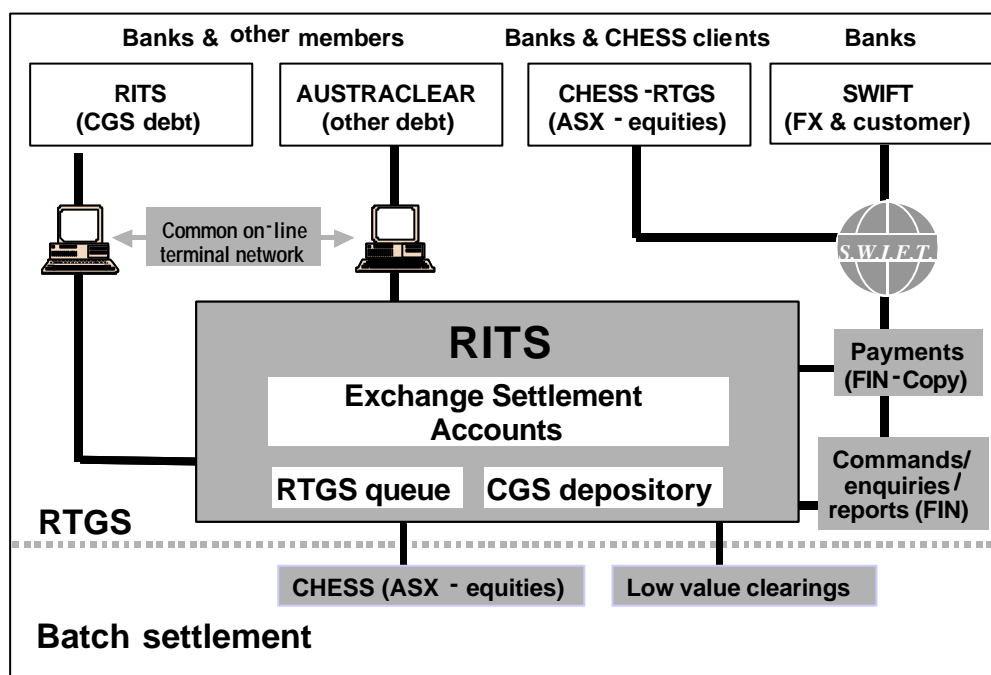
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<sup>25</sup> Note: Payment system refers to an electronic payment instruction system and not necessarily a settlement system. Like cheques, an electronic payment instruction directs commercial banks – i.e. those with ES accounts – to settle the obligation with cash where an inter-bank obligation is created. Those payment instructions that do not generate an inter-bank settlement obligation – i.e. where there is an intra-bank payment with the one bank – will not generate the need to settle in cash as no inter-bank settlement obligation is generated.

commercial bank to have sufficient cash in its ES account to settle any inter-bank RTGS obligation. RTGS processes instructions initiated by four payment systems. Payment instructions initiated using RITS itself, the Austraclear system, the Society for Worldwide Inter-bank Financial Telecommunications [SWIFT], and the Clearing House Electronic Sub-registry System [CHES]. Figure 3.1 highlights these four payment systems and how they are processed by RITS for inter-bank RTGS across commercial banks' ES accounts

Figure 3.1

RITS/RTGS System Architecture



Source: Reserve Bank of Australia

### 3.2.1.1 RITS

In addition to its role as Australia's RTGS system for inter-bank settlement obligations, commercial banks and non-bank members of RITS can, also, perform two-sided or matched cash payment instructions between themselves using a common on-line terminal network. Payment instructions generated in

RITS are initiated by one member and confirmed by the receiving member before inter-bank RTGS is completed. Non-bank members of RITS maintain a nominated bank account/s with their participating commercial bank. Commercial banks then settle payment instructions generated, by the non-bank member in RITS, automatically and continuously for inter-bank RTGS. Cash transfers, OMO, and all tender bidding for new issues of CGS takes place in RITS. Currently, there exist over 250 members, including 52 commercial banks. Payment instructions generated in RITS, itself, account for approximately 12% of the total inter-bank RTGS transactions.

### **3.2.1.2 Austraclear**

Austraclear is owned by the Sydney Futures Exchange [SFE] corporation and was established in 1984. As with RITS, Austraclear members include commercial banks and non-bank members that initiate two-sided or matched payment instructions between each other (Bank for International Settlements 1994). Many debt securities including CGS are registered electronically and traded actively in Austraclear through FINTRACS: an electronic registry and payment system owned by Austraclear Limited. Austraclear payment instructions feed into RITS for RTGS. Non-bank members of Austraclear maintain nominated bank account/s with their participating commercial bank who then settle the payment instruction generated, by their non-bank member in RITS, automatically and continuously for inter-bank RTGS. Payment instructions are initiated in Austraclear for open market repurchase agreements and new tender issues of CGS.

According to the SFE Austraclear (1994), Austraclear:

... currently services over 650 participants, holds over A\$500 billion worth of securities and via a real time link to the RBA's RTGS system

settles on average more than A\$30 billion of transactions on a daily basis (p. 1).

Of the 650 participants, 52 are commercial banks. Moreover, the 30 billion dollars in payment instructions, generated within Austraclear, account for approximately 22% of the total inter-bank RTGS transactions.

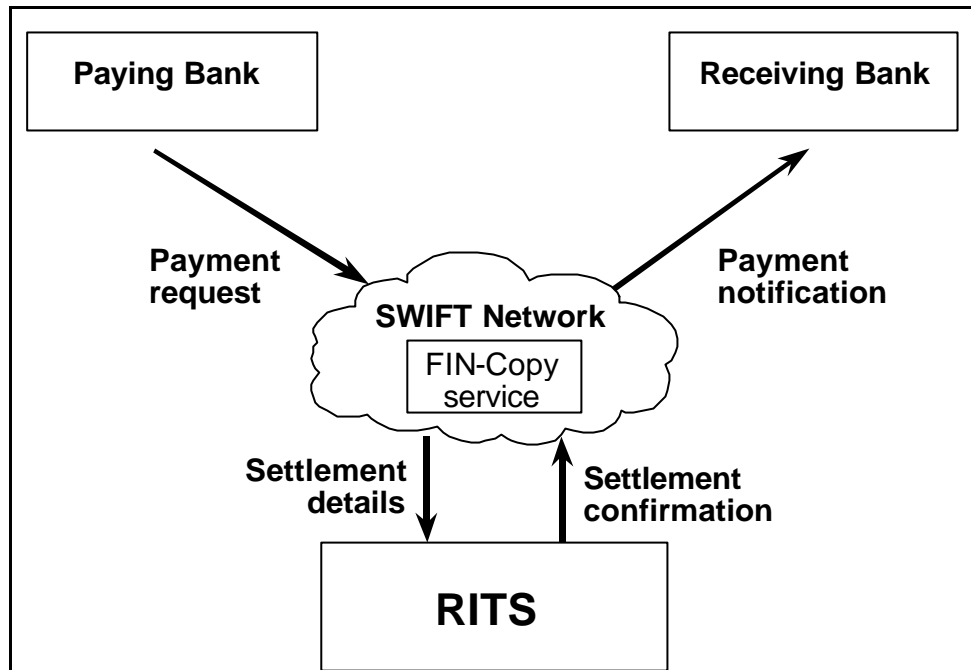
### **3.2.1.3 SWIFT**

SWIFT payment delivery system [PDS] was established in August 1997 and is based on SWIFT's FIN-Copy service. Figure 3.2 highlights the procedures involved in a SWIFT payment instruction. SWIFT PDS payment instructions are initiated using a SWIFT computer network that passes payment instructions to RITS for inter-bank RTGS. SWIFT PDS carries large-value one-sided payments predominantly relating to the Australian dollar leg of foreign exchange for Australian institutions, correspondent banks, and for non-bank clients. Non-banks instruct their commercial bank to initiate or receive SWIFT message instructions on their behalf. According to the BIS (1999), most SWIFT payments are under 50 thousand dollars, however aggregate SWIFT payments account for over 61% of the total inter-bank RTGS transactions.

### **3.2.1.4 CHESSE**

CHESSE was established by the Australian Stock Exchange [ASX]. CHESSE maintains a, continuously updated, electronic sub-register system of stock ownership and is used by commercial banks and non-banks. CHESSE payment instructions can be sent to RITS for inter-bank RTGS via SWIFT's FIN-Copy service.

**Figure 3.2**  
**SWIFT payment flows and RITS/RTGS**



Source: Reserve Bank of Australia

### **3.2.2 Multilateral net-deferred settlement obligations**

Apart from inter-bank RTGS transactions, commercial banks must also settle their inter-bank multilateral net deferred obligations. Two common batch settlements arise each day; low value inter-bank obligations and; inter-bank CHES transactions. Low value inter-bank obligations arising from cheques, credit and debit cards, and bulk electronic payments are settled on a multilaterally netted batch basis. Commercial Banks can view their deferred net obligation due for settlement, and the composition of these obligations, in RITS. RITS then performs inter-bank settlement, where commercial banks have sufficient cash, by simply updating their ES account position in real time as settlement is complete.

RITS also provides a facility for settling inter-bank obligations generated in CHESSE. Commercial banks, approved by the ASX, settle net payment obligations accumulated by themselves and their non-bank clients in CHESSE with a central party, known as the CHESSE Bank, in RITS. Inter-bank settlement occurs by one multilateral net batch of RITS cash transfers. As with inter-bank RTGS transactions, batch inter-bank settlements are irrevocable once settlement is complete.

### **3.2.3 Management of inter-bank RTGS transactions**

All payment instructions initiated through RITS and all feeder systems that involve inter-bank RTGS are recorded on the System Queue and are subject to a series of tests which need to be passed before inter-bank RTGS transactions are settled, this is known as the RITS System Queue.

#### **3.2.3.1 RITS System Queue**

The System Queue is the name for the process in the RITS central system which records, tests and settles inter-bank RTGS transactions. Payment instructions are tested in the order in which they are recorded on the System Queue. Payment instructions which pass all tests are settled while payment instructions that fail testing remain on the System Queue for retesting later during RTGS day. The System Queue attempts to settle previously unsettled inter-bank RTGS transactions through, what is known as, the “next down looping” (Reserve Bank of Australia 2002c p. 6) process. Key features of the System Queue tests are: 1. Do both the non-bank client and the commercial bank wish for inter-bank RTGS to proceed; 2. does the non-bank client have enough available funds or bank approved credit for settlement to proceed; 3.

does the commercial bank have enough cash for inter-bank RTGS? If the answer to 3 is no, and the payment instruction has been queued for more than 5 minutes, RITS will automatically offset inter-bank RTGS obligations, this is known, in RITS, as the Auto-offset facility.

#### **3.2.3.1.1 RITS Auto-Offset facility**

RITS automatically searches the System Queue for offsetting inter-bank RTGS obligation that have no deferred status and has been queued for five minutes or more following its first failed cash limit or cash sub-limit test, refer to section 3.2.4.2. If payment instructions can be offset and settled simultaneously, RITS automatically proceeds by posting the gross amounts of both payment instructions to each commercial bank's ES account. Up to 10 offsets can be selected throughout the day. Unsettled payment instructions are those payment instructions that have not been deleted or recalled and which did not settle by the end of the RTGS day. This will occur when payment instructions retain a deferred status or when it has not passed a limit test on the commercial bank's ES account or the non-bank client's nominated bank account. All unsettled transactions are removed from the System Queue following the close of the RTGS day.

#### **3.2.3.2 Prioritising payment instructions for inter-bank RTGS**

RITS/RTGS provides commercial banks with full management control of their own and their non-bank customer payments in RITS and Austraclear, from the time of the payment instruction through to completion of inter-bank RTGS. Commercial banks can set the settlement status for each individual payment or a generic settlement status for a department of a commercial bank or its non-

bank client. Every transaction on the System Queue has a status that determines how it is tested for inter-bank RTGS, three statuses exist. Payment instructions with a status of deferred are placed on the System Queue retaining its status but tested for inter-bank RTGS as the RTGS day progresses. An active status is the default status for all payment instructions. An active status allows payment instructions to be tested for inter-bank RTGS against funds available in a non-bank client's nominated bank account and the commercial banks' ES account; excluding any tranches reserved through sub-limits, refer to section 3.2.3.2.1. A priority status allows payment instructions to be tested against the full funds available in a non-bank client's nominated bank account and the commercial bank's ES account. Each payment instruction on the System Queue will have a credit status set by the paying non-bank client's commercial bank and an ES account status set by the commercial bank.

### **3.2.3.2.1 Sub-limits**

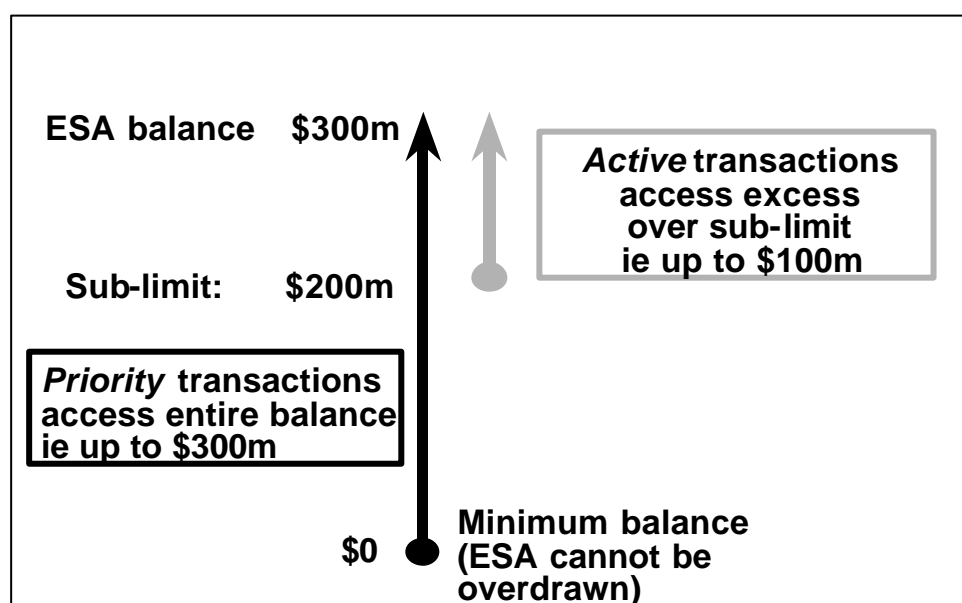
Commercial banks, as with non-bank members in RITS and Austraclear, can set sub-limits on their ES accounts. Figure 3.3 depicts how the sub-limit functions. Commercial banks reserve tranches of cash in their ES account for payment instructions to which the commercial bank has assigned a priority status. Cash surplus to the sub-limit will only settle an active payment instruction while priority payment instructions are tested against the entire amount of cash in a commercial bank's ES account.

### 3.2.4.2 Managing non-bank client credit status

In RITS and Austraclear, non-bank members initiate payment instructions throughout the RTGS day. Commercial banks can manage non-bank clients' nominated bank account/s by setting, in RITS or Austraclear, a function that enables commercial banks to review or change the limit parameters applied to their non-bank clients' nominated account.

Figure 3.3

Reserving Cash using an ES account Sub-Limit



Source: Reserve Bank of Australia

Debit limits enable commercial banks to have a known maximum daily exposure to non-bank clients. A debit limit of zero requires all purchases to be pre-funded by the non-bank client. Alternatively, commercial banks can settle non-bank clients' payment instructions manually. This allows a single credit limit to be used across RITS and Austraclear and potentially other commercial bank systems. RITS allows this to happen either manually via the commercial bank's RITS terminal or via commercial banks' internal Automated

Information Facility [AIF], where payment instructions are initiated via the SWIFT FIN network. Commercial banks elect for their non-bank clients' payment instructions to be placed on the System Queue with a status of deferred. A commercial bank will either monitor transactions via its RITS terminal, or may receive an AIF instruction with details of its client's payment instruction. Once the commercial bank is ready to settle the transaction, it instructs RITS, either via its RITS terminal or an AIF message, to change the status of the payment instruction to active or priority for the payment instruction to settle.<sup>26</sup> On any typical day, the distribution of intra-day inter-bank RTGS transactions, by value, are roughly symmetrical.

### **3.2.5 Intra-day distribution of RTGS transactions**

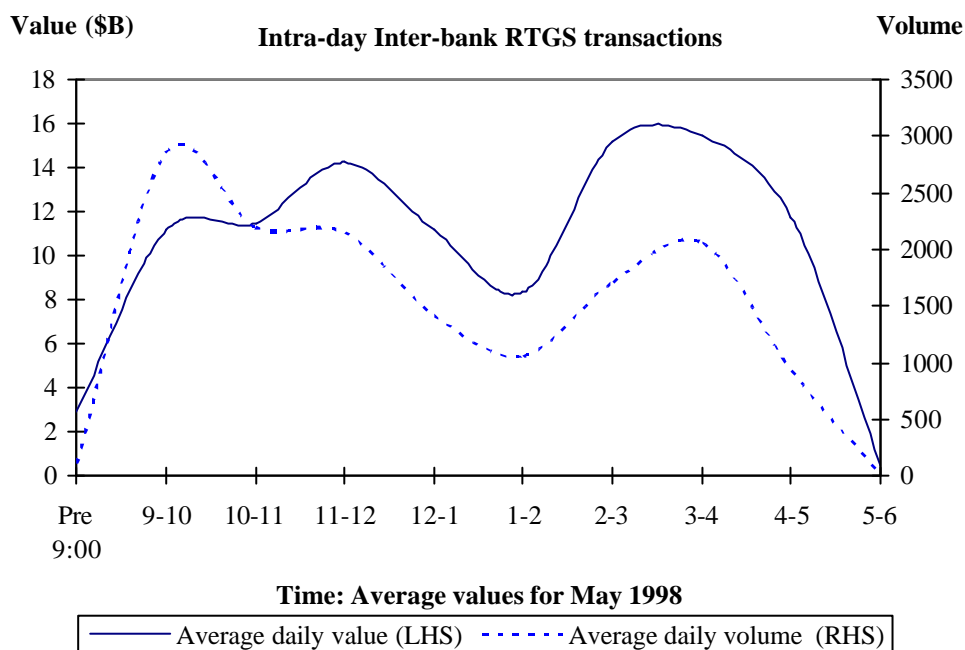
A sample of the data on intra-day inter-bank RTGS is provided for May 1998 in Figure 3.4. As the RTGS day progresses, the value of inter-bank RTGS transactions increase through to mid-morning, and then decreases late morning before peaking late afternoon. The volume or number of intra-day inter-bank RTGS transactions is roughly skewed to the right, peaking in early morning and, by late afternoon, tapering down as the RTGS day progresses. The disparagement between the distribution of intra-day values and intra-day volumes are because 60% of inter-bank RTGS transaction volumes had values less than \$1 million while, 4 percent of transaction volumes had values of more than \$100 million but accounted for 60% of the total value of inter-bank RTGS transactions (Campbell, F. 1998b). Before RTGS became fully

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<sup>26</sup> Commercial banks can manage their liquidity in the same way, using the ESA status on their payment instructions. A paying bank can allocate authority to set and alter statuses to separate areas of their organisation. For example, the credit control area of a commercial bank may independently set the credit status and Treasury may set the ESA status. The commands and enquiries available via the AIF are a subset of those that are available via RITS terminals. End of day statements are also available using the AIF

operational, the inter-bank RTGS system carried about 14,000 transactions, valued at over \$100 billion. In 2003-2004, the combined value of inter-bank RTGS transactions initiated in the RITS/Austraclear/SWIFT/CHESS payment systems have ranged from \$120 billion to \$150 billion per day.

**Figure 3.4**

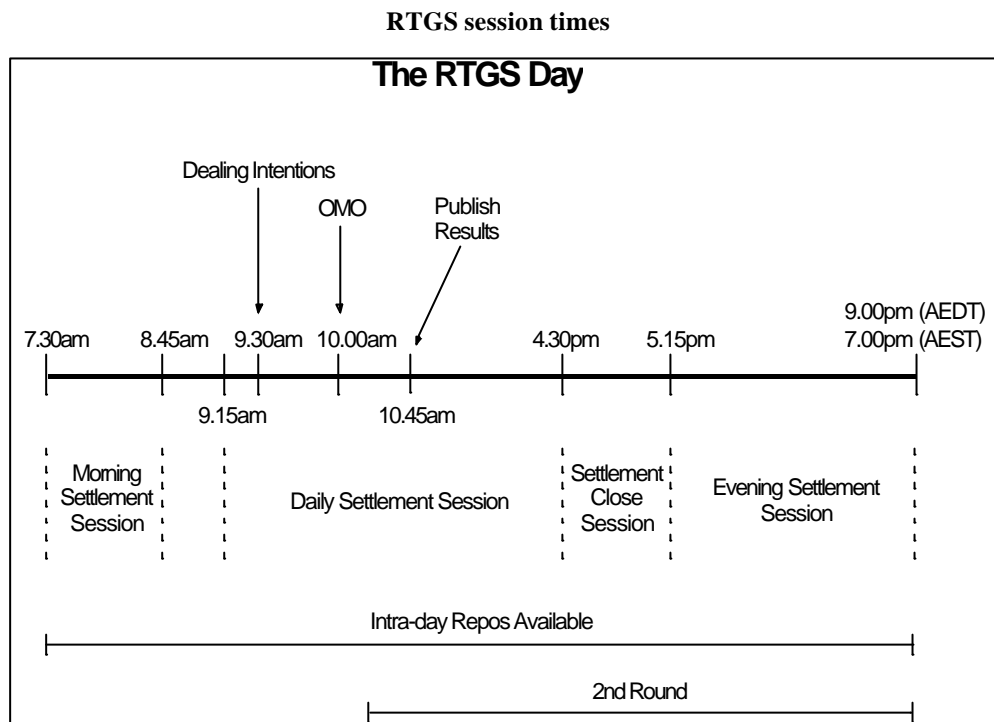


Source: Reserve Bank of Australia

### 3.2.6 The RTGS day: interbank session times and arrangements

The RTGS day describes the session times, and associated arrangements, for when the RITS central site settles payment instructions for inter-bank RTGS initiated through RITS/Austraclear/SWIFT/CHESS. Figure 3.5 illustrates session times and arrangements applicable during the inter-bank RTGS day. Presently, as shown, four inter-bank RTGS session times exist: morning settlement session; daily settlement session; settlement close session, and; the evening settlement session.

Figure 3.5



Source 7: Reserve Bank of Australia

### 3.2.6.1 Morning settlement session: 07:30 - 08:45

The morning settlement session is used by commercial banks only. From 7:30, commercial banks can view their multilateral net-deferred settlement obligations and the composition of those obligations in RITS. RITS/RTGS will only settle inter-bank RTGS transactions initiated by commercial banks in RITS/Austraclear, i.e., bank-to-bank RITS/Austraclear payment instructions only. Commercial banks can also use this time to obtain intra-day cash from the Reserve Bank for their expected multilateral net deferred inter-bank settlement obligations in RITS at 9:00am.

### **3.2.6.2 Batch Settlement: 8:45 - 09:15**

RITS/RTGS is temporarily suspended. During this time the Reserve Bank debits/credits commercial banks' ES account at 9am in one real-time batch settlement reflecting commercial banks' multilateral net inter-bank obligations to the system.

### **3.2.6.3 Daily Settlement: 9:15 – 16.30**

The daily settlement session is known as the main settlement session as RITS/RTGS settles both commercial bank and non-bank client payment instructions initiated in RITS and all three feeder systems, i.e., bank-to-bank, corporate-to-corporate, and bank-to-corporate initiated payment instructions via RITS/Austraclear/SWIFT/CHESS. Non bank clients initiate payment instructions for inter-bank RTGS up to the 4.30pm cut-off for non-bank clients. At 9.30am, the Reserve Bank announces whether it intends to buy or sell securities and in what quantities, as reflected by the opening system cash position. Bids and offers are made by commercial banks and non-bank clients at around 10.00am with results published around 10.45am. Settlements of open market purchases or sales occur throughout the inter-bank RTGS day. Commercial banks can also use this time to obtain intra-day cash from the Reserve Bank for inter-bank RTGS transactions.

### **3.2.6.4 Settlement close session: 16.30 – 17:15**

The settlement close session is used by commercial banks only. RITS/RTGS will only settle inter-bank RTGS obligations initiated by commercial banks in the RITS/Austraclear payment systems, i.e., bank-to-bank RITS/Austraclear

payment instructions only. RITS/RTGS will also continue to settle inter-bank RTGS obligations initiated, before the 4:30pm cut-off, in RITS/Austraclear by their non-bank clients.

### **3.2.6.5 Evening settlement session: 17:15 – 19:00 (21:00)**

The evening settlement session is used by evening agreed commercial banks that may continue to make inter-bank RTGS obligations initiated, before the 4:30pm cut-off, by their non-bank corporate clients. Evening agreed commercial banks also settle inter-bank RTGS foreign exchange transactions initiated in SWIFT PDS to the Continuous Linked Settlement Bank [CLS Bank]. Commercial banks that choose not to be evening agreed can still make inter-bank RTGS transactions in the RITS/Austraclear payment systems for liquidity management purposes. The SWIFT PDS day finishes at the end of the settlement close session for non-evening agreed commercial banks.

#### **3.2.6.5.1 Continuous linked settlement**

Continuous Linked Settlement [CLS] is an extension of the main inter-bank RTGS day. CLS allows evening agreed commercial banks to continuously settle their inter-bank RTGS obligations arising from foreign exchange transactions in financial markets when RITS/RTGS, and the participating foreign RTGS systems, are open. According to the Reserve Bank (2002a):

CLS is a global initiative to reduce foreign exchange settlement risk by settling both legs of foreign exchange transactions simultaneously. Transactions are settled across the books of CLS Bank, a special purpose bank established to facilitate the CLS process. Payments between CLS Bank and CLS settlement members for each participating currency are

made in the local RTGS systems. There are seven participating currencies: The Australian dollar (AUD), the US Dollar, Japanese Yen, Euro, Swiss Franc, Pound Sterling and Canadian Dollar (p. 1).

Commercial banks initiate foreign exchange payment instructions through SWIFT PDS, and provide copies of their payments to CLS Bank. CLS Bank calculates each commercial bank's net inter-bank RTGS pay-in obligation for each currency. A three hour pay-in window exists from 07:00 to 10:00 Central European Time [CET]. Commercial banks net inter-bank RTGS pay-in obligations are made at 08:00, 09:00, and 10:00.<sup>27</sup>

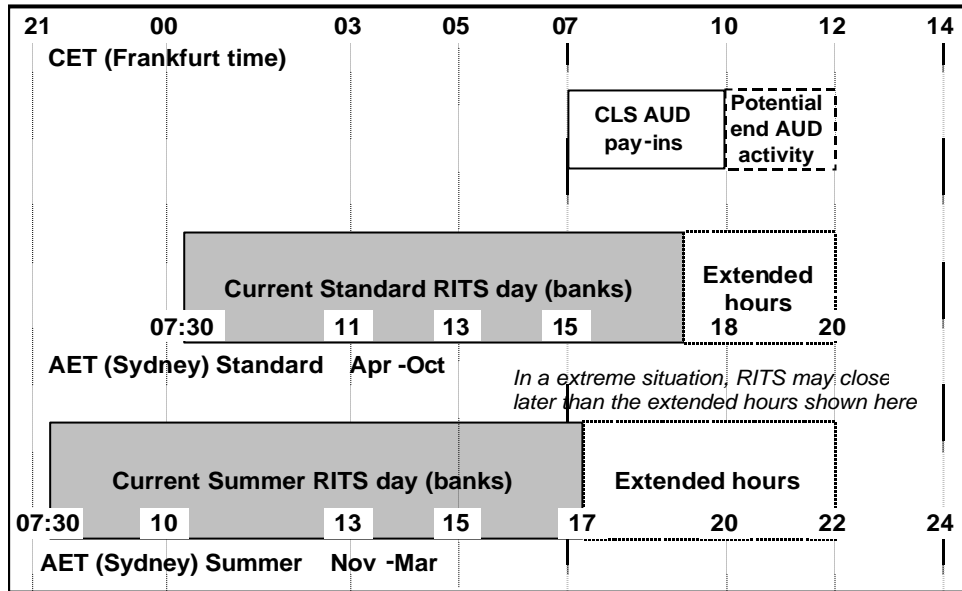
While foreign exchange deal instructions are initiated whether or not RITS/RTGS is open, the only window for inter-bank RTGS pay-in and pay-out is when the RITS/RTGS system and foreign participating RTGS systems are open. Figure 3.6 outlines the RITS/CLS extended operating hours, i.e., 17:00 Australian Eastern Standard Time [standard time] and 21:00 Australian Eastern Summer Time [summer]. If settlement difficulties arise, the RITS/RTGS settlement session can be extended further to 20:00 standard time and 22:00 summer time. Figure 3.7 summarises the inter-bank RTGS day and extension of SWIFT times for the CLS process.

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<sup>27</sup> Note: CLS pay-out obligations should in aggregate be the sum of their pay-in obligations from commercial banks. However, depending on the distribution of payments, commercial banks will still need to borrow and lend in the inter-bank market as required.

Figure 3.6

CLS and extended RITS/RTGS session times



Source: Reserve Bank of Australia

Figure 3.7

Summary of Session Time Arrangements

Session Name	Time (AET)	Time (AEST)
<b>Primary Sessions</b>		
Morning Settlement Session	07:30 - 08:45	07:30 - 08:45
Daily Settlement Session	09:15 - 16:30	09:15 - 16:30
Settlement Close Session	16:30 - 17:15	16:30 - 17:15
Interim Session	17:15 - 17:25	17:15 - 17:25
Evening Settlement Session	17:25 - 19:00	17:25 - 21:00
Post-Settlement Close Session	19:00 - 19:30	21:00 - 21:30
<b>Secondary Sessions</b>		
SWIFT Daily Settlement Session	09:15 - 16:30	09:15 - 16:30
SWIFT Final Settlement Session	16:30 - 18:30	16:30 - 20:30
SWIFT End Session (no new SWIFT payments)	18:30 - 19:00	20:30 - 21:00

Source: Reserve Bank of Australia

### **3.3 Moving the official short-term inter-bank cash rate: The function of pre-determined interest rate bands**

The current conduct of monetary policy dispenses with the notion that a change to official short-term interest rates is a consequence of manipulating the supply of cash in the banking system. As a non-restricted quantity, the supply of cash fully accommodates the demand for cash but at interest rates influenced, and directly set, by the Reserve Bank. Presently, the Reserve Bank pays 25 basis points below the official short-term inter-bank cash rate target on surplus end of day cash balances and is prepared to lend cash at 25 basis points above the official short-term inter-bank cash rate target to deficit commercial banks. The Reserve Bank fully accommodates the demand for cash through two additional facilities: intra-day and overnight repurchase agreements.

#### **3.3.1 Intra-day repurchase agreements**

Commercial banks access intra-day cash, with an immediate credit to their ES account, by discounting eligible securities in RITS/Austraclear with the Reserve Bank. Intra-day repurchase agreements can be unwound, as the inter-bank RTGS day progresses, only when commercial banks have sufficient cash in their ES account to unwind positions. A commercial bank's position, in turn, is a function on the distribution of inter-bank RTGS transactions, i.e., whether they are a net-payers or net-receivers of inter-bank RTGS transactions.

### 3.3.1.1 Eligible securities for intra-day repurchase agreements

Eligible securities for intra-day repurchase agreements include public sector securities, CGS and SGS, third party private sector securities, BAB and NCD, and select supranational securities with maturities less than 12 months. The intra-day repurchase agreement facility is free with respect to the interest rate however, failure to unwind intra-day repurchase agreements by the close of the inter-bank RTGS day are automatically rolled into borrowed funds with the Reserve Bank at 25 basis points above the official short-term inter-bank cash rate target or some 50 basis points above the interest rate set on overnight cash balances in commercial banks' ES accounts.

### 3.3.1.2 Calculating intra-day repurchase agreements

Assume on the 2<sup>nd</sup> August 2004 XYZ commercial bank enters into an intra-day repurchase agreement with the Reserve Bank using a third party BAB as security. The repurchase interest rate was zero percent, the inter-bank cash rate was 5.25%, and the current market interest rate was 5.26% on a 30 day BAB. The Reserve bank would discount the face value of a \$100 million BAB, which matures on the 17th August 2004, and credit cash to the commercial banks' ES account equal to the discounted, or consideration, amount of the BAB. The Reserve bank will supply cash to a commercial bank, on the first leg, equal to:

$$T = \frac{\$100,000,000}{\left(1 + 0.0526 \times \frac{15}{365}\right) \times 1.02} = \$97,827,746.94 \quad (3.1)$$

The face value of the security is discounted using the prevailing market yield-to-maturity with an additional 2% discount as collateral. If the distribution of

inter-bank RTGS transaction was such that the commercial bank was a net-receiver of cash, the intra-day repurchase agreement would be unwound as the inter-bank RTGS day approaches the settlement close session. The second leg, or unwind consideration, would simply be the value of the first leg consideration [\$97,827,746.94]. However, if the distribution of cash was such that a commercial bank was a net-payer of inter-bank RTGS transactions, and was not in a position to unwind intra-day repurchase agreements with the Reserve Bank on the same day, then XYZ commercial bank has two options:

1. Convert outstanding intra-day repurchase agreements into an overnight loan with the Reserve Bank under an overnight repurchase agreement at 25 basis points above the official short-term inter-bank cash rate target.
2. Borrow in the overnight inter-bank cash market at, or near, the official short-term inter-bank cash rate target.

### 3.3.1.2.1 Overnight repurchase agreements

Any intra-day repurchase agreements not unwound, on the same day, by the close of the inter-bank RTGS day are converted into overnight loans with the Reserve Bank at 25 basis points above the target for the official short-term inter-bank cash rate. In this case, the second leg, or unwind consideration, would equal:

$$\begin{aligned}
 T+1 &= \$97,827,746.94 + \left( \$97,827,746.94 \times \left( \frac{0.0525 + 0.0025}{365} \times 1 \right) \right) \\
 &= \$97,842,488.11
 \end{aligned}
 \tag{3.2}$$

The second leg, or unwind consideration, is equal to the first leg [\$97,827,746.94] plus an overnight repurchase interest rate charge [\$14,741.17] payable to the Reserve Bank on the 3<sup>rd</sup> August 2004. However, the Reserve Bank would not want continuous and excessive borrowing under

this facility. A cheaper alternative for any commercial bank is to borrow funds in the overnight inter-bank cash market.

### 3.3.1.2.1.1 The overnight inter-bank cash market

The inter-bank cash market, in Australia, is the market for overnight unsecured funds between commercial banks. The weighted average overnight interest rate paid and received in the inter-bank cash market is the interest rate to which the Reserve Bank influences. Commercial banks aren't obliged to borrow or lend in the overnight inter-bank cash market however, the current pre-determined interest rate band set directly by the Reserve Bank provides an incentive to surplus and deficit commercial banks to minimise their respective opportunity cost.

In other words, commercial banks' accumulating cash in their ES account can lend in the inter-bank cash market and receive 25 basis points above the interest rate set on surplus end of day cash balances. Likewise, commercial banks facing a deficit, i.e., accumulating insufficient cash, at the end of the day, to reverse intra-day repurchase agreements with the Reserve Bank, can borrow in the inter-bank cash market and minimise their opportunity cost by 25 basis points. With respect to equation 3.3, the overnight cost, to XYZ commercial bank, of unwinding intra-day repurchase agreements with the Reserve Bank equals:

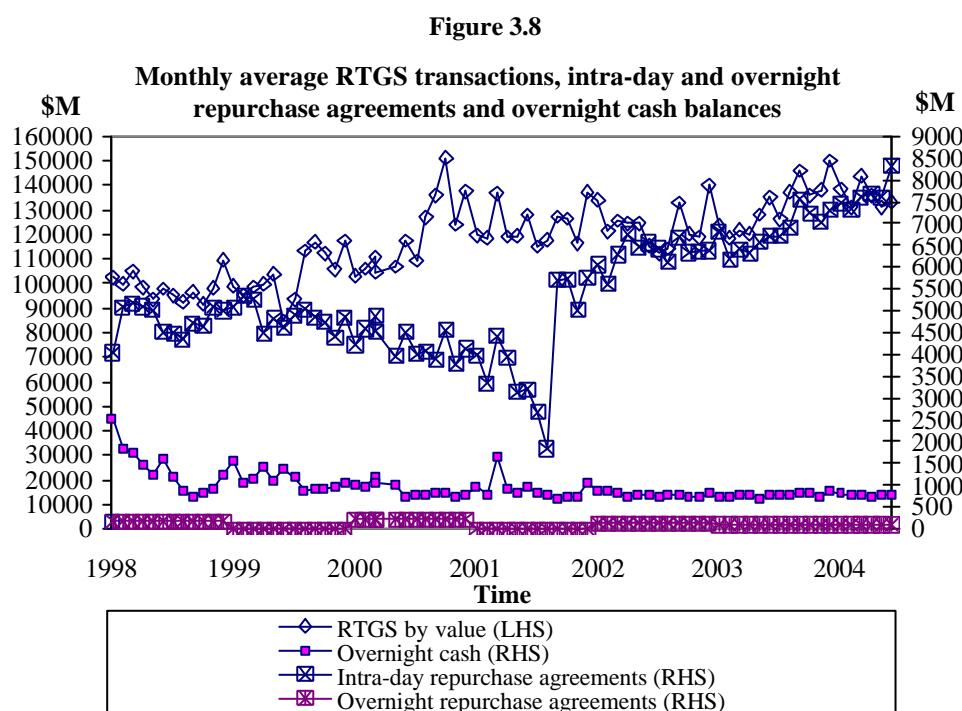
$$\begin{aligned}
 T+1 &= \$97,827,746.94 + \left( \$97,827,746.94 \times \left( \frac{0.0525}{365} \times 1 \right) \right) \\
 &= \$97,841,818.05
 \end{aligned}
 \tag{3.3}$$

XYZ commercial bank would borrow \$97,827,746.94 in the inter-bank cash market to unwind the intra-day repurchase agreement and repay the

consideration amount plus the overnight inter-bank cash rate on the amount borrowed [\$14071.11].

### 3.3.2 Time series data: inter-bank RTGS transactions, intra-day, and overnight repurchase agreements.

An examination of the monthly average values for inter-bank RTGS transactions, intra-day, and overnight repurchase agreements are provided, for the period beginning the 22<sup>nd</sup> June 1998 to 31 December 2004, in Figure 3.8.



Source Reserve Bank of Australia

Figure 3.8 highlights a number of interesting observations. First, the values of intra-day repurchase agreements moves, roughly, with the value of inter-bank RTGS transactions. In recent years, the daily value of intra-day repurchase agreements entered into, with the Reserve bank, has exceeded \$7 billion.

In relative terms, intra-day repurchase agreements have exceeded the value of end of day or overnight cash balances by a ratio of 9.5:1.

Second, the majority of intra-day repurchase agreements are unwound by the close of the inter-bank RTGS day. This is evident by the extremely small recourse to the overnight repurchase agreement facility. Since the introduction of RTGS, the monthly average use of this facility has not exceeded \$217 million.

Thirdly, it is clearly evident that intra-day repurchase agreements are the primary facility for settling inter-bank RTGS transactions not overnight or end of day cash balances. Thus, as examined in chapter two, observing the correlation between the quantities of overnight cash balances to the official inter-bank cash rate fails to understand the operating procedures within the settlement process.

Finally, the demand for cash is fully accommodated either at the official inter-bank cash rate and/or 25 basis points above the official inter-bank cash rate target. While the difference between the cost of an overnight repurchase agreement relative to the cost in the inter-bank cash market is small, the significance of marginal amounts becomes more apparent when considering the distribution dynamics of inter-bank RTGS system.

### **3.3.3 Dynamics of the inter-bank RTGS system and the overnight inter-bank cash market**

The daily uncertainty associated with a commercial banks' inter-bank RTGS obligation, and settlement obligations between the Reserve Bank, ensures corresponding uncertainty with their funding requirements in the inter-bank cash market. As a function of banking, commercial banks must continuously

settle payment instructions, in RITS/ Austraclear/SWIFT/CHESS, on behalf of their own business and their non-bank clients.

Monetary policy can set a base cost of funds during the inter-bank RTGS day regardless of the distribution of inter-bank RTGS transactions. Movements in the official inter-bank cash rate target sends a signal about changes to the banking system's cost of funds during the inter-bank RTGS day regardless of a commercial bank's distribution of inter-bank RTGS transactions. According to the Reserve Bank (2003a), reported turnover, among the most active commercial banks, in the inter-bank cash market was approximately 7 billion dollars in the 2002/2003 financial year. Taking \$3.5 billion as the average amount borrowed in 2002/2003 and multiplying this amount by the inter-bank cash rate of 5.25%, the amount of interest paid in the inter-bank cash market would have been approximately \$184 million in one fiscal year.

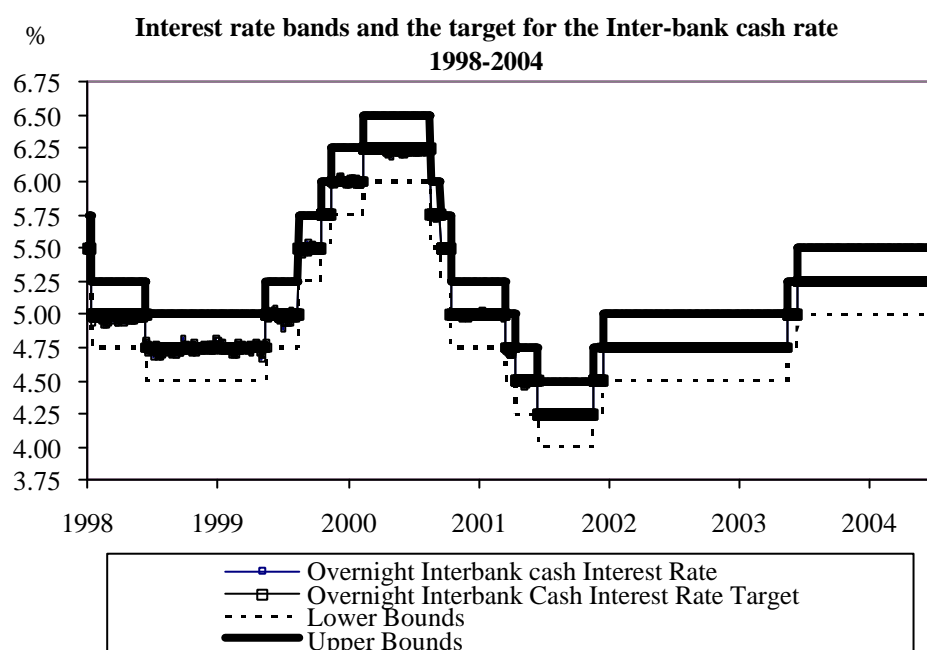
Again however, in sophisticated financial markets where billions of dollars are bought, sold, and transacted domestically and internationally, commercial banks will be uncertain of their borrowing requirements but certain about their cost of funds.

### **3.3.4 Time series data: Interest rate bands and movements in the official inter-bank cash rate**

An examination of movements in the official inter-bank cash rate from the introduction of RTGS in 1998 to 2004 is provided in figure 3.9. Evidently, the Reserve Banks' official inter-bank cash rate moves simultaneously with the target for the official short-term inter-bank cash rate. Moreover, both the actual and target rates move with changes to the Reserve Bank's predetermined interest rate band. A 25 basis point increase in the official inter-bank cash rate target is directly achieved through a 25 basis point increase in

the interest rate on surplus overnight or end of day cash balances [lower bounds] and a 25 basis point increase on the interest rate on borrowed funds using overnight repurchase agreements [upper bounds]. While the official short-term inter-bank cash rate could fluctuate by 100 basis points between the lower and upper bounds, 90% of borrowing and lending in the inter-bank cash market is arranged at the official short-term inter-bank cash rate target.

**Figure 3.9**



Source: Reserve Bank of Australia

This suggests that, on most days, commercial banks do not finesse the market, and are prepared to take the official cash interest rate as their cost of funds. This is highlighted by the small deviations, less than 5 basis points, in the official short-term inter-bank cash rate around the target inter-bank cash rate. Moreover, as chapter two examined, the pre-determined interest rate band and movements in the official inter-bank cash rate can be achieved irrespective of the quantity of overnight or end of day cash balances commercial banks demand in their ES account. Finally, the Reserve Bank's official short-term interest rate feeds into in other short-term interest rates.

### **3.3.4.1 Other short-term interest rates**

The Reserve Bank's official short term inter-bank cash rate becomes a critical reference rate, for commercial banks and financial markets, in pricing alternative sources of funds, in particular wholesale deposit interest rates and money market interest rates. Commercial banks price wholesale deposit interest rates with respect to the current or expected official short-term inter-bank cash rate.

The relationship with non-bank clients is also very important. Most, if not all, deposit and money market interest rates are tiered according to not only the term but also the quantity of money invested/borrowed. Clients with more money to invest become more valued in the sense that these funds can be withdrawn at short notice, requiring commercial banks to either raise additional non-bank client funds and/or borrow in the inter-bank cash market. Thus, the inter-bank cash rate becomes the key reference rate for determining other short term interest rates because commercial banks are aware that any major outflows from their ES account requires funding in the short-term inter-bank cash market.

In a financial system, where many large payments are initiated and settled continuously across commercial banks ES accounts, particularly settlements that are unrelated to a commercial banks' own business, the inter-bank cash market can become a major source of short-term funding. The unpredictability of commercial banks ES account position, particularly as a consequence of large inter-bank RTGS transactions, coupled with a known cost of funds during the settlement process, ultimately means that commercial banks price deposits and market instruments with respect to their official cost of funds.

The broader money market is also highly competitive. Commercial banks and NBFIs compete aggressively to finance non-bank clients. Access to highly

competitive money and capital markets, directly or indirectly through a commercial bank or NBFIs mediating the process, coupled with the broad array of financial market instruments ultimately forces commercial banks to accept small margins, or acceptance fees, for mediating the financial process while guaranteeing default risk on behalf of their clients.

BAB is a prime example.<sup>28</sup> Commercial banks discount BAB to what the market is willing to buy them at, provide the discounted value to their borrowing clients, and on-sell the instrument in financial markets. BAB and the Bank Bill Swap Rate [BBSW] also become reference rates for commercial banks and the broader financial markets. A client's cost of funds would become, for example, BAB + 50 basis points to which the commercial bank would receive the 50 basis points for accepting or guaranteeing the face value of the bill when presented by the holder.<sup>29 30</sup>

### 3.5 Concluding remarks

Chapter three examined, also from a technical perspective, the role of interest rates bands in moving short term interest rates, the payment and settlement system architecture, and the endogeneity of ES liquidity in a RTGS system. Chapter three provides a significant technical insight into the institutional settlement framework of the Australian payment and settlement system, and

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<sup>28</sup> For a basic and non technical summary of the basic spreads between some Australian interest rates relative to the cash rates, pre RTGS, refer to: RESERVE BANK OF AUSTRALIA (1992): "Bank Interest Rate Margins," *Reserve Bank of Australia Bulletin*, May, 1-6.

<sup>29</sup> For an examination of the pass through effect of cash rates, pre RTGS, and other interest rates refer to: BATTELLINO, R., J. BROADBENT, and P. LOWE (1997): "The Implementation of Monetary Policy in Australia," *Reserve Bank of Australia Research Discussion Paper*, 9703, 1-34., and, LOWE, P. (1995): "The Link between the Cash Rate and Market Interest Rates," *Reserve Bank of Australia Research Discussion Paper*, May, 9504.

<sup>30</sup> In relation to section 3.2.6.5.1 For an examination of foreign exchange settlement practise refer to: RESERVE BANK OF AUSTRALIA (1997): "Foreign Exchange Settlement Practices in Australia," Sydney: Reserve Bank of Australia. Research undertaken by Bernie Egan, Jeff Grow, Nathan Hale and Karen Cole from the Bank's Financial System department, 1-63.

the operating procedures employed by the Reserve Bank in determining a cost of funds during the inter-bank RTGS day.

The content in chapter three extends on the examination, perspective, and findings presented in chapter two. Accordingly, there are three critical and interesting findings presented within chapter three. First, the daily implementation of monetary policy revolves around the institutional settlement framework and the operating procedures employed within the payment and settlement system itself. Commercial banks continuously settle inter-bank RTGS transactions initiated in RITS/Austraclear/SWIFT/CHES. Chapter three provides an original insight and examination into the inter-bank RTGS day, how commercial banks manage inter-bank RTGS transactions, and the internal liquidity management operations of their own ES account.

Second, the payment and settlement system are critical components in not only understanding how the financial markets operate but also why liquidity becomes an endogenously determined variable during the inter-bank RTGS day. The Reserve Bank fully accommodates the demand for inter-bank RTGS transactions via intra-day and overnight repurchase agreements. Intra-day repurchase agreements are provided on demand, free of charge or interest rate, and are the primary facility for obtaining cash for inter-bank RTGS transactions.

Finally, the Reserve bank is able to move the short-term inter-bank cash rate not by manipulating the supply of liquidity but rather by changes to a pre-determined interest rate band. Currently, the Reserve Bank pays 25 basis points either side of the official short-term inter-bank cash rate target. Movements in the lower and upper interest rate bands automatically moves the official short-term inter-bank cash rate irrespective of the quantity of intra-day, overnight, and end of day liquidity demand by commercial banks' during

the inter-bank RTGS day. Chapter three provides perspective on these issues by examining how the system operates, the pricing and dynamics of the inter-bank RTGS system, and the role of the inter-bank cash market in redistributing cash at the Reserve Bank's official short-term inter-bank cash rate.

## CHAPTER FOUR

### **C**oncluding remarks

#### **4.1 Revisiting the general purpose of the thesis**

The main purpose of this thesis has been to examine the current implementation of monetary policy in Australia over the last 10 years. Traditional theory has modelled the supply of money as exogenously determined by the central bank and limited, strictly, by parameters of the money multiplier. This thesis dispensed old and outdated models in search of a more realistic, insightful, and technical understanding into the implementation of monetary policy in Australia. By providing a technical account into the daily operating procedures and the institutional settlement framework surrounding the implementation process, the thesis was able to analyse the mechanics of short-term interest rate targeting, and the endogeneity of liquidity within the banking system.

#### **4.2 Interest rate targeting and the endogeneity of liquidity**

Under present arrangements, the Reserve Bank sets a target for its official short-term inter-bank cash rate and fully accommodates the banking system's demand for liquidity. Thus, the conduct of monetary policy is in terms of making liquidity available to the banking system but at interest rates influenced, or set directly, by the Reserve Bank. The demand for liquidity becomes a settlement demand not a reserve requirement demand. Commercial banks can, therefore, determine their own liquidity demand as long as each

commercial bank ends the day with a non-negative ES account balance with the Reserve Bank. Chapters two and three are dedicated to examining two separate but inter-connected facets to implementing modern monetary policy in Australia.

#### **4.2.1 Summary of main findings**

Chapter two examined the role of OMO in the stability of short-term interest rates and the endogeneity of system-wide ES liquidity. The supply of system-wide liquidity fully accommodates the system-wide demand for liquidity. These findings suggest that Reserve Bank does not manipulate the system-wide supply of liquidity in order to move official short-term interest rates.

On an operational perspective, the Reserve Bank is not preoccupied with the quantity of liquidity but is more concerned that the banking system has an ongoing demand for liquidity to settle obligations with itself. The system-wide demand for liquidity is the sum of the banking system's liquidity to settle obligations with the Reserve Bank plus the banking system's end of day liquidity position with the Reserve Bank.

Deviations in the demand or supply of system-wide liquidity are quickly counter-acted in the opposite direction, and roughly the same magnitude, via the use of OMO. OMO is designed to fully accommodate the demand for system-wide liquidity in order to maintain stability in short-term interest rates rather than a tool to manipulate the money supply and, as the findings suggest, their official short-term interest rate.

Time series data into the dynamics of the system-wide liquidity position of the banking system reveals many interesting facts. Again, the quantity of liquidity which the banking system actually demands, in their ES account with the

Reserve Bank, is not the anchor of monetary policy. The banking system determines the quantity of end of day balances not the Reserve Bank. In a system where liquidity is accommodated fully within the settlement process, end of day balances are neither significant in their magnitude nor their settlement use. Thus, on an operational basis, the banking system can, in theory, demand a zero non-negative end of day cash balance.

Finally, the instruments of OMO are more dynamic than traditional undergraduate textbooks convey. The Reserve Bank does not limit itself to risk-free government securities but rather it has adapted to dealing with a range of public and private sector securities among a broad range of participants, both commercial banks and NBFIs. The short term money market is highly competitive in the sense that NBFIs, and potentially any large non-bank corporation, can borrow funds at market interest rates as opposed to a reliance on commercial bank loan facilities.

OMO is just one small but significant section of the short-term money market. Repurchase agreements account for over 96% of the total turn over in domestic OMO, in recent years. Their calculations and terms become a critical component to understanding operating procedures of the Reserve Bank and the institutional settlement framework of the Australia money/financial markets.

Chapter three examined the role interest rate bands in moving short-term interest rates, the payment and settlement system architecture, and the endogeneity of ES liquidity in a RTGS system. Chapter three explored the payment and settlement system in unprecedented detail to provide an examination of the demand for liquidity during the inter-bank RTGS day. To move the official short-term inter-bank cash rate, the Reserve Bank does not need to manipulate the quantity of liquidity to hit its target rate. Instead the Reserve Bank pays 25 basis points either side of the target rate on surplus and

deficit ES account positions which serve as a constant opportunity cost on surplus and deficit ES positions during the inter-bank RTGS day.

Commercial banks obtain intra-day liquidity on demand through intra-day repurchase agreement facilities in order to settle inter-bank RTGS obligations. Intra-day repurchase agreements need to be unwound by the close of the RTGS day. A commercial bank with surplus funds, above that required to unwind intra-day repurchase agreements, would lend surplus liquidity to deficit commercial banks in the inter-bank market at, or around the, target rate. Likewise, a commercial bank in deficit, below the amount required for unwinding intra-day repurchase agreements and unable to borrow from a surplus commercial bank as needed, converts intra-day repurchase agreements into an overnight repurchase agreement with the Reserve Bank at 25 basis points above the target rate. The findings into the inter-bank RTGS day suggest that ES liquidity is always provided on demand at interest rates influenced and directly determined by the Reserve Bank.

These findings highlight the fact that the quantity of liquidity does indeed float to accommodate demand for inter-bank RTGS transactions without the Reserve Bank jeopardising its official short term interest rate target. OMO, intra-day repurchase agreements, and overnight repurchase agreements facilities ensure that the supply of liquidity fully accommodates the demand for settlement obligations both between the banking system and the Reserve bank, and in the inter-bank settlement process.

While OMO maintains stability in the Reserve Bank's official short-term inter-bank cash rate, a pre-determined interest rate band of 25 basis points either side of the target rate serves to move the official short-term inter-bank cash rate to its new target. All these facilities ensure the banking system can settle obligations at a cost influenced and set directly by the Reserve Bank. Without such facilities the banking system is unable to settle obligations as

they arise; whether that is between the Reserve bank and the banking system or between commercial banks within the inter-bank cash market.

### **4.3 Final Remarks**

While central banks have explicitly expressed the view that they target short-term interest rates, and the money supply is determined outside the system by the demand for credit, proponents of the old exogenous money approach still perpetuate false and misleading statements. Recently, Friedman (1994) stated:

It's simple to state how the money supply is so centrally controlled. It's hard to believe. I have observed that noneconomists find it almost impossible to believe that twelve people out of nineteen...sitting around a table in a magnificent Greek temple on Constitution Avenue in Washington have the awesome legal power to double or two halve the total quantity of money in the country. How they use that power depends on [a range] of complex pressures...But that does not alter the fact that they and they alone have the arbitrary power to determine the quantity of what economists call base or high-powered money...And the entire structure of liquid assets, including bank deposits, money-market funds, bonds, and so on, constitutes an inverted pyramid resting on the quantity of high-powered money at the apex and dependent on it (p. 18).

The findings of this thesis have concluded an opposite view. In Australia, the Reserve Bank fully accommodates the demand for its own liabilities or order to target a cost of funds to the banking system and not a prescribed money base quantity.

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