MODELLING RECENT DEVELOPMENTS IN AUSTRALIAN ASSET MARKETS:

SOME PRELIMINARY RESULTS

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ABSTRACT

This paper represents a first attempt to model the macroeconomic implications of recent changes in Australian financial markets: the floating of the Australian dollar; the introduction of tendering for government bonds; and the deregulation of banking in August 1984.

The RBII model is adapted to incorporate these changes, and subjected to a series of shocks in simulation. The results are used to illustrate the properties of the modified model.

The conclusions suggest that the model's behaviour is consistent with received theory; monetary control is facilitated and a form of the Fleming-Mundell result holds in the longer term.

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1. Introduction

A central feature of the RBII model of the Australian economy has been its use of policy reaction functions to endogenise the exchange rate and interest rate management through which the authorities attempted to implement economic policy. Furthermore, the estimated structure of RBII reflects the regulation of deposit-taking by banks and the effect of this regulation on, in particular, the own rate of interest on money. This structure requires revision after the adoption in 1982 of the system for selling government securities (hereafter "bonds") by tender, the floating in 1983 of the Australian dollar, and the removal of banking controls in August 1984.

In particular, changes need to be made to the policy reactions estimated on the basis of past relationships and to some of the private reactions based on the historical experience, including the determination of the own rate of interest on money.[1]

This respecified model cannot be estimated until there is a sufficient run of data generated by the current system. This paper, therefore, presents a simulation version of the RBII model designed to represent a first attempt to model the present structure of the financial system. Sections 2, 3 and 4 deal with the modelling of the money market, bond market and foreign exchange market respectively. Section 5 examines some basic properties of the modified model, and Section 6 concludes with some final remarks on research strategy.

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1. Previous studies have used the RBII model to investigate alternative monetary policies (as in Jonson and Trevor (1981)) and exchange rate policies (as in Jonson, McKibbin and Trevor (1982)). While these studies retained interest rates and exchange rates as the instruments of the respective policies, their modifications to the policy reaction functions represented a first step in the direction explored more fully in this paper.

2. The Money Market

The deregulation of deposit-taking by banks can be expected to lead to less variation in interest differentials between money (which is predominantly bank deposits) and non-money assets.[2] Therefore, movements in the own rate of interest on money should, after deregulation, follow movements in other market rates more closely than in the past.

Beginning with the estimated structure of the most recent version of the RBII model,[3] this is modelled here by revising the definition of the equilibrium money rate, $\hat{r}_m$, in equation (19) of RBII to depend on both the bond rate r_b, and the bill rate, r_{bl}, rather than only on the bond rate. The new specification is:[4]

$$\hat{r}_m = r_{mo} + \beta'_{64} r_b + (1-\beta'_{64}) r_{bl}$$

It is also desirable that, after deregulation of the own rate on money, the demand for money should be less affected by changes in the general level of interest rates. In the current exercise, it has been assumed that money demand is homogeneous of degree zero in all interest rates (the own rate, and bond and bill rates) together.[5]

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2. See, for example, Moses (1983), p6.

3. This is the version described in detail in Fahrer, Rankin and Taylor (1984).

4. A full listing of the notation and data definitions is given in the Appendix. In the simulations below, β'_{64} is set to 0.5.

5. Homogeneity is imposed by reducing the coefficient on the bond rate to be the inverse of the sum of the coefficients on the other two interest rates.

3. The Bond Market

With the adoption of the tender system for selling government securities after 1982, the authorities no longer directly control the rates of interest on these securities. A quantity of paper to be offered for sale is now decided by the authorities, and the price is that at which the market will absorb this addition to the stock.

The method adopted for modelling this system is as follows. The estimated demand function for bonds is

$$\log \hat{Pb} = \log b_o + \log P + \log y + \beta_{40} r_b + \beta_{41} r_m + \beta_{42}(r_b^e - r_b)$$

This function is inverted to obtain the interest rate which would clear the market, which is denoted $\hat{\hat{r}}_b$. It is further assumed that the expected future bond rate, r_b^e, is equal to this market-clearing value. This yields an expression for $\hat{\hat{r}}_b$ as:

$$\hat{\hat{r}}_b = \beta_{40}^{-1}(\log B - \log b_0 - \log Y - \log P - \beta_{41} r_m)$$

The actual level of the bond rate, r_b, is assumed to adjust towards $\hat{\hat{r}}_b$ through a first-order error-correction process as assumed in most RBII equations. Therefore,

$$Dr_b = a_{20}' (\hat{\hat{r}}_b - r_b) \tag{20'}$$

This specification implies that the market will remain off its demand function for a time after any change in bonds. This seems reasonable given that the supply of bonds (through periodic tenders) is changed at discrete intervals and, therefore, that a "long-run" demand function such as that implicit in equation (20) will not move exactly in line with discrete jumps in supply.[6] (It is the face value of bonds, not market value, that is modelled in RBII.)

Equation (20) is used to replace the reaction function for the bond rate in the estimated version of RBII. A new reaction function is assumed for the quantity of bonds supplied by the authorities:

$$DB = \beta'_{62} (P_g g_1 + Pg_2 + P_c - T_1 - T_2 + DMISC) + \beta'_{63} (M - M_T) \qquad (13')$$

This equation assumes that the supply of bonds responds partly to the size of the government's deficit and partly to the degree of monetary tightness desired. The two coefficients can be adjusted to provide for greater or lesser "weights" on the two objectives in the assumed policy reaction function.[7]

It is also assumed that the interest elasticities of other asset demands will be altered by the change in structure in the bond market. Since the effect of the respecification of the bond and money markets will be to make interest rates more variable in the short-run, and as noted above the asset demands are long-run in nature, the interest elasticities of money demand and desired bank advances are reduced.[8]

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6. The interpretation of these demand functions as "long-run", "equilibrium", or "target" relationships is discussed in Davidson (1984), section 2, as well as in earlier papers on the RBII model.

7. In the simulations reported below, β'_{65} and β'_{63} are both set to 0.7. The use of alternative values for each, in a range of 0.4 to 0.8, has little effect on the qualitative results obtained.

8. All interest rate coefficients in these functions are exactly halved, preserving homogeneity. The case of the demand for net foreign capital is treated below.

Following the reasoning of Jonson, McKibbin and Trevor (1982), this change may represent a "sensible" (though not necessarily "rational" in the Lucas sense) response of private sector demands to the structural change in the bond market.

Finally, it should be emphasised that equation (13') is only one simple member of a large class of possible reaction functions. For example, if the authorities were assumed to intervene in exchange markets, it would be necessary to introduce targets for international reserves as well as money, since any monetary objective could in principle be met by a mix of exchange market and bond market operations.

4. The Foreign Exchange Market

The third change to be considered here is the floating of the Australian dollar in December 1983. This is modelled within the RBII framework as follows.

The authorities are assumed to decide on a target level for reserves, R_T, which reflects their intended intervention in each period; in the pure float modelled in this paper, this target level is constant.[9] The supply of and demand for foreign exchange by private agents are then equated by movements in the exchange rate. Net transactions are, therefore, zero, so that the level of foreign reserves is unchanged at the (constant) target value.

The foreign exchange market is assumed to clear instantaneously since both demand and supply are elastic even within the trading day. This differs from the assumption about adjustment in the bond market, and requires that the

9. The target level of reserves is set to the actual level at the start of the simulation period used.

specification of the net supply of foreign exchange is short-run in nature, and not a long-run "equilibrium" relationship as used elsewhere in RBII.

Mechanically, the procedure adopted involves alterations to three equations. The exchange rate reaction function is dropped from the model. The reserves equation is replaced with an expression which equates reserves to their target level:

$$R = R_T \text{ (= } R_o \text{ in this paper)} \tag{22'}$$

The identity which is used in the estimated model to determine reserves is inverted to determine the rate of net capital inflow required to yield the change in reserves given by (22'):

$$DF = DR - P_x x + EP_i i - DF_g \tag{14'}$$

Finally the estimated net capital equation

$$\begin{aligned} DlogF = {} & a_{14} \log P\hat{f}/F) + \beta_{43} \log (M/M_o e^{\lambda_2 t}) \\ & + \beta_{44} \log(q_o P_x x/EP_i i) + \beta_{45}(Dr_{bl} - Dr_{eu} \\ & \beta_{46}(r_{bl} - r_{eu}) + \beta_{47} \log (\hat{E}/E) + \beta_{48}\, QF \end{aligned}$$

$$\hat{F} = f_o ye$$

is inverted to obtain an equation for the floating exchange rate:

$$\begin{aligned} \log E = {} & (\alpha_{14}\beta_{47} + \beta_{44})^{-1} [\alpha_{14} \log f_o \\ & + \alpha_{14} \log P + \alpha_{14} \log y + \alpha_{14}\beta_{46}(r_{bl} - r_{eu}) \\ & + \alpha_{14}\beta_{47} \log\hat{E} + \alpha_{14}\beta_{48}\, QF + \beta_{43} \log(\frac{M}{M_o e^{\lambda_2 t}}) \\ & + \beta_{44} \log(q_o P_x x/P_i i) + \beta_{45}(Dr_{bl} - Dr_{eu}) \\ & - DlogF] \end{aligned} \tag{21'}$$

where $\hat{E} = E_o(P/P_w)$ as before.

Since β_{43}, β_{44} and β_{47} are negative, while β_{45} and β_{46} are positive, it can be seen that the exchange rate responds positively (depreciates) to rises in the purchasing power parity rate $\hat{E}$, world interest rates, and domestic money growth; and negatively (appreciates) to increases in domestic interest rates or surpluses on the current account (which necessarily correspond to negative values of DlogF).

To represent the removal of capital controls at the time of floating, the adjustment speed of net capital flows is increased. Moreover, the more rapid response of the exchange rate under floating suggests that expectations about the exchange rate should also adjust more quickly; the coefficient of $\log\hat{E}$ in the demand for net foreign capital is therefore increased as well.[10] Because of the short-run nature of the demand for net foreign capital implicit in equation (21'), no adjustment is made to the interest elasticities in this case.

It should be emphasised that, because the model is simulated as a simultaneous system, the exchange rate is determined jointly with capital flows and trade components even though it is the estimated capital flow equation which is used to calculate E.

The net supply of foreign exchange is the sum of balances on the current account and capital account. In RBII, these two components are proximately determined by different

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10. These modifications were used by Jonson, McKibbin and Trevor in their more-flexible-rate model. As already noted in Section 3 above, they were chosen to represent "sensible" responses to the change in exchange rate regime. In the present paper, the expectations parameter β_{47} is reset from -0.5 to -5.0, while the adjustment speed is raised from 0.056 to 6.0.

factors: the current account by activity and relative prices, with relatively slow adjustment speeds; and the capital account by expected relative rates of return and monetary conditions, with relatively fast adjustment speeds. (The capital account includes a small offset to the current account, due to the role of capital transactions in trade financing.) Under a pure floating exchange rate, where the net supply of foreign exchange is zero, the two markets are interdependent: a current account deficit or surplus must be offset by a capital account surplus or deficit of equal magnitude. The adjustment to any disturbance will take place through movements in the determinants of both the current and capital accounts.

5. Simulation Results

The version of RBII used as a basis for the construction of this simulation model is that described in detail in Fahrer, Rankin and Taylor (1984); the resulting simulation model is presented in summary in the Appendix to this paper.

A control solution was found for the modified model, using 1976(1) as a starting point and running for 28 quarters. In this solution, the target growth rate of money is set to a constant 0.025 per quarter, which was approximately the historical average over the period. This gives a specification for the money target variable in equation (13') of $M_T = M_0 e^{0.025t}$ where M_0 is the actual value of the money supply at the start of the simulation, at which time t=0.

This control solution cannot be compared with the historical outcome, since the assumptions about market structures and policy determination did not apply over the period. It is possible, however, to examine the properties of the simulation model itself by analysing the deviations from the control solution caused by exogenous shocks of various kinds.

Three shocks are considered:

. a sustained 5 per cent increase in real current government spending (a non-accommodated fiscal expansion);

. as above, with an increase of 0.5 per cent per quarter in targeted monetary growth (an accommodated fiscal expansion); and

. as the first shock, with a decrease of 1.0 per cent in the long-run target value of real household saving (a non-accommodated fiscal expansion with increased consumer confidence).

The effects of these shocks, in terms of deviations from the control solution, are shown for key variables in figures 1-7.

The degree of accommodation or non-accommodation in each case is clear from figures 3, 5 and 6. In the first and third cases, the money supply (figure 6) is held to within 0.2 per cent of control throughout the simulation period. Bonds (figure 5) rise strongly, as does the bond rate (figure 3). In the second case, the additional growth of money implies a path for bond sales which has the effect of stabilising the bond rate within 0.1 percentage points of its control value.

In all cases, it is monetary growth that is assumed to be targeted, and the results show that the assumed reaction function (13') keeps the money supply quite close to its specified target.

5(a). <u>The case of non-accommodated fiscal expansion</u>

This case is shown as the solid lines in the figures.

Figure 1

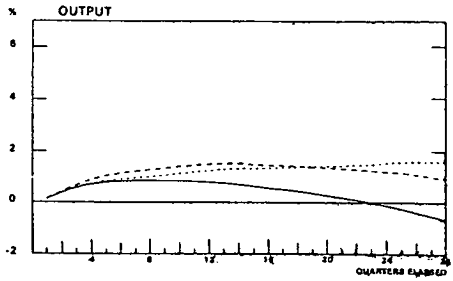


Figure 2

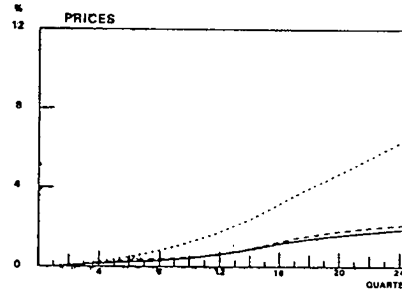


Figure 3

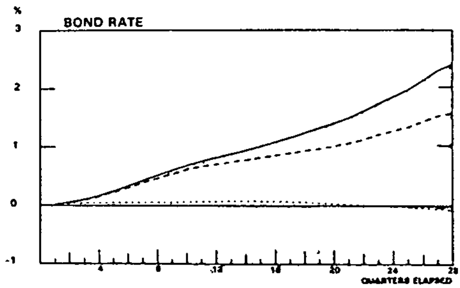


Figure 4

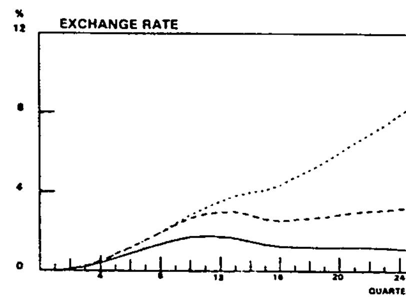


Figure 5

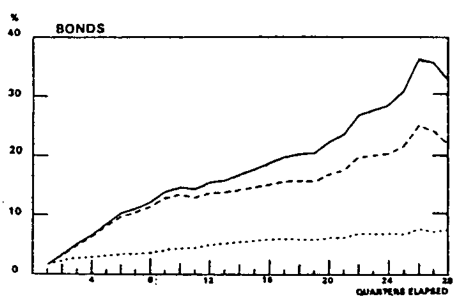


Figure 6

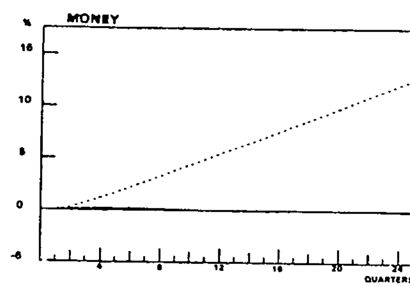
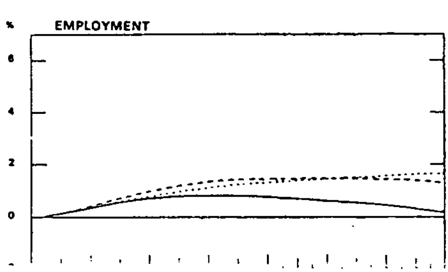


Figure 7



Key:

Non-accommodated fiscal shock: —

Accommodated fiscal shock: .....

Non-accommodated fiscal shock wi
confidence effect: ---------

Output (figure 1) rises slowly, peaking after seven quarters and declining thereafter. The peak multiplier is approximately 0.97, and declines to zero after twenty-two quarters. This "crowding out" effect is due primarily to the large rise in interest rates produced by the bond-selling policy assumed but also because of the real appreciation that occurs towards the end of the simulation period, and the increase in the excess supply of inventories that is present throughout all but the first six quarters of the simulation.

The price level (figure 2) is permanently increased, though only slightly: on average, the annual inflation rate is about 0.3 percentage points higher than control, primarily due to rises in unit labour costs. It is slower at first, when most of the spending stimulus is reflected in output, but rises as the output multiplier declines.

The increased demand worsens the current account for six years. This is offset by capital inflow which is attracted by higher domestic interest rates and (for the first four years, while interest rates are rising slowly) by a real depreciation (a rise in EP_W/P) which generates an expectation of appreciation in the future. From the fifth year, with income declining and the current account improving, the exchange rate appreciates in real terms.[11]

The stock of money is held to within 0.2 per cent of control throughout the simulation; this result shows closer

11. This is consistent with macroeconomic theory, as exemplified by the Fleming-Mundell model, which predicts a real appreciation of the exchange rate as a result of a non-accommodated fiscal expansion.

monetary control than earlier versions of the model.[12] With money being held at control, a large increase in bond sales (figure 5) is needed to finance the budget deficit (via equation 13'). This increase in the supply of bonds leads to an increase in the bond rate (equation (20'); figure 3). By the end of the simulation period it is about 2.5 percentage points above control.

The response of employment is shown in figure 7. Real wages slightly rise at first, due to the pressure of higher activity, but begin to decline after eleven quarters. The initial rise in real wages prevents employment rising in line with output but as real wages fall employment is prevented from falling below control towards the end of the period. Variations in real wages are, therefore, an important factor in smoothing the employment effects of the cycle in real output in this simulation.

5(b). <u>The case of accommodated fiscal expansion</u>

The effects of the accommodated rise in government expenditure are shown by the short-dashed lines in the figures.

Output grows more quickly than under non-accommodating monetary policy, and levels out to approximately 1.61 per cent above control after seven years. (This implies a multiplier of about 1.88). This result is again conventional; the rise in interest rates which limited the rise in output under non-accommodation is prevented by the higher growth of money.

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12. Previous RBII results under assumptions of monetary targeting, such as those of Jonson and Trevor (1981), found the money stock varied more substantially from control for the first two years after a similar shock.

The price level rises substantially, however. At the end of the simulation, prices are 8 per cent above control; this is equivalent to an addition to inflation of 1.1 per cent per year on average over the seven years. There are two main contributing factors to the higher prices - the increases in the supply of money and unit labour costs. The rate of inflation increases by less than the growth rate of money because of the higher level of activity during the simulation run.

The higher demand and higher prices worsen the current account throughout the simulation. The capital inflow required to balance this is obtained (in the absence of any increase in domestic interest rates) by a real depreciation which is sustained throughout the seven year period. The average rate of depreciation of the nominal exchange rate, of 1.28 per cent per year, is 0.18 per cent per year greater than the increase in the inflation rate.

Real wages are slightly above control throughout, although they peak after three years at 0.52 per cent above control; this ensures that employment rises by less than output for the first five years. Thereafter, the slowdown in real wages, together with the disincentive to investment caused by the higher inflation rate, allow the employment-output ratio to rise marginally above control.

The comparison of the non-accommodated policy with the accommodated policy shows clearly that there is a "medium-run" trade-off of activity and inflation effects between these forms of monetary policy.[13] In the simulation version of RBII presented here, a higher level of output can be obtained, through accommodating the spending increase, but at the cost of adding significantly to the rate of inflation.[14]

The importance of this inflation cost can be best appreciated by considering the third shock.

5(c). <u>The case of a non-accommodated fiscal expansion with reduced saving</u>

It has been argued that uncertainty associated with rising inflation may have been a factor increasing the savings ratio in the 1970's. The results above show that the adoption of a policy of non-accommodation rather than one of accommodation implies lower future inflation; if this outcome is expected, the choice of the lower inflation policy may lead to some reduction in the savings ratio.

This possibility is simulated by combining the non-accommodated spending shock with a fall of 1.0 per cent in long-run target value of the household saving ratio.[15] The results are shown by the long-dashed lines in the figures.

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13. The specification of RBII precludes any systematic long-run trade-offs of this type (although inflation can alter long-run output through effects on the capital stock). Since the long-run equilibrium bond rate and exchange rate in the estimated reaction functions of the unmodified RBII model are consistent with market equilibrium, the long-run results of the present version should be broadly similar to the long-run results of the unmodified version.

14. As shown, however, by Jonson, McKibbin and Trevor (1980), relatively small changes to the structure of an earlier verion of RBII made this trade-off even less favourable. Similar results would be expected to apply to the current model.

15. See, for example, Williams (1979), Section 4.2.

In this case, the response of output is greater than for accommodated policy for the first four and a half years and much greater, right throughout, than for the simple non-accommodated shock. It reaches a peak after three and a half years at a multiplier of approximately 1.80, and declines slowly towards control thereafter. The price level rises, on average, by 0.34 per cent per year. Thus the fall in savings adds only 0.04 per cent per year to inflation, which is small enough to be unlikely to overturn the confidence effect assumed.

The increase in employment is also stronger than for accommodated policy in the first five years, (and for the simple non-accommodated shock throughout), reflecting the larger boost to activity.

Qualitatively, the remaining variables respond similarly in this case as in the first case of a non-accommodated spending rise. Higher activity implies a smaller budget deficit, however, reflected in smaller bond sales (figure 5), and a lower bond rate (figure 3), than resulted in the first case.

It appears from these results that the small reduction in the savings ratio is able to give a considerable increase in output and employment at a virtually unchanged rate of inflation.[16]

Of course, the savings ratio is not a policy instrument under the authorities' control, and the reduction

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16. In a supplementary simulation with a simultaneous reduction of demand for money and bonds to offset the higher consumer spending (thus explicitly enforcing a household sector budget constraint in ex-ante terms), this result was substantially unchanged.

simulated here is merely one possible structural shift that could follow a shift in expectations about future inflation. Such an effect, if it exists, may be stronger or weaker than assumed here, and may appear elsewhere than in household behaviour. The present exercise only serves to underline the potential for "structural" shifts to alter the properties of an econometric simulation model like RBII.

6. Conclusion

This paper has attempted to show how a macroeconometric model can be adapted to handle changes of policy regime, such as the floating of the exchange rate, the introduction of a tender system for government bonds and interest rate deregulation. In doing so, the approach has recognised the interdependence of the current and capital accounts of the balance of payments under a floating exchange rate.

It has also been assumed:

- that because bonds are not supplied continuously, but at discrete intervals (through the periodic tenders), the Walrasian tatonnement process may not apply and thus that a partial adjustment mechanism may be appropriate for the determination of the bond rate;
- that interest rate expectations are consistent with market-clearing in the bond market and are fulfilled asymptotically;
- that the government's decision to sell a given quantity of bonds can allow for the need to fund the budget deficit while simultaneously achieving a targeted rate of growth for the money supply.

Attention has also been paid to some of the structural changes that might occur under these changes of policy regime, both to the model's parameters generally and to the specification of particular shocks.

Some of the properties of the model have been illustrated with counterfactual policy simulations. The results of these simulations suggest that fiscal and monetary policy, by themselves, cannot sustain an economic recovery with stable prices unless they induce (through expectations) changes in private agents' behaviour not captured in the structure of the model.

Comparison of these results with those of earlier versions of RBII (which use the estimated policy reaction functions) suggests that the structural modifications introduced in this paper facilitate the pursuit of monetary objectives in the short run. However, they have not much altered the real government spending multipliers (for output and employment) as might be expected in a model where nominal wages are assumed to adjust fully to movements in prices.

These results must, of course, be interpreted with caution. They are produced with an econometric simulation model in which some relationships are assumed rather than estimated. Moreover, the model assumes a simple specification for policy reactions. However, in attempting to apply existing econometric evidence to questions of the behaviour of "flex price" rather than "fix price" asset markets and their interaction with the "real" economy, it is hoped the paper makes some contribution to the understanding of the workings of these markets.

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APPENDIX: RBII SPECIFICATION[1]

1. Household Expenditure

$$D\log(P_d d) = \alpha_1 \log(P\hat{d}/P_d d) + \beta_1 \log(P\hat{m}/M)$$

$$\hat{d} = d_o y_d e^{\beta_2[(r_a/4.0)-D\log P]}$$

$$y_d = y - T_1/P + c$$

$$P_d = P_{d_o}[EP_i(1+t_3)]^{\beta_3} P^{(1.0-\beta_3)}$$

$$\hat{m} = m_o\, y e^{\beta_4 r_m + \beta_5 r_b + \beta_6 r_{bl}}$$

2. Rate of Growth of Business Fixed Capital Stock

$$Dk = \alpha_2 (\hat{k} - k)$$

$$\hat{k} = \beta_7 \hat{k}_1 + (1.0-\beta_7)\hat{k}_2$$

$$\hat{k}_1 = \beta_8 (mpk - r_k) + \beta_9 (D\log P - (\lambda_2 - \lambda_1))$$

$$\hat{k}_2 = D\log K_{minv} - (\lambda_2 - \lambda_1)$$

$$mpk = \beta_{10} (\hat{y}_{nf} - g_1)/K$$

$$r_k = (r_b/4.0) - D\log P$$

3. Stock of Dwellings

$$D\log K_h = \alpha_3 \log(\hat{K}_h/K_h) + \beta_{11} \log(L/\phi_o N)$$

$$\hat{K}_h = K_{h_o} y_d e^{\beta_{12} r_a}$$

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1. A subscript of zero (o) indicates a constant. D is the differential operation d/dt, e is the exponential operator, and log is the logarithmic (to base e) operator. A variable with a hat (^) above it indicates the desired value of the variable.

4. Exports of Goods and Services

$$\mathrm{Dlog}\ x = \alpha_4 \log(\hat{x}^d/x) + \beta_{13} \log(\hat{v}/v) + \beta_{14}\ QDS$$
$$+ \beta_{15} \log(\dot{\mu}_o y_f/y)$$

$$\hat{x}^d = x_o^d\ x_w(P_x/EP_w)^{\beta_{16}}$$

$$\hat{v} = v_o s_p^e$$

5. Imports of Goods and Services

$$\mathrm{Dlog}i = \alpha_5 \log(\hat{i}/i) + \beta_{17} \log(\hat{v}/v)$$

$$\hat{i} = [i_o[EP_i(1.0+t_3)/P]^{\beta_{18}} e^{\beta_{19}Q_i}](s^e - y_f)$$

6. Domestic Production

$$y = y_{nf} + y_f$$

$$\mathrm{Dlog}y_{nf} = \alpha_6 \log(\hat{y}_{nf}/y_{nf}) + \beta_{20} \log(\hat{v}/v)$$

$$\hat{y}_{nf} = [1.0-\hat{i}](s^e - y_f)$$

7. Price of Domestic Production

$$\mathrm{Dlog}P = \beta_{21}\ \mathrm{Dlog}P_{bt} + \beta_{21}\ \mathrm{Dlog}(1.0+t_6) + (1.0-\beta_{21})\mathrm{Dlog}P_x$$

$$\mathrm{Dlog}P_{bt} = \alpha_7 \log(\hat{P}_{bt}/P_{bt}) + \beta_{22} \log\ (\hat{Pm}/M)$$
$$+ \beta_{23}\log(\hat{v}/v)$$

$$\hat{P}_{bt} = P_{bt_o}[1.0/(1.0-\beta_{10})]WL(1.0+t_4)/\hat{y}_{nf}$$

8. Price of Exports of Goods and Services

$$\mathrm{Dlog}P_x = \alpha_8 \log(\hat{P}_x/P_x) + \beta_{24} \log(\hat{v}/v)$$

$$\hat{P}_x = P_{x_o}(EP_{w1})^{\beta_{25}}[EP_i(1.0+t_3)]^{(1.0-\beta_{25})}$$

9. Price of Government Current Expenditure

$$D\log P_g = \alpha_9 \log(\hat{P}_g/P_g)$$

$$\hat{P}_g = P_{g_0} W^{\beta_{26}} P^{(1-\beta_{26})}$$

10. Average Weekly Earnings

$$D\log W = \alpha_{10} \log(\hat{W}/W) + \beta_{29} \log(L/\phi_0\hat{N})$$

$$+ \beta_{32} \log(P\hat{m}/m) + \beta_{30} \log(w_a/w_{a_0} e^{\lambda_5 t})$$

$$+ \beta_{31} (D\log w_a - \lambda_5)$$

$$\hat{W} = W_0(1.0-\beta_{10}) P\hat{y}_{nf}/L$$

11. Rate of Growth of Employment

$$D\ell = \alpha_{11} (\hat{\ell}-\ell) + \beta_{33}\log(y/\bar{y})$$

$$\hat{\ell} = \beta_{34} (mp\ell - \beta_{35}w_r)$$

$$mp\ell = (1.0-\bar{\beta}_{10}) \hat{y}_{nf}/L$$

$$w_r = W(1.0+t_4)/P$$

$$\bar{y} = y_0 e^{\lambda_3 t} L^{(1.0-\beta_{10})} K^{\beta_{10}}$$

12. Labour Supply

$$D\log N = \alpha_{12} \log(\hat{N}/N) + \beta_{36} \log(L/\phi_0 N)$$

$$\hat{N} = N_0 \{W(1.0-t_1)/P_d w_0 e^{\lambda_4 t}\}^{\beta_{37}} Z$$

13. Non-Bank Holdings of Government Securities

$$DB = \beta_{62}(P_g g + Pg_2 + Pc - T_1 - T_2 + DMISC) + \beta_{63} (M - M_T)$$

14. Net Australian Private Capital Owned by Overseas Residents

$$DF = DR - P_x x + EP_i i - DF_g$$

15. Bank Advances

$$D\log A = \alpha_{15} \log(\hat{A}/A) + \beta_{49} \log(Py/P_o y_o e^{\lambda_2 t})$$

$$+ \beta_{50} D\log(Pv) + \beta_{51} QA$$

$$\hat{A} = A_o(1.0-h)Me^{\beta_{52}(r_b - r_a)}$$

16. Personal Income Taxes

$$D\log T_{11} = \alpha_{16} \log(\hat{T}_{11}/T_{11}) + \beta_{53} (D\log\hat{T}_{11} - \lambda_2)$$

$$\hat{T}_{11} = T_{11_o} t_1 WL$$

$$t_1 = t_{11} W^{\beta_{54}}$$

17. Bank Bill Rate

$$Dr_{bl} = \alpha_{17} (\hat{r}_{bl} - r_{bl}) + \beta_{55} DQr_{bl}$$

$$\hat{r}_{bl} = r_{bl_o} + \beta_{56} r_{eu} + (1.0 - \beta_{56}) r_m + \beta_{57} \xi + \beta_{58} QE$$

$$\xi = \log (\hat{E}/E)$$

18. Bank Advances Rate

$$Dr_a = \alpha_{18}(\hat{r}_a - r_a) + \beta_{59} D\log M/A$$

$$\hat{r}_a = r_{ao} + \beta_{60} r_b + (1-\beta_{60}) r_w + \beta_{61}\xi$$

19. Money Rate

$$Dr_m = \alpha_{19}(\hat{r}_m - r_m) + \beta_{27} D\log M/A + \beta_{28} Qr_m$$

$$\hat{r}_m = r_{mo} + \beta_{64} r_b + (1 - \beta_{64}) r_{bl}$$

20. Bond Rate

$$Dr_b = \alpha_{20} (\hat{r}_b - r_b)$$

$$\hat{r}_b = \beta_{40}^{-1} (\log B - \log b_o - \log Y - \log P - \beta_{41} r_m)$$

21. ($A/$US) Exchange Rate

$$\log E = (\alpha_{14} \beta_{47} + \beta_{44})^{-1} [\alpha_{14} \log f_o + \alpha_{14} \log P + \alpha_{14} \text{lo}$$

$$+ \alpha_{14} \beta_{46} (r_{bl} - r_{eu}) + \alpha_{14} \beta_{47} \log \hat{E}$$

$$+ a_{14} \beta_{48} QF + \beta_{43} \log \left(\frac{M}{M_o e^{\lambda_2 t}}\right)$$

$$+ \beta_{44} \log (q_o P_x x / P_i i) + \beta_{45} (Dr_{bl} - Dr_{eu}) - D\log F]$$

$$\hat{E} = E_o (P/P_w)$$

22. Foreign Reserves

$$R = R_T$$

23. Domestic Credit

$$DC = P_g g_1 + Pg_2 + Pc - T_1 - T_2 - DB + DA + DMISC$$

$$T_1 = T_{11} + T_{12}$$

$$T_{12} = t_5 CTB$$

$$T_2 = T_{21} + T_{22}$$

$$T_{21} = t_2 Pd$$

$$T_{22} = T_{22_o} t_4 WL$$

24. Volume of Money

$$DM = DR + DC - DF_g$$

25. Inventories

$$Dv = y + i - s$$

$$= y + i - d - DK - DK_h - x - g_1 - g_2 - g_3 - sd$$

26. Expected Sales

$$Dlogs^e = \alpha_{22} \log(\hat{s}^e/s^e)$$

$$\hat{s}^e = s_o^e \, s$$

$$s = d + x + DK + DK_h + g_1 + g_2 + g_3 + sd$$

27. Private Expected Sales

$$Dlogs_p^e = \alpha_{23} \log (\hat{s}_p^e / s_p^e)$$

$$\hat{s}_p^e = s_{p_o}^e \, s_p$$

$$s_p = s - g_1$$

28. Business Fixed Capital Stock

$$DlogK = k$$

29. Employment

$$DlogL = \ell$$

VARIABLES USED IN RBII

A	bank advances to private sector
B	government bonds held by private non-bank groups
c	real cash benefits to persons
C	domestic credit
CTB	effective company tax base
d	real household consumption expenditure
E	exchange rate ($A/$US)
F	net Australian private capital owned by overseas residents
F_g	net Australian government capital owned by overseas residents
F	net Australian private capital owned by overseas residents
g_1	real government current expenditure
g_2	real government capital expenditure
g_3	real public authorities capital expenditure
h	required liquidity ratio of the banking sector
i	real imports of goods and services
I	interest payments on government debt
k	proportionate change in the real stock of business fixed capital
k_1	proportionate change in the real stock of non-mining business fixed capital
k_2	proportionate change in the stock of mining business fixed capital
K	real stock of business fixed capital
K_h	real stock of dwellings
K_{minv}	stock of mining capital
ℓ	proportionate change in employment
L	employment
m	real stock of money (M/P)
mpk	marginal product of capital
mpℓ	marginal product of labour
M	stock of money (M3)
M_T	target stock of money (M3)
MISC	miscellaneous items in the Commonwealth budget deficit
N	labour supply
P	price of domestic output
P_{bt}	price of domestic output net of indirect taxes
P_d	consumption deflator
P_g	price of government consumption expenditure
P_i	Australian import prices ($US)
P_w	world prices ($US)
P_{wl}	price of wool ($US)
P_x	price of exports
QA	synthetic variable for growth of bank advances, 1973
QDS	synthetic variable for U.S. dock strike, 1969
QE	synthetic variable for expectations about the exchar rate, 1972-6
QER	synthetic variable for timing of exchange rate chang 1972, 1973, 1974, 1976
QF	synthetic variable for capital inflow during "resour boom", 1980
Q_i	synthetic variable for growth of imports, 1974-1980
Ql	dummy variable for shake-out effect in labour market 1974-6
Q60	synthetic variable for period of fixed exchange rate 1959-1971
Qr_{bl}	dummy variable for increases in commercial bill rate 1974
Qr_m	synthetic variable for rise in r_m, 1973
QS	synthetic variable for increases in official interes rates, 1961, 1973
QSB	dummy variable for the introduction of Australian Savings Bonds 1976(1)-(2)
QUS	dummy variable for devaluation of $US, 1973
r_a	interest rate on bank advances
r_b	interest rate on 10 year government bonds
r_b^e	expected next-period interest rate on 10 year government bonds
r_{bl}	interest rate on 90 day commercial bills
r_{eu}	interest rate on 90 day Eurodollar bills
r_k	real marginal cost of capital
r_m	interest rate on trading bank fixed deposits
r_w	interest rate on 10 year US government bonds
R	gold and foreign exchange reserves
R_T	target stock of gold and foreign exchange reserves
s	sales
s^e	expected sales
s_p^e	private expected sales
sd	real statistical discrepancy
t	time trend starting in 1959(3)
t_{11}	index of income tax rate schedule
t_2	average rate of tax on consumption
t_3	average rate of tariffs
t_4	average rate of payroll tax
t_5	statutory company tax rate
t_6	average rate of tax on expenditure
T_1	receipts of direct taxes
T_{11}	receipts of personal income tax
T_{12}	receipts of company tax
T_2	receipts of indirect taxes
T_{21}	receipts of sales tax
T_{22}	receipts of payroll tax
v	real stock of inventories of goods
w_a	index of real award wages

w_r	real marginal cost of labour
W	index of average earnings
x	real exports of goods and services
x^d	real demand for exports of goods and services
x^s	real supply of exports of goods and services
x_w	real world exports of goods and services
y	real domestic output (net of depreciation)
$\tilde{y}$	real normal domestic output (net or depreciation)
y_d	real disposable income
y_f	real farm output (net of depreciation)
y_{nf}	real non-farm output (net of depreciation)
Z	population of working age
ξ	expected rate of depreciation

TAPLE A1 PARAMETER ESTIMATES

Parameter	Estimate	Parameter	Estimate
α_1	0.112	β_{26}	0.718
α_2	0.688	β_{27}	-0.130
α_3	0.024	β_{28}	0.005
α_4	0.834	β_{29}	0.200
α_5	0.207	β_{30}	0.048
α_6	0.900	β_{31}	0.381
α_7	0.413	β_{32}	-0.044
α_8	0.538	β_{33}	0.258
α_9	1.435	β_{34}	0.081
α_{10}	0.232	β_{35}	1.56611
α_{11}	2.169	β_{36}	0.139
α_{12}	0.130	β_{37}	-0.327
α_{13}		β_{38}	
α_{14}	0.056	β_{39}	
α_{15}	0.206	β_{40}	19.606
α_{16}	0.415	β_{41}	-19.606
α_{17}	0.225	β_{42}	
α_{18}	0.219	β_{43}	-0.503
α_{19}	0.447	β_{44}	-0.113
α_{20}	0.272	β_{45}	0.250
α_{21}	0.048	β_{46}	6.765
α_{22}	0.500	β_{47}	-0.500
α_{23}	0.500	β_{48}	0.163
β_1	-0.029	β_{49}	0.057
β_2	-5.775	β_{50}	0.172
β_3	0.200	β_{51}	0.029
β_4	7.321	β_{52}	-3.8025
β_5	-4.086	β_{53}	0.558
β_6	-3.235	β_{54}	0.5436
β_7	0.934	β_{55}	0.043
β_8	0.489	β_{56}	0.500
β_9	-0.391	β_{57}	0.050
β_{10}	0.400	β_{58}	0.022
β_{11}	0.009	β_{59}	-0.027
β_{12}	-1.019	β_{60}	0.530
β_{13}	-0.117	β_{61}	0.050
β_{14}	0.061	β_{62}	0.700
β_{15}	0.214	β_{63}	0.700
β_{16}	-0.333	β_{64}	0.500
β_{17}	0.645		
β_{18}	-1.065		
β_{19}	0.015		
β_{20}	0.188		
β_{21}	0.928		
β_{22}	-0.079		
β_{23}	0.180		
β_{24}	0.019		
β_{25}	0.231		

IMPOSED STEADY STATE GROWTH RATES

Variable[2]	Notation	Growth Rate
$d, K, K_h, x, i, y, v, g_1^*, g_2^*, g_3^*, c^*, s^e, s_p^e, sd^*, y_f^*, x_w^*$	λ_1	(.012)
$P, P_x, P_i^*, P_w^*, P_{wl}^*$	$\lambda_2 - \lambda_1$	(.009)
P_g, W	$\lambda_2 - \lambda_1 + \lambda_4$	(.0165)
N, L, Z^*	$\lambda_1 - \lambda_4$	(.0045)
Trend rate of technical progress	λ_3	(.0045)
Trend rate of growth of labour productivity	$\lambda_4 = \lambda_3/(1 - \beta_{10})$	(.0075)
w_a	λ_5	(.0040)
$B, F, A, T_{11}, R^*, C, M, CTB^*, F_g^*, MISC^*, M^{t*}, I^*, K^*_{minv}$	λ_2	(.021)
$E, r_b, r_{bl}, r_w^*, r^*_{eu}, r_m, r_a, k, \ell, h^*, t_{11}^*, t_2^*, t_3^*, t_4^*, t_5^*, t_6^*$	-	(0.0)

2. An asterisk (*) next to a variable indicates that it is exogenous.