

MONETARY POLICY SIMULATIONS WITH THE RESERVE BANK'S ECONOMETRIC MODEL

Ray Brooks uses the latest version of the Reserve Bank's econometric model of the economy to simulate the effects of a monetary policy change.

Executive Summary

Simulation experiments with the Reserve Bank's econometric model show that monetary policy has only negligible real effects on the economy in the long-run. A loosening of monetary policy temporarily raises investment, output and employment, but the effects are minor and the real economy returns to around the original level after nine years. The temporary increase in activity is at the expense of a rise in external debt relative to Gross Domestic Product (GDP).

The loosening of monetary policy, however, has a more significant impact on the nominal variables in the model. Domestic prices rise by just under 4 per cent after nine years. The policy implication from these results is that a loosening in monetary policy is generally only a short-term panacea to any economic ills facing the economy.

Introduction

The aim of this article is to outline how monetary policy affects economic variables such as inflation and growth within the context of the Reserve Bank's econometric model of the New Zealand economy.¹ The Reserve Bank's model is a mathematical model that describes the main characteristics of the New Zealand economy. It consists of a number of equations that describe key economic variables such as employment, output and the Consumers' Price Index (CPI). These variables are explained by other variables in the model. The nature of the linkages are determined by fitting theoretical economic relationships to historical data dating back to the mid 1960s.

¹ A more complete and technical description of the model, along with an outline of further simulation experiments, is available in the forthcoming RBNZ Research Paper No. 42.

The latest model is the twelfth version of the Reserve Bank Model and incorporates a range of improvements compared with the earlier version. As well as incorporating a number of technical improvements, the model uses new data based on the Department of Statistics' new quarterly national accounts.

This article initially outlines how monetary policy influences other variables within the model. It compares this "monetary policy transmission mechanism" with the transmission mechanism outlined in a recent article by Craig Beaumont and Michael Reddell in the *Bulletin*.² A simulation of a loosening in monetary policy in the model is then presented.

The Monetary Policy Transmission Mechanism

The linkages within the model reflect, as near as possible, the current monetary policy transmission mechanism in New Zealand. The monetary policy transmission mechanism in the model is summarised in Figure 1. The real 90-day interest rate is the Reserve Bank's sole monetary policy instrument in the model. No attempt is made to model the real 90-day rate as a function of settlement cash or other influences. Instead, the real 90-day interest rate is independent of other variables in the model so recognising that the Reserve Bank can temporarily influence the real 90-day interest rate through a number of channels.

The exchange rate is the most direct route in the model through which a change in monetary policy is transmitted to the ultimate objective of monetary policy - inflation. A fall in the real 90-day interest rate has a downward effect on the nominal exchange rate as investors hold less of their savings in New Zealand. The decreased demand for New Zealand dollars leads to a depreciation of the nominal exchange rate and a rise in the price of tradeable goods. In turn, this raises the domestic price level and inflation.

The other channels of the monetary transmission mechanism in the model impact on inflation in a more indirect manner. The major indirect link between a change in interest rates and inflation in the model is via an induced change in economic activity that influences wage rates and labour productivity which thereby influences labour costs.

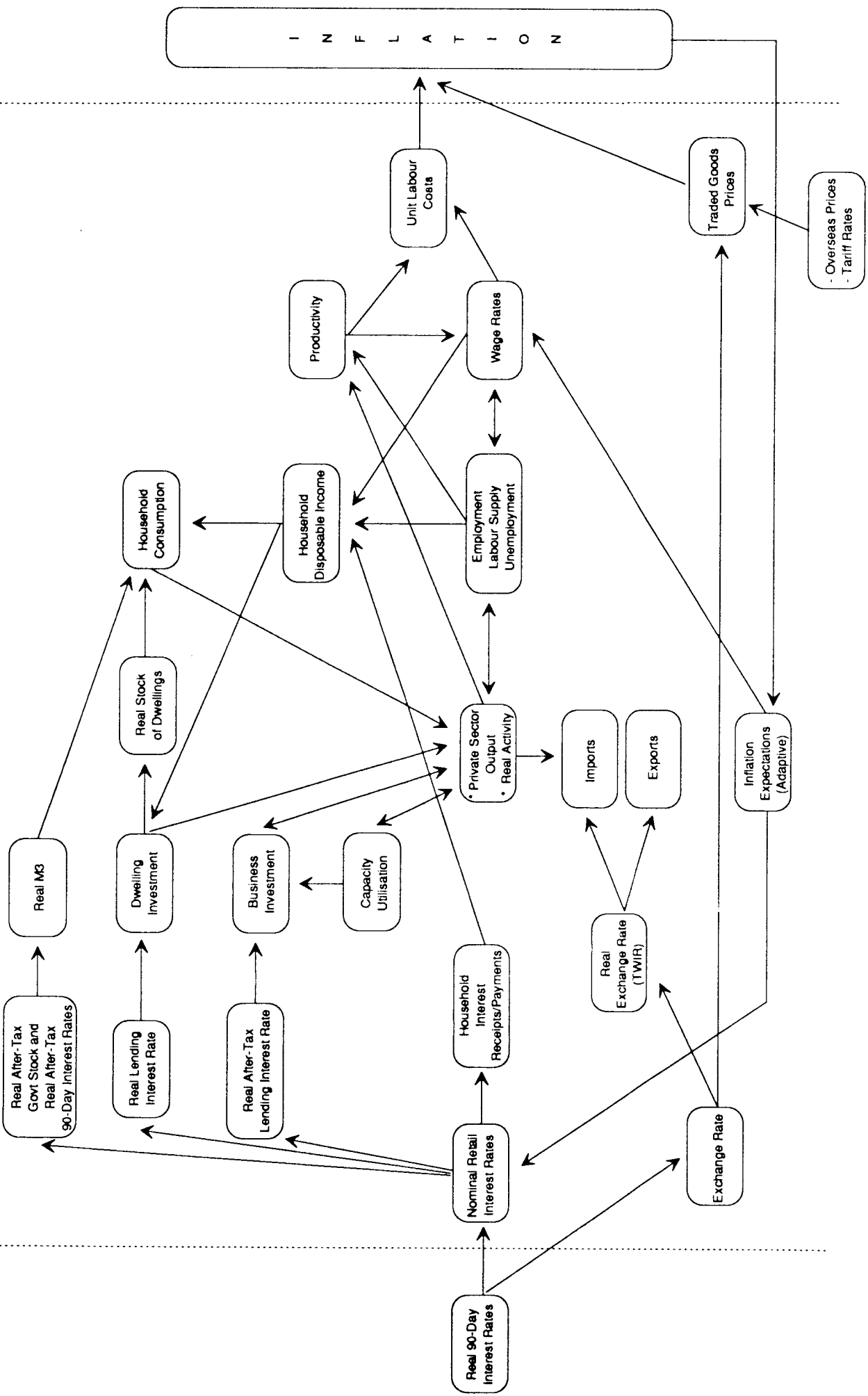
In the model, changes in unemployment influence real wage rates. If a fall in interest rates increases private sector output via one of the channels shown in Figure 1 (and discussed below) there will be an increase in employment and a rise in the real wage rate. This, in turn, will raise unit labour costs and thereby raise producer and consumer prices. Nominal wage rates rise in line with producer prices in the model. This indexation means that a change in foreign prices or in the exchange rate that affects domestic producer prices will be fully reflected in both private and government wage rates.

² See Craig Beaumont and Michael Reddell, "How Monetary Policy Influences Inflation", *Reserve Bank Bulletin*, December Quarter 1990, pp. 358-378.

The Monetary Policy Transmission Mechanism in Model XII

MONETARY
POLICY
OBJECTIVE

MONETARY
POLICY
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The labour market and real sectors of the model are affected in various ways by a change in the monetary policy instrument (the real 90-day interest rate). The real 90-day interest rate influences all other interest rates in the model and these interest rates affect other variables.

Dwelling investment, for instance, is influenced by a change in the real bank lending interest rate. A fall in the real bank lending interest rate leads to a rise in dwelling investment as it lowers the real cost of financing house construction.

Business investment is affected by the real-after-tax bank lending rate and a range of other variables. A fall in the real after-tax interest rate leads to a rise in business investment in the model. This occurs because a fall in the real after-tax interest rate lowers the cost of financing prospective investment projects, so increasing the net return to these projects.

Changes in investment brought about by changes in real interest rates have a direct influence on private sector output. A fall in the real after-tax interest rate raises investment, and hence the capital stock, and thereby raises the productive capacity of firms. Changes in investment will also influence the demand for private sector output as the goods used for investment must be either produced domestically or imported.

The real exchange rate is also an important transmission mechanism in the model as it influences the demand for imports and the supply of exports. A fall in the exchange rate, which will follow from a fall in the real 90-day interest rate, will encourage import substitution and exporting. However, a monetary policy change will not induce a permanent change in the real exchange rate in the long-run because wage rates in the model are fully indexed to domestic inflation. A nominal depreciation of the exchange rate can only be transformed into a permanent real depreciation if the flow-on effect of the nominal depreciation on domestic prices is dampened. This requires either a fall in real wage rates, an improvement in productivity or a fall in wholesale or retail margins.

The transmission mechanism within the model is similar to the transmission mechanism described in the article by Beaumont and Reddell. This is not a coincidence as the model was constructed in an attempt to find empirical relationships for the theorised links. The key difference between the model and the real world is the way inflationary expectations are formed. Inflationary expectations are determined in the model as the historical outcome for inflation whereas inflationary expectations in the real world are formed as a result of both backward and forward looking behaviour. In particular, the Monetary Policy Targets agreement between the Minister of Finance and the Governor of the Reserve Bank (and the credibility associated with the Bank meeting the targets) will influence the expectation of inflation formed by forward looking individuals. No such forward looking behaviour is built into the model because of the technical difficulty involved in doing so with such a large model.

Monetary Policy Simulation

A major strength of the model is that a better understanding of the interaction of the various channels of the monetary policy transmission mechanism can be obtained by simulating a change in monetary policy within the model.

A simulation of a change in Government policy in the model involves running the model over a historical period of several years using historical data. This is called the "control" run. In this case the period chosen was 1979 to 1987. The model is then re-run with a change made to the real 90-day interest rate. Other model variables react in response to this change in monetary policy.

A loosening in monetary policy was simulated by temporarily reducing the real 90-day interest rate by 1 percentage point for one year at the beginning of the simulation period, and running the model for nine years. This temporary loosening in monetary policy acknowledges that the Reserve Bank has the ability to alter *real* short-term interest rates but only for a limited period. New Zealand is a small open economy and in the long-run its real interest rates will be determined by the rest of the world.

A summary of the results of this simulation are presented in Table 1. The results are presented as deviations from the control values (i.e., deviations from the actual values of the variables prior to the simulation of the monetary policy change).

The impact of the loosening in monetary policy on the real sector of the model is very limited. Business investment and stocks are the variables most significantly affected, with investment rising by the equivalent of one-half of one per cent of the capital stock over the first three years. The main impetus for the rise in business investment is the fall in the real after-tax lending rate, which lowers the cost of financing extra investment.

The increase in aggregate demand as a result of the initial rise in investment is partly met by a rise in imports but is also met by a run down in stocks and a rise in private sector output. The fall in the ratio of stocks-to-sales leads to a further rise in investment and to a small increase in capacity utilisation.

The rise in capacity utilisation and investment both boost private sector output, which in turn leads to a rise in employment. The model has a direct long-run link between private sector output and employment: a one per cent rise in private sector output is associated with a one per cent rise in employment, assuming all other things are unchanged. Unemployment falls marginally (by 1,000 people after three years) as a result of the increase in employment.

The rise in employment and output has second round effects through a rise in both household and company income. The rise in real household disposable income, however, is only small (+0.5 per cent after five years) and the impact of this increase on household consumption is offset by the fall in real wealth holdings due to inflation eroding the real value of the private sector's M3 financial wealth.

TABLE 1
MONETARY POLICY LOOSENING

(Deviations from Control)

Years after beginning of simulation:

	<u>1 Year</u>	<u>3 Years</u>	<u>5 Years</u>	<u>9 Years</u>
<u>Real Sector</u>				
Consumption (% YTD)	-	0.1	0.1	-
Capital Stock - Dwellings (%)	-	-	-	-
- Business (%)	0.1	0.7	0.9	0.6
Imports - Total (% YTD)	0.1	0.8	0.6	-0.1
Exports - Total (% YTD)	0.2	0.1	0.1	-
Private Sector Output (% YTD)	-	0.5	0.3	-
Final Sales (% YTD)	0.1	0.4	0.2	-0.1
Stock to Sales Ratio (P.P)	-0.8	-1.1	0.4	2.4
Capacity Utilisation (%)	0.1	0.6	-	-0.7
<u>Labour Market and Incomes</u>				
Private Sector Employment (%)	-	0.3	0.2	0.1
Labour Supply (%)	-	0.1	0.1	0.1
Unemployment (000s)	-0.2	-1.0	-0.7	0.2
Real Wage Rate (%)	-	0.1	0.4	0.1
Real Household Disposable Income (% YTD)	0.1	-	0.5	-
<u>Prices and Exchange Rate</u>				
CPI - Level (%)	0.7	1.6	2.5	3.7
- Year-to-Year Change (%)	0.8	0.2	0.7	-0.2
GDP Deflator (%)	0.5	1.7	2.5	3.8
Unit Labour Costs (%)	0.7	1.5	2.7	3.8
Exchange Rate (%)	1.6	-1.5	-2.5	-3.6
Real Exchange Rate (%)	-0.7	-	-	-
<u>External Sector</u>				
BOP Current Account Balance (PP GDP)	-	-0.2	-0.2	-0.1
External Debt (PP GDP)	0.6	-	0.7	1.0
<u>Fiscal and Monetary Sector</u>				
Budget Table 2 Balance/GDP (PP YTD)	-	0.1	0.1	0.2
Government Debt/GDP (PP YTD)	-	-0.5	-0.7	-1.1
Nominal 90-Day Interest Rate (PP)	-0.1	0.2	0.7	-0.1
Real After-Tax Interest Rate (PP)	-1.0	-0.1	-0.3	0.1
Real M3 (%)	-0.9	-0.5	-0.8	-1.0

% = percentage deviation from the control value
 YTD = year to date
 P.P. = percentage point
 - = insignificant

In the long-run, there is little or no impact of the loosening in monetary policy on the real variables in the model. Private sector output is only marginally higher as a result of more capital in place (despite lower capacity utilisation) and slightly higher employment. The supply of labour is largely unaffected and unemployment is actually fractionally higher than its control level after nine years. The stocks-to-sales ratio, however, is above the control level and capacity utilisation is below the control level at the end of the simulation as the model has not fully adjusted to the change in monetary policy. The temporary improvement in activity in the early years of the simulation is at the expense of a one percentage point rise in the ratio of external debt to GDP after nine years. This results from the worsening in the balance of payments throughout most of the simulation.

The nominal variables in the model are much more significantly affected by the monetary policy loosening than the real variables. The rise in nominal wage rates and prices in the model stems from the depreciation of the exchange rate in response to the temporary fall in the New Zealand real 90-day interest rate relative to the Australian real 90-day interest rate. The nominal exchange rate falls by 1.6 per cent by the end of the first year. This raises the price of tradeable goods and leads to an increase in the Consumer Price Index (CPI) by 0.7 per cent by the end of the first year. Nominal wage rates adjust to the increase in domestic prices with a lag and therefore unit labour costs rise as there is no significant offsetting increase in productivity. The CPI rises by the full amount of the depreciation in the long-run because of the full indexation of nominal wage rates. The CPI is 3.7 per cent higher than control after nine years as a result of a 3.6 per cent fall in the exchange rate and a 3.8 per cent rise in unit labour costs.

The relative importance of the various paths of the monetary transmission mechanism in the model can be obtained by 'shutting-off' key linkages. This allows an assessment of the extent of the differences between the original simulation and a model simulation without the linkage in place.

Following this procedure, the influence of the real after-tax lending rate on business investment was identified as the key path of the monetary policy transmission mechanism on the real sector in the model. When this path is 'shut-off' (i.e. if the real after-tax lending rate is assumed to have no effect on business investment) there is a significantly lower impact of a loosening in monetary policy on business investment, private sector output and employment in the short term. Inflation, however, does not differ significantly from the original simulation as a result of 'shutting-off' this path.

The key path of the monetary policy transmission mechanism to inflation in the model is through the influence of the real 90-day interest rate on the nominal exchange rate. If the real interest rate is assumed to have no effect on the exchange rate, there is virtually no impact of the loosening in monetary policy on wage and price inflation. The effect of monetary policy on inflation via the real sector of the model is therefore minor compared with the effect through the exchange rate.

Conclusion

Simulation experiments with the Reserve Bank's econometric model show that monetary policy has only negligible real effects on the economy in the long-run. A loosening of monetary policy temporarily raises investment, output and employment, but the effects are minor and the real economy returns to around the original level after nine years. The temporary increase in activity is at the expense of a rise in external debt relative to GDP.

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