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Financial Deregulation, the Demand for Money, and Monetary Policy in Australia

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Abstract

This study reviews the factors contributing to the deregulation of the Australian financial system and discusses the implications of such deregulation for the transmission mechanism of monetary policy, the interest elasticity of money balances, and the stability of money demand. Several models of money demand are estimated using both fixed coefficient and random coefficient estimation techniques. Empirical results are presented which provide evidence that random coefficient estimation of money demand models that incorporate inflationary expectations not only greatly reduces forecast errors, but eliminates any tendency to underpredict the surge of real money balances which occurred following deregulation.

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Contents

1. Introduction

In recent years deregulation and innovation in financial markets have had widespread implications for the conduct of monetary policy in a number of countries. Simple and well-behaved relationships between money and nominal income that held in the regulated framework have apparently broken down in the changed financial environment. Indeed, several writers--including Fama (1980), Hall (1982), and Jonson and Rankin (1986)--have argued that the more or less stable and predictable demand for money relationships estimated in earlier studies were themselves by-products of the system of financial regulations in force over the period examined. As Jonson and Rankin (1986) observe, controls on interest rates limited the scope for interest rates to adjust; observed interest rates did not necessarily reflect market clearing values, thus leading to situations of excess demand or supply in money markets. Quantity rationing in contractionary periods and the unwinding of rationing in expansionary periods established a positive statistical correlation between the supply of money and nominal income. Consequently, the lifting of controls in financial markets resulted in a deterioration of the old correlations between money and nominal income.

In the aftermath of financial deregulation and innovation, and the apparent breakdown of stable and predictable money demand relationships, there has been a move away from strict monetary targeting as the primary objective of monetary policy. In a number of countries, increased reliance is now placed on other indicators of monetary policy, sometimes in association with published growth objectives for the monetary aggregates. For example, in Australia the practice of announcing conditional projections for the broad monetary aggregate, M3, was terminated in 1985. 1/ Although monetary growth rates continue to be closely monitored in Australia, this is done in concurrence with developments in a wide range of financial and real economic indicators.

This paper examines the factors underlying financial deregulation and innovation in Australia, and investigates the implications of such deregulation for money demand stability and monetary policy. The paper is divided into six sections, including this introduction. Section 2 provides a background to Australia's regulated financial system as of the 1970s and gives an overview of the conduct of monetary policy in that environment. Section 3 then analyzes the factors which contributed to financial deregulation. That section also discusses the deregulatory measures which have so far been implemented and the changed nature of monetary policy in such a deregulated financial system.

One consequence of financial deregulation in Australia has been a surge in the quantity of money, M3, particularly over the period 1984:4 to 1985:3. Recent studies of money demand in Australia by Veale,

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1/ M3 is defined as currency plus bank deposits (including certificates of deposit).

Boulton, and Tease (1985) and Stevens, Thorp, and Anderson (1987) have shown that various specifications of the demand for money, incorporating several definitions of money, all exhibit instability over this episode--specifically, all severely underpredict real money balances. These studies, in accord with much recent work on money demand estimation, are based on the traditional econometrics assumption of constant parameter values throughout the estimation period. Yet, as Goodhart (1986) has observed, in periods of financial deregulation there is a problem of distinguishing between responses to money supply shocks and underlying money demand changes. Goodhart further stresses that traditional econometrics is not able to deal with this problem. Additionally, Hendry (1986), who has been extremely critical of existing methods of money demand estimation, 1/ argues that one of the major drawbacks of existing estimation methods is that they assume nonchanging parameter values even in periods of structural change.

In order to address these criticisms of money demand estimation, and to investigate their implications, in what follows we estimate several models of money demand using for each both traditional nonchanging parameter techniques--ordinary least squares (OLS) and instrumental variables estimation--and a random coefficient estimation procedure developed by Swamy and Tinsley (1980). Accordingly, Section 4 of the paper discusses the money demand models employed, and the data used to estimate them. Section 5 presents the empirical results. Post-sample forecasts for each model, estimated on the basis of both constant parameter and random parameter techniques, are presented and compared. The implications of our results along with concluding observations are provided in Section 6.

2. Financial deregulation

a. Background

The financial system in Australia that had emerged by the 1970s was so highly regulated that it led to a strict segmentation of the financial marketplace. The system was centered on a small number of trading banks which controlled important segments of the market and were closely regulated by the authorities. The trading banks operated the clearing system and had the sole right to issue checking accounts. They were the only institutions eligible to deal in foreign exchange and acted as agents for the Reserve Bank in implementing a comprehensive set of exchange controls. The savings banks, mainly affiliated to the trading banks, were essentially limited to the function of supplying housing finance. Finance companies and merchant banks 2/ were

1/ In response, Hendry has pioneered the error-correction estimation procedure. See, for example, Hendry and Ericsson (1986).

2/ Formally known as Money Market Corporations.

considerably less restricted 1/ and consequently tended to meet the higher risk credit demands that would not usually be considered by the trading banks. Finance companies, in many cases affiliated with trading banks, were the main suppliers of consumer credit. Merchant banks, frequently representing the local presence of foreign banking groups, tended to specialize in trade finance and instruments tailored to the needs of corporate customers. The thrift institutions--building societies and credit unions--were subject to various state government controls; the former dealt predominantly in mortgage financing and the latter in consumer credit. Money market dealers were set up to make a market in short-term government securities and to provide safe investment opportunities for ultra short-term cash; these institutions had access to Reserve Bank lender-of-last-resort facilities 2/ and were required to hold the bulk of their assets in government securities. Alternatively known as authorized dealers, they continue to constitute the "official" short-term money market. Other intermediaries that constituted a significant portion of the "captive market" (see below) for government securities were life insurance companies and superannuation funds.

Regulation of the financial sector took several forms. First, a set of restrictions applied to bank deposit rates and lending rates. For example, trading banks were prohibited from offering interest on large deposits ($A 50,000 and over) for periods of less than 30 days or on small deposits (less than $A 50,000) for periods of less than three months. Implicit in these short-term maturity controls on trading bank deposits was a prohibition on the payment of interest on current account balances. 3/ Likewise, savings banks were subject to a range of interest rate and maturity controls on deposits; they were also subject to interest rate ceilings on housing loans, small overdrafts, and personal installment loans. Second, banks had to comply with certain restrictions on their portfolios. For example, in an "understanding" reached with the Reserve Bank in 1956, trading banks agreed to maintain a minimum ratio (usually set at 18 percent) of liquid assets and government securities to their deposits. This so-called LGS convention typically referred to currency, deposits with the Reserve Bank, treasury notes, and other Commonwealth Government Securities (CGS). The deposits lodged with the Reserve Bank under the LGS convention were in addition to a designated proportion of all deposits used as statutory reserves

1/ Under the Financial Corporations Act of 1974, the Reserve Bank acquired extensive powers over nonbank financial institutions, empowering it to prescribe asset ratios and determine their lending policies. However, these powers have not been used.

2/ The trading banks also had access to lender-of-last-resort facilities from the Reserve Bank.

3/ A limited range of long-standing exceptions included accounts of governments, other banks, nonprofit organizations, and bank staffs.

(the SRD ratio). 1/ Similarly, savings banks had been required to hold 100 percent of their assets in prescribed form, mainly housing loans and government securities. Other financial institutions were also subject to portfolio restrictions. For example, life insurance companies and superannuation funds operated under the 30/20 Regulation; this referred to a tax concession given to these institutions in return for their holding no less than 30 percent of their assets in public securities, with at least 20 percent of total assets in Commonwealth securities. Hence, this regulation contributed to the "captive market"--it forced or enticed loan funds into public securities by tax concessions.

Third, the entry of new banks had been tightly controlled. For a period of some 35 years prior to 1981 no new trading bank authorities had been granted while the only new savings bank authorities were issued to existing banking institutions. The net result of these controls on entry was that, through a series of mergers, by the early 1980s the Australian banking system developed into a highly concentrated sector; four trading banks accounted for more than 85 percent of all trading bank assets. However, it also resulted in a situation in which banks in many instances were not able to compete effectively with other financial institutions.

b. Monetary policy in an environment of regulation

In March 1976, the authorities began announcing annual projections for the growth of M3. 2/ However, because of what was considered to be the insufficient short-term controllability of monetary aggregates and the inadequate short-term stability of the relationship between the aggregates and ultimate economic objectives, the authorities stressed that the projections were not "rigid targets" but "conditional projections." 3/ In particular, under the managed exchange rate regime then in operation, any tightening, for example, in monetary policy could be offset by capital inflows, thus weakening the link between monetary policy action and the monetary aggregates.

1/ The SRD ratio was used for monetary policy purposes. Banks received a below-market rate of interest on the funds held in these accounts. The interest rate paid on SRDs was increased from 2.5 percent to 5 percent in May 1982.

2/ The projections were made on the basis of the fiscal year, which runs from July to June.

3/ Several empirical studies on the demand for the aggregates during the 1970s found a structural break in the middle of the decade. See Adams and Porter (1976) and Pagan and Volker (1981). Subsequently, Horne and Monadjemi (1985) examined the case for debt targeting over the quarterly interval, 1961:Q1-1981:Q1. They found no support for the adoption of total debt as an intermediate target, although bank credit performed reasonably well on all empirical tests.

For some time, the main operational objective of monetary policy had been on the control of the lending capacity (i.e., "free liquidity") of the banks as a means of controlling liquidity conditions within the financial system as a whole. Monetary policy relied on: (1) changes in the reserve (i.e., SRD) ratio; (2) quantitative guidance; and (3) interest rate controls on bank deposits and bank lending. In this context, the LGS assets of banks were viewed as the main determinant of bank lending. For example, if the Reserve Bank considered the level of free liquidity to be excessive, it would--in addition to informing the banks of this view by way of consultations and (if desired) increasing the interest rate on Commonwealth Government Securities--raise the SRD ratio and thus force the banks to reduce their LGS assets. 1/ Because of the existence of controls, changes in the reserve ratio had a direct impact on banks' lending. This approach depended crucially on the CGS being readily cashable at the holder's discretion, without incurring significant capital losses. In fact, under the tap system (which was in effect during the 1970s) of selling government securities whereby the price (and not the quantity) of these securities was fixed, there was very little risk of capital losses. Although open market operations were used to affect liquidity conditions, they were not the primary instrument of monetary policy. Indeed, one consequence of the tap system was that the availability of securities on the primary market discouraged the development of a secondary market, impairing both portfolio adjustments by holders of government debt as well as the Government's ability to conduct open market operations. 2/

c. Factors contributing to deregulation

The system of regulatory measures in force at the end of the 1970s was constructed to protect investors and to maintain confidence in the stability of financial markets and institutions. Also, direct regulation was used to promote certain social and sectoral goals. For example, interest rate ceilings on housing loans by savings banks were instituted to make these loans affordable to low income earners. Finally, many of the interest rate controls and portfolio restrictions on both the banks and nonbank financial intermediaries (NBFIs) were seen as necessary to assist in the implementation of monetary policy and to aid the sale of government securities. In particular, an important justification for the special treatment of banks in the financial system

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1/ The SRD ratio was changed six times in both 1976 and 1977, three times is each of 1975 and 1979, and once in 1981. It ranged from a low of 3.5 percent to a high of 10.0 percent. It has not been changed since 1981.

2/ See Davis (1985), Chapter 2.

was their role in money creation. Banks alone were empowered to offer transactions accounts, and monetary policy was conducted through controls on these and other deposits. 1/

The regulations had allowed the banks to emerge into highly profitable institutions, but with a declining market share and at a high cost to depositors. A number of developments emerged during the 1970s, however, which altered the impact of regulations on financial institutions and had important ramifications for the conduct of monetary policy. One was the upsurge of and increased variability in inflation. High and variable rates of inflation increased the opportunity cost of holding money balances, thereby inducing a move away from lower-yielding money balances. This increased sensitivity of savers placed pressure on the financial system to offer new financial instruments which made it possible to economize on lower-yielding financial assets. The increased variability of inflation led investors to prefer short-dated over longer-dated claims; maturity controls imposed upon the banks restricted their ability to meet this demand. The limited flexibility of banks in the face of high and variable inflation rates afforded an opportunity for NBFIs to expand. Consequently, over the decade of the 1970s, money market corporations, building societies, and credit unions recorded spectacular growth. 2/

A second factor emerging during the 1970s was the progressive increase in the size of government budget deficits. The Public Sector Borrowing Requirement (PSBR), which averaged less than 2 percent of GDP in the first half of the decade, averaged 5.2 percent of GDP during the five years to 1979/80. The effect of this rapid growth in the PSBR was to increase the Commonwealth Government's role as a competitor for household savings, placing considerable pressure on existing methods for the sale of public securities.

The third factor to emerge during the 1970s was the rapid advance in communications and data processing technology; improvements in technology greatly increased the opportunities for financial innovation and lowered the transaction costs involved in shifting funds among assets. This development, in turn, made it easier for unregulated financial institutions to grow and for regulated institutions to innovate in order to avoid the regulations. An example of the former phenomenon was the growth in cash management trusts as a means of providing retail investors (by pooling their funds) access to higher interest rates available in the relatively unregulated wholesale finance

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1/ Australian Financial System, Report of the Review Group, Canberra, Australian Government Publishing Service, 1984, p. 91. Hereafter cited as the Martin Report.

2/ Harper (1986). See also Martin Report, pp. 6-12.

markets. An example of the latter was the development of the "sweep" account by banks as a device for the avoidance of the official requirement not to pay interest on bank current deposits. 1/

A fourth factor operating in the 1970s was the emergence of stronger links between domestic and international markets, reflecting, in part, an increased presence of foreign-owned institutions (principally representative offices of foreign banks) in domestic financial markets. This increased presence raised the potential for international capital transactions, both borrowing and lending. The stronger linkage of domestic and international markets increased the access to international capital flows as a source of funds to offset fluctuations in domestic liquidity or to achieve a higher rate of return on investment. Consequently, the Australian financial system increasingly reflected the behavior of external influences--such as interest rate portfolio substitution pressures. The volatility and unpredictability of international capital flows posed an intensifying problem for the conduct of monetary policy under the managed exchange rate system.

d. Deregulatory measures

One result of the foregoing developments was a weakening in the competitive position of regulated financial institutions relative to that of unregulated financial institutions. In this regard, there was a sharp fall in the market share of banks between the 1950s and the late 1970s. In 1953, for example, the assets of trading and savings banks together accounted for about 81 percent of all assets of financial institutions (excluding the Reserve Bank and insurance corporations); by 1978 this share had fallen to 59 percent. Meanwhile, the growth of NBFIs operating beyond the direct influence of the Reserve Bank, the development of new financing techniques by banks, and the increasing integration of domestic and overseas markets contributed to a steady erosion in the ability of the monetary authorities to control monetary conditions. In response to these circumstances, a reform process was initiated with the setting up of the Committee of Inquiry into the Australian Financial System (The Campbell Committee) in January 1979. 2/ The Committee adopted the view that the efficiency of the system would be maximized in an open competitive environment and, accordingly, made recommendations aimed primarily at breaking down the mass of regulations that had long maintained the system in a segmented

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1/ These examples are provided by Harper (1986). The "sweep" account involves the automatic shifting by a bank of surplus current account balances into an interest-bearing deposit or money market fund.

2/ Australian Financial System, Final Report of the Committee of Inquiry, Australian Government Publishing Service (Canberra), September 1981, p. 125, Table 5.7. Hereafter cited as the Campbell Report.

and highly structured form. A subsequent review of the financial system (the Martin Group Report) in 1984 reaffirmed the broad recommendations of the Campbell Committee to deregulate the system. 1/

The Martin and Campbell Reports propelled a major reform of the Australian financial system, including the opening of the system to new (including foreign) banks. Among the most notable changes have been: (i) the introduction of a tender system for selling treasury notes (in December 1979); (ii) the removal of ceilings on interest rates on some deposits payable by trading and savings banks (in December 1980); (iii) in late 1983, virtually all exchange controls were lifted and the Australian dollar was allowed to float; (iv) in August 1984, the remaining controls on bank deposit interest rates were abolished; and (v) in April 1985, interest rate ceilings on bank loans under $A 100,000 other than owner-occupied housing were removed. The major changes that were announced between December 1979 and the end of 1986 are summarized in Appendix I.

3. Monetary policy and money demand in the deregulated financial system

a. The transmission mechanism

Financial deregulation has set in motion changes in both the manner in which monetary policy is transmitted to the real economy and the stability and interest elasticity of the demand for money. With regard to the transmission mechanism, the introduction of a tender system of selling government securities and the move to a floating exchange rate regime increased the monetary authorities' potential control over injections of liquidity into the domestic monetary system, thus enhancing their ability to use open market operations to influence domestic monetary conditions. Financial deregulation also contributed to a weakening of nonprice credit rationing as a channel of monetary policy and strengthened the role of market forces in determining financial and credit flows. Consequently, the effects of monetary policy are increasingly transmitted via open market operations to the real economy through changes in interest rates. 2/ With greater competition in the financial sector, changes in interest rates tend to spread quickly through the whole range of financial assets and liabilities. Nevertheless, the transmission of monetary actions to the real economy has probably lengthened compared to the previous regulated system which relied on quantity rationing. Specifically, in the deregulated financial environment, the volume of deposits is both demand and supply determined. Consequently, any, say tightening of monetary

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1/ Martin Report. The Martin Group was convened by the then new Labor Government.

2/ There remains some residual rationing in the market for housing finance, where interest rates on loans made by savings banks prior to April 1, 1986 remain regulated.

policy by the Reserve Bank will induce a rise in deposits' rates, resulting in an increase in the supply of deposits and offsetting to some extent the Reserve Bank's effort to reduce the growth of money. Thus, financial institutions (particularly banks) are now better able to protect their deposit base and to sustain their lending than they had been in the regulated framework in which the volume of deposits was primarily demand determined. 1/

The demand for credit may also have become less sensitive to interest rates in the deregulated system. For example, increased use of floating interest rates and more innovative and flexible loan packages may have resulted in less discouragement to marginal borrowers as rates rise. Borrowers and lenders may also have become more accustomed to interest rate variability and, as a result, may not materially alter their behavior until interest rates are perceived as having shifted in a sustained manner. 2/

b. The demand for money

A precondition for the successful implementation of monetary targeting is the existence of a stable and predictable relationship between the targeted monetary aggregate and economic activity. The recent financial changes, however, have altered the interest elasticity of the demand for money and have made it more difficult to differentiate among the various aggregates, contributing to money demand instability.

With regard to the interest elasticity of the demand for money, the payment of market-determined yields on bank deposits has reduced the interest elasticity of money (M3). The share of financial instruments within M3 with market-related rates has risen in recent years. Consequently, the yields on those instruments tend to move up or down with the rates depository institutions can earn on their assets, leaving the differential unchanged. Since the opportunity cost of holding money is the spread between the market rate on substitute financial assets and the own deposit rate on money, the adjustment of deposit rates to follow market rates closely has made the opportunity cost of money vary less than market rates. Thus, the demand for deposits, however sensitive to the differential between market rates and deposit rates, has become less

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1/ Everything else remaining the same, the supply of deposits is inversely related to the deposit rate (since an increase in the deposit rate reduces the profit margin) and the demand for deposits is positively related to the deposit rate. As long as the deposit rate is maintained below its equilibrium (i.e., market) rate, the quantity of deposits will be determined by the demand schedule for deposits.

2/ However, in the spirit of the Mundell-Fleming model, following the floating of the Australian dollar, the impact of monetary policy on aggregate demand tends to be reinforced by changes in the exchange rate. Goldstein (1984, pp. 22-23) provides a critical discussion of the monetary policy consequences associated with the Mundell-Fleming model.

sensitive to the general level of rates; a larger change in market yields is required to achieve a particular change in relative yields than was necessary when deposit rates were controlled. Accordingly, given increases in the demand for money would be associated with even larger decreases in market rates; the elasticity of money demand with respect to market rates has declined.

Financial deregulation has also contributed to shifts in the demand for money. Some deregulatory measures, such as the entry of new banks and the decontrols on deposit interest rates, boosted the growth of banking aggregates (and thus, of M3) relative to other intermediaries and direct financing. Increased competition following deregulation also encouraged nonbank financial intermediaries to seek business from areas previously financed directly, which added to the process of intermediation and thus to the growth of broad money. Additionally, changes in the financial environment took place during a period (beginning in early 1983) when a disinflationary process had set in. Consequently, determinants of money demand--notably interest rates and inflationary expectations--changed sharply and perhaps unpredictably. These factors contributed to a surge in M3 growth. In the 12 months to September 1985, M3 growth reached 19.6 percent compared to a rate of 11.7 percent in the year to September 1984. 1/ As a result of the surge in M3 growth, the income velocity of M3 fell by over 4 percent in 1985/86, compared to an upward trend of about 1 1/2 percent per annum during much of the postwar period. 2/

The foregoing shifts in money demand reflect adjustments from one financial regime to another and may, therefore, be transitory. However, financial deregulation may also involve a more sustained degree of instability of money balances. Since M3 now includes a larger proportion of financial instruments yielding market-related rates, deregulation probably has induced an increased flow of investment balances into M3, resulting in an amalgamation of funds held for transactions balances with those held for investment balances. As investment balances tend to be more sensitive than transactions balances to small changes in the broad range of interest rate spreads (including yields on long-term bonds and common stocks), changes in M3 could be dominated at times by shifts in the composition of the public's portfolio rather than by changes in income and prices, resulting in a greater degree of instability in the demand for money.

To summarize briefly, financial deregulation has lowered the interest elasticity of the demand for money, and has furnished the

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1/ The acceleration in the growth of broad money (i.e., M3 plus borrowing from the private sector by NBFIs) was less pronounced--from 13.1 percent to 16.3 percent. This circumstance primarily reflected the fact that some NBFIs became banks during this period.

2/ The cumulative fall in velocity in 1984/85 and 1985/86 was 7 percent.

potential for both transitory and permanent money demand instability. In terms of the Hicksian IS-LM apparatus, this implies that the LM schedule--which represents various combinations of real expenditures and interest rates at the equilibrium levels of the demand for and supply of money--has become steeper; other things remaining the same, given changes in the supply of money are associated with larger changes in interest rates. However, the variance associated with given monetary policy changes has also increased; a wider band of uncertainty is associated with any given change in the quantity of money.

4. The models and data

As noted, various specifications of the demand for money, based on the traditional econometric techniques, have severely underpredicted the growth in real money balances in Australia from the end of 1984 through the third quarter of 1985. Furthermore, as mentioned in Section 3, the breakdown of previously established relationships between real money balances and its determinants should not be that surprising in view of the extensive changes that have occurred within the Australian financial system. The question remains, however, whether there are any available methods which can do better in predicting outcomes so as to--even in the event of changed relationships--provide the monetary authorities with reliable forecasts of future values of variables.

a. The partial adjustment model (Model I)

In order to address this issue, we estimated several specifications of the demand for money. Our point of departure was the conventional, partial adjustment model which treats the demand for real money balances in the following form (all variables are in logarithms):

$$M_t^d = a_0 + a_1 Y_t + a_2 r_t + a_3 r_t^o + a_4 M_{t-1}^d + u_t \qquad (1)$$

where M^d is a measure of real money balances (i.e. nominal money balances divided by the price level); Y is a scale variable such as income or wealth, r is an opportunity cost variable, r^0 is the own rate of return on money, and u is an error term. 1/ In estimating equation (1), real money balances was defined as M3 divided by the GDP price deflator. Our choice of M3 was predicated on the facts that M3 was the aggregate used for conditional projections while such projections were in effect (from 1977 until 1985), and that much of the recent

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1/ Empirical work performed at both the Treasury in Australia and the Reserve Bank of Australia supports the hypothesis that variables representing the opportunity cost of holding money balances and the own rate of return on money affect money balances with a one-period lag. Accordingly, these variables were entered into all equations with a one quarter lag.

instability in the monetary aggregates has involved M3. 1/ For the other regressors in equation (1), we used real GDP as the scale variable, the interest rate on 10-year Government bonds as the nominal opportunity cost variable, and the interest rate on trading bank fixed deposits (as compiled by the Reserve Bank of Australia) as the own rate of return on money. A more detailed description of the data used is provided in Appendix II.

b. Price expectations (Model II)

While a good deal of recent empirical work on Australian money-demand has involved estimating the partial adjustment model, using various definitions of money as well as various definitions and specifications of the regressor variables, none of the work, at least to our knowledge, has included a variable representing price expectations. Yet such a variable is particularly relevant if the historical data are largely generated in the context of a regulated financial environment in which nominal interest rates do not necessarily reflect market clearing values due to ceilings and maturity controls on deposits. That being the case for most of the estimation period in Australia, we also estimated another specification of the partial adjustment model as follows:

$$M_t^d = a_0 + a_1 Y_t + a_2 r_t + a_3 r_t^0 + a_4 M_{t-1}^d + a_5 \sum_{j=0}^{n} w_j \dot{p}_{t-j} + u_t \quad (2)$$

where $\sum_{j=0}^{n} w_j \dot{p}_{t-j}$ is a measure of inflationary expectations, $\dot{p}$ is defined as the annualized consumer-price inflation rate, and w_j is the weight attached to inflation in period t-j in formulating price expectations.

While there are a number of lag procedures available with which to estimate the weights attached to previous inflation rates in determining inflationary expectations, we experimented with the following four procedures: (1) least squares estimates; (2) posterior mean for Shiller's smoothness prior on lag coefficients; (3) the Almon polynominal distributed lag; and (4) Ridge regression. Each of these procedures was implemented using several lag lengths and both with and without a first-order serial correlation correction. After dividing the sample period, 1967:Q1-1985:Q3, into the estimation period 1967:Q1-1984:Q3, and the prediction period, 1984:Q4-1985:Q3, the choice of lag length was predicated upon which length provided the best forecast of the dependent variable for the prediction period under each procedure, in terms of yielding the smallest root mean square forecast error. The addition of a price expectation variable was found to be significant and

1/ However, empirical specifications for all of the monetary aggregages underpredicted the actual behavior of the aggregates from late 1984 through 1985. See Veale, Boulton, and Tease (1985).

to improve upon the forecast based on Model (I). A more detailed description of the lag procedures used, and the coefficients assigned to the weights, is presented in Appendix III.

c. The buffer stock model (Models III and IV)

A substantial and influential body of money demand literature has been devoted to estimation of the buffer stock model. Interestingly, the buffer stock model was pioneered by economists at the Reserve Bank of Australia (e.g. Jonson (1976) and Jonson and Taylor (1978)) in the context of the Reserve Bank's macroeconometric model, but more recently it has been used to estimate money demand relationships in a number of countries. 1/

The increased use of the buffer stock model has been due, in part, to several troublesome attributes associated with the partial adjustment money demand model. In particular, empirical estimates of Model (I) have often displayed parameter instability, indicating that the demand for money is not stable. Second, an implication of Model (I), that does not seem to be borne out in the real world, is that changes in the money supply are accompanied by interest rate overshooting in the short run. 2/

In response to these difficulties associated with the conventional money demand specification, the buffer stock approach formulates the demand for money in the following form:

$$M_t^d = a_0 + a_1Y_t + a_2r_t + a_3r_t^0 + a_4M_{t-1}^d + a_6(M_t^* - M_t) + u_t \qquad (3)$$

where

$$M_t{*} = gZ_t \qquad g > 0, \qquad (4)$$

and

$$M_t = gZ_t + v_t, \qquad (5)$$

Z is a set of variables that agents assume have a systematic influence on the money supply, M* is the anticipated money supply, g is a vector of coefficients to be estimated and v is an error term. Unanticipated changes in the money supply, $M^u = (M_t - \hat{g}Zt)$ are the residuals from

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1/ Laidler (1984;1987) provides excellent discussions of the buffer stock concept. See also Cuthbertson and Taylor (1987). For a discussion of recent empirical studies of buffer stock money, see Milbourne (1987).

2/ For a discussion of these attributes, see Judd (1983).

equation (5). As Laidler (1987) demonstrates, the buffer stock model can be interpreted as a reduced form equation of a complete macro model in which prices adjust sluggishly. 1/

Incorporation of the term (M-M*) in equation (2) is supposed to be able to empirically account for why short-term overshooting does not occur, at least to the extent implied in Model (I). 2/ Additionally, if the buffer stock model--which consists of equations (3) through (5)--is the "true" model of money demand, it means that Model (I) is mis-specified. Omission of (M_t-M_t*) as a regressor would result in biased coefficients on the included explanatory variables to the extent that these included variables are not orthogonal with the omitted variable. This may be one reason why estimated equations based on Model (1) have exhibited parameter instability. In particular, incorporation of (M-M*) in the money demand specification where the buffer stock model is the true model means that short-run variations in the observed stock of money would not have to be induced by shifts in people's underlying demand for money; such variations could also result from independent, exogenous changes in the quantity of money.

The buffer stock model contains at least one specification problem, since the M_t component of the unanticipated money supply variable may be correlated with the numerator of the dependent variable, real money balances. Accordingly, two procedures were employed in an attempt to deal with this problem. In one specification of the buffer stock model--denoted as Model (III)--instrumental variables estimation was used to generate estimated series on the M_t component of M^u and the other contemporaneous regressor, Y_t. The instruments used were: the constant, both interest rates lagged one period, the price level lagged one and two periods, Y_{t-1}, Y_{t-2}, $M3_{t-1}$, $M3_{t-2}$, and $M3_{t-3}$. 3/

In an alternate version of the buffer stock model--denoted as Model (IV) below--the monetary base was used in lieu of the money supply in order to generate a series on the unanticipated monetary base. The motivation in adopting the latter procedure was that changes in base money are likely to precede and influence changes in the money supply. In both the instrumental variables and base specifications of the monetary shock variable, a second-degree, 12-period (beginning in period t-1) polynomial distributed lag of M3 and the base, respectively, on their past values was used to generate the anticipated component of M^u. Also, since the addition of a price expectations variable in

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1/ Laidler also argues that the coefficients of the reduced form equation are likely to be variable because they are not structural parameters.

2/ See Judd (1983).

3/ Since the choice of instruments can be quite arbitrary, we chose the same set of instruments used by Mackinnon and Milbourne (1984) in their application of instrumental variables estimation to the buffer stock model.

Model (II) was found to improve the forecasting performance of the partial adjustment model, both versions of the buffer stock model were estimated on the basis of the same approach used to generate price expectations in Model (II). Specifically, the same four lag procedures were employed with and without first-order serial correlation corrections; the price expectations series that was retained in each model was that which yielded the best forecast.

d. Random coefficient estimation

The stochastic coefficient representation of the models estimated here is presented in equations (6) through (8),

(6) $M_t^d = x_t^{'}\beta_t$

(7) $\beta_t = \bar{\beta} + \varepsilon_t$

(8a) $\varepsilon_t = \gamma\varepsilon_{t-1} + v_t$

(8b) $E(v_t) = 0$

(8c) $E(v_t v'_s) = \Delta$ if t=s and 0 otherwise,

where $x_t, \beta_t, \bar{\beta}\ \varepsilon_t, v_t$ are all k x 1 vectors, γ and Δ are k x k matrices, x_t represents the vector of the explanatory variables, and β_t is a vector of coefficients. Note that equations (6) - (8) represent a special case of a more general variable coefficient specification which allows one to describe variations in coefficients with explanatory variables, allows for "simultaneous equations" complications, and allows for more general specifications of the error processes. 1/

In equation (7), each coefficient in each period, β_{it}, has two components: a time-independent fixed component, $\bar{\beta}_i$, and a time-dependent stochastic component, ε_{it}. ε_t is a vector stationary first-order autoregressive process (which can also be represented as a vector moving average process). Combining (6), (7), and (8) reveals that the stochastic coefficient representation can be viewed as a fixed coefficient model with errors that are both serially correlated and heteroscedastic, where the form of serial correlation and heteroscedasticity is very general:

(9a) $M_t^d = x_t' \bar{\beta} + u_t$

(9b) $u_t = x_t' \varepsilon_t$

(9c) $\varepsilon_t = \gamma \varepsilon_{t-1} + v_t$

Estimation of $\bar{\beta}$ can be viewed as an application of generalized least squares or Aitken estimation, assuming that γ and Δ are known. Swamy and Tinsley (1980) have developed a minimum average risk linear estimator which for given a priori moments of $\bar{\beta}$, γ and Δ, can be shown to be more efficient than the Aitken estimator. Because $\bar{\beta}$, γ and Δ are not known and must be estimated, Swamy and Tinsley developed an

1/ The general model developed by Swamy and Tinsley (1980) is as follows:

(i) $M_t^d = x_t' \beta$, for all t

(ii) $\beta_t = \bar{\beta} z_t + \varepsilon_t$

(iii) $\varepsilon_t = \sum_{i=1}^{p} \gamma_i \varepsilon_{t-1} + \sum_{j=1}^{q} \theta_j a_{t-j} + a_t$

where $\bar{\beta}$ is a k x m matrix, γ_i, i=1, 2,...p, θ_j, j=1, 2,...q, are k x k matrices of fixed but unknown parameters, z_t is a mx1 vector of explanatory variables, and a_t is a white noise variable. Note that if some of the elements of x_t are correlated with β_t because of simultaneous equations complications, then those elements of x_t are also entered into z_t to account for such correlations. Note also that (iii) represents a wide class of time series specifications. Hence, the nondeterministic component of M_t^d is a nonstationary process (an ARMA(p,q) with time-dependent coefficients); it is a complicated mixture of serially correlated and heteroscedastic error terms. The usual fixed and variable coefficient models can be shown to be special cases of this general model.

iterative estimation procedure in which γ and Δ initially arbitrarily chosen but through iteration are consistently and efficiently estimated after initial consistent estimates of $\bar{\beta}$, γ, and Δ are obtained. 1/

5. The empirical results

Briefly to summarize, four money demand models were estimated: (I) the partial adjustment specification; (II) partial adjustment with price expectations; (III) the buffer stock model with price expectations where the montary shock term was estimated on the basis of the instrumental variables technique; and (IV) the buffer stock model with price expectations where the monetary base was used to estimate the monetary shock term. Four lag procedures were used to formulate price expectations, and they were used with and without first order serial correlation corrections. The models were estimated on the basis of fixed coefficient and random coefficient estimation procedures with the aim of comparing prediction results both across models and with respect to the estimation techniques.

1/ Comparisons of the Swamy and Tinsley procedure with the Kalman and Bayesian procedures are given in Narasimham, Swamy, and Reed (1987). It should be noted that as emphasized by Narashimham, Swamy, and Reed (1987) the statistical notions of consistency and efficiency require the existence of the true values of parameters and hence do not apply to the estimators of $\bar{\beta}$, γ, and Δ (or any other fixed parameter estimators either) if these parameters do not represent "real" physical quantities or if equation (7) does not have a natural interpretation in terms of physical quantities. Since this equation is about the β_t which are never observed, it is necessarily arbitrary. Therefore it is difficult to believe that there are model-free physical quantities associated with each of these arbitrary model parameters. It is difficult to take consistent estimation seriously as an essential procedure if one must always interpret the parameters as "real" physical quantities. Equations (6) - (8c) are used here as a way of obtaining good predictions of the observable real money balances without requiring that β_t are used here as a way of obtaining good predictions of the observable real money balances without requiring that β_t represent real physical quantities. The β_t are used only to index the set of distributions of M_t.

The regression results are reported in Table 1. 1/ Models estimated using the fixed coefficient procedure are denoted with the subscript (a) and those with the random coefficient technique with the subscript (b). All the coefficients have a priori plausible values and right algebraic signs. In Model (Ia)--the fixed coefficient partial adjustment model--all the coefficients are significant. Model (Ia) has a short-run income elasticity of .26 and implies a long-run income elasticity of .72. These results are similar to those obtained in other recent studies of the demand for money in Australia. 2/

Model (IIa) includes the effects of price expectations, as estimated by the least squares procedure, on real money balances. While all four of the lag procedures for estimating price expectations yielded significant results and improved the forecasting performances of the models, in all cases the least squares procedure for determining expectations resulted in lower root mean square errors. (The root mean square errors for each of the alternate lag procedures in Models (IIa), (IIIa), and (IVa) are reported in Appendix III). The coefficient on price expectations in model (2a) is -1.64 and is significant indicating that nominal interest rates have not fully captured the Fisher effect over the estimation period; however, the incorporation of the price expectations term does not significantly alter the coefficients of the other nonconstant explanatory variables. Model (IIa) was the only instance where an autocorrelation correction was found to improve the forecasting accuracy of the model.

Model (IIIa) shows the effect of the monetary shock term, as constructed by using instrumental variables estimation. The monetary shock variable has a positive impact--equal to .65--on real money balances and is significant, in accordance with the buffer stock hypothesis. The coefficients of the other regressors are near their corresponding values as obtained in Models (Ia) and (IIa). The coefficient on price expectations, at -1.92, is somewhat higher and is significant. Use of the monetary base to construct the monetary shock series--Model (IVa)--decreases the impact of the shock variable (to .13) but increases its significance. Again, the coefficients on the other regressors do not change significantly; the coefficient on price expectations is -1.58.

1/ Note that usual summary statistics such as the R^2 and the Durbin-Watson statistic are not reported in Table 1, since these statistics do not provide an adequate basis for comparing different models and the estimators that we considered. In this study of alternate models and estimators, we use predictive methods--extrapolation to data outside the sample--which permit sharper discrimination.

2/ See, for example, Veale, Boulton, and Tease (1985).

Table 1. Australia: Regression Results: The Demand for Money in Australia

(Quarterly Data, 1967:Q1-1984:Q3)

Model	Estimation Technique	Constant	Real GDP	Own Rate	Ten-Year Bond Rate	Price Expectations S wj	Price Expectations a_5	Monetary Shock	Lagged-Dependent Variable	Rho
(Ia)	Fixed coefficient	1.38	0.26	0.06	-0.09				0.64	
	(3.2) (4.5)	(2.0)	(3.8)				(8.7)			
(Ib)	Random coefficient	0.90	0.19	0.05	-0.07				0.74	
	(0.5) (0.9)	(1.4)	(0.4)				(2.0)			
(IIa)	Fixed coefficient	0.77	0.25	0.10	-0.11	-1.64 2/			0.70	-0.9
	(2.2) (3.8)	(3.1)	(4.2)	(3.5)			(8.9)	(0.7)		
(IIb)	Random coefficient	-0.44	0.39	0.05	-0.12		1.00		0.69	
	(6.2) (54.5)	(12.6)	(36.8)		(42.0)		(99.6)			
(IIIa)	Fixed coefficient	0.80	0.21	0.10	-0.10	-1.92 2/		0.65	0.73	
	(2.2) (2.9)	(3.3)	(4.1)	(3.8)		(2.0)	(8.7)			
(IIIb)	Random coefficient	1.57	0.24	0.09	-0.10		0.67	0.87	0.63	
	(2.6) (3.6)	(3.4)	(5.8)		(6.3)	(4.9)	(7.8)			
(IVa)	Fixed coefficient	0.77	0.22	0.10	-0.10	-1.58 2/		0.13	0.73	
	(2.2) (3.4)	(3.2)	(4.0)	(3.4)		(3.0)	(9.3)			
(IVb)	Random coefficient	0.67	0.20	0.10	-0.10		1.05	0.15	0.75	
	(3.0) (6.9)	(6.2)	(7.2)		(11.6)	(5.0)	(19.5)			

Source: Reserve Bank of Australia, Bulletin, various issues; and Department of the Treasury, The Roundup, various issues.

1/ Figures in parentheses are the t-ratios.
2/ Sum of 22 (t-j, j = o through 21) coefficients.

The means of the coefficients on the models estimated on the basis of the random coefficient procedure are close to the values obtained with the fixed coefficient technique. The coefficients on the price expectations variables are -1.64 in Model (IIb), -1.66 in Model (IIIb), and -1.29 in Model (IVb). 1/ However, in interpreting the results of random coefficient estimation, care should be taken not to interpret the t-statistics of the estimates in the conventional manner. In some instances the t-ratios of random coefficient estimation are not significantly different from zero on the usual convention that a t-ratio is less than two in absolute value--for example, in Model (Ib)--while in some other instances they are far more significant than the corresponding fixed coefficient estimates--for example, in Model (IIb). Even if the power of the t-test is very high, the interpretation of this result under random coefficient estimation differs from that of the result applicable to fixed coefficient estimation. The reason why this is so is that a nondegenerate distribution of a random coefficient is not the same as a degenerate distribution of a fixed coefficient at zero even if the mean of the former distribution is zero. 2/ A nondegenerate distribution with mean equal to zero may help to improve the accuracy of a forecast whereas a degenerate distribution at zero may not.

The forecasts of real money balances over the post-sample period, 1984:Q4 through 1985:Q3, and the root mean square errors (RMSE) are presented in Table 2. Table 2 also reports the actual values of real money balances over the forecast period. The conventional partial adjustment model estimated using the fixed coefficient procedure--Model (Ia)--yields a RMSE of 4 percent and the forecasts of real money balances based on Model (la) are considerably below their corresponding actual values in each period. This result is merely a reflection of what is already known: i.e., forecasts of real money balances in Australia based on the conventional money demand model and using conventional estimation techniques have severely underpredicted real money balances in late 1984 and in 1985. The application of the random coefficient procedure to the partial adjustment specification--Model (Ib)--reduces the RMSE by more than half (to 1.8 percent). It eliminates the underpredictions of the forecasts of real money balances in the first two post-sample quarters, and narrows the underpredictions in 1985:Q2 and 1985:Q3.

1/ Note that the coefficients on price expectations in the random coefficient equations are determined by multiplying their corresponding fixed coefficient weights (Σwj) by a_5. The magnitude of the coefficients found in this study are in line with previous work, which find coefficients in the range from -.5 to -3. See, for example, Kahn and Knight (1982).

2/ A degenerate distribution is a distribution concentrated entirely at one point.

Table 2. Australia: Predictions and Root Mean Square Forecast Errors: Real Money Balances, 1984:Q4-1985:Q3

(In billions of Australian dollars, expressed in natural logarithms)

	1984	1985			
	4th qtr.	1st qtr.	2nd qtr.	3rd qtr.	RMSE
Actual	10.906	10.923	10.973	10.991	
Predictions:					
(Ia) Partial adjustment: F.c. 1/	10.885	10.896	10.911	10.951	0.0403
(Ib) Partial adjustment: R.c. 2/	10.906	10.924	10.939	10.982	0.0175
(IIa) Partial adjustment with price expectations: F.c.	10.899	10.913	10.951	10.987	0.0126
(IIb) Partial adjustment with price expectations: R.c.	10.911	10.924	10.965	10.995	0.0050
(IIIa) Buffer stock using instrumental variables with price expectations: F.c.	10.901	10.914	10.954	10.990	0.0107
(IIIb) Buffer stock using instrumental variables with price expectations: R.c.	10.906	10.916	10.960	10.984	0.0081
(IVa) Buffer stock using monetary base with price expectations: F.c.	10.896	10.908	10.956	10.485	0.0129
(IVb) Buffer stock using monetary base with price expectations: R.c.	10.906	10.916	10.966	10.998	0.0059

Source: Reserve Bank of Australia, Bulletin, various issues; and Department of the Treasury, The Roundup, various issues.

1/ F.c. denotes fixed coefficient equations.
2/ R.c. denotes random coefficient equations.

Model (IIa)--partial adjustment with price expectations using fixed coefficient estimation--reduces the RMSE to 1.3 percent and narrows the underpredictions in 1985:Q2 and 1985:Q3 still further, although it also slightly underpredicts in the first two post-sample quarters. Model (IIb)--partial adjustment with price expectations using random coefficient estimation--shows almost no tendency to underpredict real money balances over the post-sample period and reduces the RMSE to 0.5 percent.

The buffer stock specifications using fixed coefficient estimation --Models (IIIa) and (IVa)--yield RMSEs of 1.1 percent and 1.3 percent, respectively, lower than in Model (Ia), and about the same as in Model (IIa). The application of random coefficient estimation to the buffer stock models reduces the RMSE to 0.8 percent in model (3b) and 0.6 percent in Model (IVb).

Thus, in all cases, the estimation of money-demand models with random coefficient estimation significantly decreased the RMSEs compared to conventional fixed coefficient estimation. In three of the Models--(Ib), (IIb), and (IVb), the RMSEs were more than halved. The incorporation of price expectations also helped to significantly reduce the RMSE of the forecasts and helped to eliminate the systematic tendency of the partial adjustment model to underpredict real money balances. The two specifications of the buffer stock model further improved the forecasting results when using fixed coefficient estimation; however, the buffer stock models did not further reduce the forecast errors when estimated with the random coefficient procedure. 1/ The procedure which yielded the lowest RMSE and eliminated the systematic tendency to underpredict real money balances during the post-sample period was random coefficient estimation of the expectations augmented partial adjustment model.

6. Summary and conclusions

The conduct of monetary policy in Australia has changed substantially in recent years in conjunction with the deregulation of the Australian financial system. In the regulated financial system monetary policy consisted of changes in the Statutory Deposit Ratio, interest rate and maturity controls on deposits and lending, and quantitative lending guidance. Because of the existence of controls, changes in the reserve ratio had a visible and direct impact on banks' lending. A number of

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1/ However, as Laidler (1982) has shown, the buffer stock idea is quite consistent with price expectation affects of the type described in Model (II). Only when combined with a particular story about money supply expectations do we get equations (3)-(5). Also, as noted, Laidler argues that the coefficients of the buffer stock model are reduced forms, and thus likely to be variable. For these reasons, the success of the random coefficient technique is quite consistent with the basic buffer stock message.

factors emerged during the 1970s which gave impetus to the deregulation of the financial system, including high and more variable inflation, larger government budget deficits, the rapid advance in communications and data processing technology, and the emergence of stronger links between domestic and international markets. Monetary policy in the deregulated financial environment is implemented mainly through open market operations which initially affect short-term interest rates and, with a lag, other rates in the spectrum. In contrast to the earlier financial environment in which the volume of deposits was primarily demand determined, in the deregulated system the volume of deposits is both demand and supply determined. With banks better able to protect their deposit base and their lending, and with the demand for credit less sensitive to interest rates (due to, for example, floating interest rates) the transmission mechanism of monetary policy has lengthened.

Financial deregulation has also distorted the relationship between the monetary aggregates, on the one hand, and real economic activity and nominal interest rates, on the other. As a result, money demand models severely underpredicted the surge in real money balances which occurred in late 1984 and in 1985, culminating, in early 1985, in the abandonment of the practice of announcing conditional projections of M3.

This paper has discussed both transitory and permanent factors which may have contributed to money demand instability in Australia. In either case, there are strong reasons to caution against forming predictions of real money balances on the basis of fixed coefficient models. If financial deregulation involves a change in financial regimes in which a stable money demand function once again reappears, it is unlikely that the determinants of money demand will bear the same relationship to real money balances in the new regime as they did under the regulated framework--the new money demand relationship may not be in the same guise as the earlier relationship. Indeed, our discussion of why the interest rate elasticity of money demand has been reduced in the new financial environment is just one manifestation of this argument. Consequently, fixed coefficient money demand functions estimated on the basis of sample data which consist largely of observations drawn from the regulated framework, will be contaminated by that data; they will not yield consistent (in the probability sense) parameter estimates of the new stable money demand relationship. Hence, forecasts of the demand for money will not be reliable.

On the other hand, if the demand for money exhibits a more sustained degree of instability in the deregulated financial environment (due, perhaps, to the increased proportion of investment balances held within M3), the rationale for fixed coefficient estimation is also highly suspect. In either case, the results of this paper support the hypothesis that a greater degree of predictive information would be generated by an estimation technique which incorporates changing relationships, rather than one which assumes them away. The results of the paper also indicate that incorporation of price expectations, in addition to nominal interest rates, in money demand models reduces forecast errors (under both fixed coefficient and random coefficient estimation) of real money balances; this supports the view that price expectations are particularly relevant as a proxy for the opportunity cost to holding money in models estimated on the basis of data largely from a sample period in which nominal interest rates may not have reflected market clearing values.

Australia: Financial Deregulation

(December 1979-December 1986)

Date of Announcement	Deregulatory Move
December 1979	Tender system for sales of Treasury notes was introduced.
December 1980	Ceilings on interest rates offered by trading and savings banks on deposits were removed.
August 1981	Minimum maturity on trading bank certificates of deposit was reduced from 3 months to 30 days.
March 1982	The minimum period for which trading banks may offer fixed deposits and CDs was reduced from 30 days to 14 days for amounts of $A 50,000 and over and from 3 months to 30 days for fixed deposits of under $A 50,000.
March 1982	Savings banks were authorized to offer fixed deposits of less than $A 50,000 for terms of 30 days to 4 years.
June 1982	Effective July 1, authorized money market dealers were allowed more flexibility (i.e., could hold up to 30 percent rather than 20 percent of gearing limits) in the composition of the non-Commonwealth Government component of their portfolios.
June 1982	The Loan Council 1/ decided that: (i) a tender system would replace the tap system for selling Commonwealth treasury bonds; (ii) the power to determine the terms and conditions of Australian Savings Bond issues would be delegated to the Treasurer; and (iii) major electricity authorities would be freed, in respect of their domestic borrowing, from Loan Council controls.
June 1982	With effect from the end of June, quantitative controls on trading bank lending were discontinued.
August 1982	Effective August 31, the 40 percent "prescribed assets ratio" imposed on savings banks was replaced with a 15 percent "liquidity ratio." In addition, savings banks were allowed to invest up to 6 percent of deposits in assets (other than fixed assets) of their choice.

Australia: Financial Deregulation

(December 1979-November 1986)

Date of Announcement	Deregulatory Move
July 1983	Loan Council controls over the domestic borrowing of larger local authorities were discontinued.
December 1983	Effective December 12, the Australian dollar was allowed to float freely and exchange control to be largely dismantled.
April 1984	Effective August 1, all maturity controls on trading and savings banks were removed. This step allowed banks to take deposits for less than 14 days and over 4 years to maturity.
April 1984	Effective August 1, banks were permitted to offer interest on checking accounts and call money.
April 1984	Effective August 1, savings banks were: (i) be able to offer checking facilities on all accounts; (ii) no longer be subjected to the $A 100,000 limit on deposits held by a trading or profit-making body; and (iii) be able to take fixed deposits of over $A 50,000.
September 1984	The "30/20" rule imposed on life insurance companies and pension funds was abolished.
September 1984	Criteria for (foreign) bank entry were clarified and applications for new banking licenses were invited.
February 1985	The names of the 16 foreign concerns to receive banking licenses were anounced.
February 1985	Macquairie Bank Limited was granted an authority to carry on banking business as a trading bank. It commenced operations on March 1.
April 1985	Remaining ceilings on bank loan rates except ceilings on loans for owner-occupied housing of amounts less than $A 100,000 were removed.
May 1985	The LGS convention was terminated; and the prime assets ratio was introduced.

Australia: Financial Deregulation

(December 1979-November 1986)

Date of Announcement	Deregulatory Move
June 1985	An authority was granted on June 1 to the Advance Bank Australia Limited to carry on banking as a savings bank. It commenced operations on that day.
October 1985	The Prime Minister announced that a Group of Commonwealth officials had been established to conduct a review of the regulatory framework governing the financial sector.
April 1986	The interest rate ceiling on new home loans of less than $A 100,000 was removed.
September 1985-June 1986	Nineteen banks commenced operations.
July 1986	The Government announced its intention to exempt pure offshore banking from interest withholding tax. Legislation is expected to be introduced in 1987.
November 1986	The Treasurer announced the relaxation of restrictions on investments at interest by foreign governments. There will be no restriction on the type of interest bearing investments permitted although the investing entity will be expected to be at arms length from the borrower. Only central banks and the IBRD and ADB will be allowed to make unlimited investments. The level of allowable reserve investment for other institutions will be determined by the RBA.

Sources: Martin Report; and Reserve Bank, Bulletin, various issues.

1/ The Loan Council was set up with the aim of preventing competition between the Commonwealth and various State Governments in raising loans. It consists of the Prime Minister, who is its Chairman, and the Premier of each State--or their representatives.

Data Definitions

The monetary base consists of holdings of notes and coin by the private sector plus deposits of banks with the Reserve Bank, and Reserve Bank liabilities to the private nonbank sector. M3 is currency plus bank deposits (including certificates of deposit of the private nonbank sector). The M3 series is seasonally adjusted and excludes deposits with new banks since March 1985.

Real money balances is M3 divided by the implicit GDP deflator (1979/80 = 1.00).

Y is real GDP at average 1979/80 prices (fiscal year ending in June).

r^o is the interest rate on trading bank fixed deposits. This comprises the rate of 18- to 24-month maturity from 1972, first quarter, to 1974, second quarter, and the midpoint of the range of 24- to 48-month deposits thereafter. This series was provided by the Department of the Treasury, Australia.

r is the yield on ten-year Commonwealth Government securities.

Lag Procedures

Some of the demand for money models we considered in this paper may be expressed as

$$M_t = \beta_o + \beta_1 P_t^e + \gamma' z + u_t \tag{1}$$

Where u_t follows an autoregressive process of the first order, P_t^e represents an expected price variable and z_t represents the other variables we included on the right-hand side of money demand equations. Four procedures were used to estimate the distributed lags for price expectations: (i) ordinary least squares; (ii) Almon polynomial lag distribution. In this technique the n coefficients of the lagged explanatory variables are assumed to be on a polynomial (i.e., a function of the lag length) of order r. This allows for a flexible lag structure with a reduction in the numer of parameters that require estimation if r is less than n. It can be viewed as imposing a specific set of linear constraints on OLS estimation; (iii) Shiller's distributed lag is a variant of this in which these restrictions are stochastic; the coefficients of the lagged explanatory variable lie close to, rather than on, a polynomial; (iv) the ridge regression method confines the coefficient vector to an ellipsoid about the origin covering all smooth coefficient vectors of certain length. The position of the ellipsoid in the parameter space is determined in such a way that the mean square error of the corresponding ridge estimator is the smallest.

Specifically, we model the unobservable price expectations variable, P_t^e, as a distributed lag model in actual prices; algebraically

$$\beta_1 P_t^e = \sum_{j=o}^{n} W_j P_{t=j} \tag{2}$$

where p_t is the actual price in period t.

Combining (1) and (2) gives

$$M_t = \beta_o + \sum_{j=o}^{n} W_j P_{t-j} + \gamma' z_t + u_t \tag{3}$$

We further assume that for $j=0,1,2,\ldots n$:

$$W_j = \alpha_o + \alpha_1 j + \ldots + \alpha_{P-1} j^{P-1} + \lambda_j \tag{4}$$

where the vector $(\lambda_o, \lambda_1, \ldots, \lambda_{n-1})'$ is a priori distributed with mean vector 0 and covariance matrix Δ implied by Shiller's smoothness restrictions; for an explicit derivation of Δ, and the estimators of the coefficients of (3), see Thurman, Swamy, and Mehta (1986), and Kashyap, Swamy, Mehta, and Poreter (1986).

Equation (4) reduces to Almon's restrictions if the variance of λ is zero for every j. Thurman et al (1986) and Kashyap et al (1986) derive the ridge estimators of the coefficients of equation (3) when the w_js lie within an ellipsoid implied by Shiller's smoothness restrictions. Equation (4) is not binding if the variance of λ is ∞ and the posterior mean for the prior (4) reduces to the generalized least squares estimator in this case.

The root mean square errors of the alternate lag procedure obtained in models (IIa), (IIIa), and (IVa) were:

	Model (IIa)	Model (IIIa)	Model (IVa)
Least squares	0.0126	0.0107	0.0129
Posterior mean for Shiller's smoothness prior	0.0130	0.0110	0.0132
Almon	0.0327	0.0356	0.0350
Ridge	0.0129	0.0109	0.0132

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