Trans-Tasman Transmission of Fiscal Shocks

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Abstract

This paper investigates how shocks to government spending and income taxes in Australia affects both Australia and New Zealand economies and looks at the channels through which these effects are transmitted from one economy to the other. A semi-structural vector auto regressive (VAR) approach is used to analyse quarterly data from the period: 1974:3 – 2005:4. The empirical results show that a shock to Australian income tax revenues leads to a decrease in both Australian and New Zealand output, and a shock to Australian government consumption leads to an increase in both Australian and New Zealand output. The impact of government expenditure shocks is transmitted through the interest rate channel only. The empirical results also suggest that the impact of an income tax shock is transmitted through the interest rate channel, which dominates the effect of the exchange rate channel.

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1. Introduction

The Australian and New Zealand economies are closely linked. Australia is New Zealand's largest trading partner both in goods and in services with 19.95% of New Zealand exports to Australia and 19.56% of New Zealand imports from Australia, in the year ended June 2006 (http://www.stats.govt.nz). Australia is also the largest source of foreign direct investment for New Zealand, and is the most common destination for direct equity investment from New Zealand

The international transmission of monetary shocks has been examined thoroughly in papers such as Koray & McMillin (1999), Kim (2001) and Arin & Jolly (2005). Arin & Jolly (2005) look specifically at New Zealand and Australia and the transmission of monetary policy between the two economies. Using a VAR approach their study finds that a monetary shock in either country has a real effect on the other economy in the short run.

Relatively less attention however, has been paid to the transmission of fiscal shocks. Some empirical study has been carried out on the impact of fiscal policy on the trade balance and exchange rate in the U.S. (Kim and Roubini, 2004) and the international transmission of fiscal shocks from the U.S. to Canada (Arin and Koray, 2005). The case of New Zealand and Australia however, has been neglected despite their close economic links and widespread investigation into the possibility of a currency union between the two countries.

Trans Tasman fiscal transmission also warrants investigation as New Zealand is a strong example of a small open economy; it has little or no influence on world prices or interest rates and has relatively low barriers to trade and a floating exchange

rate regime. This provides an ideal setting for examining the international transmission of fiscal shocks.

This study aims to show the channels through which Australian fiscal policy is transmitted to the New Zealand economy. This will be done by using a quarterly data set that spans the period 1974:3-2005:4. With a very close trading and economic relationship and high levels of migration between the two countries it seems likely that changes in the larger economy of Australia would have an effect on New Zealand variables. Therefore, changes in the Australian economy should be considered by policy makers in New Zealand.

The remainder of this paper is organised as follows; Section 2 reviews the previous literature, Section 3 discusses the data, Section 4 discusses the empirical methodology used, Section 5 presents the empirical results, Section 6 presents the robustness checks, and Section 7 concludes.

2. Previous Literature

2.1. Domestic Transmission of Fiscal Shocks

Ricardian Equivalence is a central focus of study on the effect of fiscal shocks. Ricardian equivalence theorem contends that changing from lump-sum tax financing to deficit has no effect on the economy. Ricardian equivalence states that there is an intertemporal budget constraint for government. Reduced tax means reduced government spending either now or in the future, conversely increased tax means increased government spending now or in the future. Economic agents are aware of this and act accordingly.The present value of government revenues should be equal to the present value of government expenditures. Ricardian equivalence implies that economic agents are not myopic and they know that cutting taxes today means an increase in taxes some time in the future.

Initial study on fiscal policy focuses on Ricardian Equivalence, first proposed by Barro (1974). Kormendi (1983) empirically tests Ricardian equivalence and finds evidence to support it. His results indicate that government debt effects private wealth negatively when the present value of future tax revenues is greater than the future value of government consumption. The results of Kormendi (1983) are questioned in a paper by Feldstein and Elmendorf (1990) who question robustness under several alternative specifications. These questions are taken into account and Kormendi (1983)'s original results are shown to hold in Kormendi and Meguire (1990).

Fiscal policy can affect the economy not only through consumption but thorough other channels. VAR studies therefore have been extensively used to analyse the effects of fiscal shocks on the economy.

Edelberg, Eichenbaum and Fisher (1999) look at how shocks to government defense spending affect the U.S. economy. The study uses a narrative approach and utilizes dummy variables for such events as the Korean and Vietnam wars. With their 5 variable VAR model, they show that a shock to defense spending has a temporary positive effect on output and a temporary negative effect on real wages.

Fatas and Mihov (2002) then use a semi-structural VAR model with US data from 1960 to 1996 to investigate the effects of government expenditures on output. They show that an increase in government spending has a significant positive and persistent effect on output while investment does not respond significantly to an increase in government spending. This is in contrast to Edelberg et al (1999) who find that the positive response of output to a shock to defense spending is only temporary.

Blanchard & Perotti (2002) also find that spending shocks tend to have longer lasting effects than tax shocks using a structural VAR model. A unique feature of their study is the incorporation of taxes along with spending shocks in characterising the response of output. They show that fiscal policy shocks cause temporary changes in GDP and its components, a result consistent with Edelberg *et.al.* (1999).

Perotti (2002) is the first study to use non-U.S. data. Data for five OECD countries; the U.S., West Germany, the UK, Canada, and Australia, is used in a structural VAR model to investigate the effects of fiscal policy on GDP, prices and interest rates. The results show that in general, government spending multipliers are positive. There is also evidence of positive tax multipliers in some countries; namely Australia, the UK and West Germany. Interestingly, Perotti (2002)'s results demonstrate that fiscal multipliers are smaller in the period post 1980 and also note that the response to fiscal shocks in the U.S. is not consistent with the rest of the OECD countries in his sample.

Arin and Koray (2006) investigate the positive tax multipliers shown by Perotti (2002). They look at four different types of taxes; income, corporate, indirect and social security. They use a semi-structural VAR model to investigate Canadian data and contend that positive tax multipliers only occur for corporate tax shocks. Their results suggest that different taxes have different and sometimes offsetting effects on the economy. They also suggest that the variation in the sign and magnitude of tax multipliers for different countries, found in previous studies, can be explained by the composition of tax shocks in those countries.

It is obvious that different taxes have different effects on the economy; accordingly it is best to concentrate on a particular tax rather than taxes as a whole. In this study the focus is on income taxes, as income taxes are the largest component, making up close to 69% of total tax revenues.

2.2. Fiscal Policy and Economic Growth

In the Neoclassical setting, as in Solow (1956), growth depends endogenously on the accumulation of technology, physical and human capital. In this framework, fiscal shocks would have no effect on output growth.

Barro (1990) develops an endogenous-growth model with the assumption that there are constant returns, infinite-lived households in a closed economy and most importantly tax-financed government services. According to Barro (1990), growth is found to be adversely affected by income taxes, and the paper shows that the increasing utility-type expenditures lower growth and saving rates.

Emperical work by Kocherlakota and Yi (1997) supports the endogenous growth model. The study uses a time series model with data from the UK and the U.S. The UK data spans 100 years and the U.S. data spans 160 years. Kocherlakota and Yi (1997) show that permanent changes in fiscal policy can have permanent effects on the growth rate.

Kneller, Bleaney, and Gemmell (1999) also re-evaluate the effect of fiscal policy tools on economic growth and find that most previous literature ignores a very important bias which may occur in specifying government budget constraints. They argue that to specify the government budget constraint is very important for the interpretation of fiscal parameters, and incorporating government expenditure into these specifications can eliminate the bias. Their model however, is limited to a five-year average of the variables which can only capture the short-run effects. Kneller *et al.* (1999) classify taxes and government spending into two different groups; distortionary and non-distortionary taxation as well as productive expenditure and non-productive expenditure. Distortionary taxes are described as taxes on income,

profit, payroll, property and social security taxes. Non-distortionary taxes on the other hand are taxes on domestic goods and services (such as GST). Productive expenditures are those on general public services, defence, educational, health, housing, and transport and communication. Unproductive expenditures include social security, welfare, recreation and economic services expenditure. Kneller *et al* (1999)'s results show that distortionary taxation has a negative effect on economic growth whereas non-distortionary taxation does not. They also show that productive expenditure, not surprisingly, enhances growth whereas non-productive expenditures dampen it.

Widmalm (2001) uses pooled cross-sectional data for the period 1965-1990 for 23 OECD countries. This study looks at the importance of income tax revenues as a proportion of total tax revenues and finds that the proportion of tax revenue raised by income tax has a negative correlation with economic growth, which is consistent with Kneller *et al.* (1999).

Lee and Gordon (2005) study how tax structure affects a country's growth rate, by using cross-country data from the period 1970-1997, while controlling for four determinants of economic growth in their model; domestic productivity which can be approximated by a Cobb-Douglas function, changes in capital/labour ratio, changes in education, and corruption. Their results show that average tax rates on labour income and the effective overall marginal tax rates are not significantly associated with economic growth. This contradicts the findings of Padavano and Galli (2001) who show that marginal income tax rates are negatively associated with economic growth.

It seems that average labour taxes and the top corporate tax rate are negatively associated with growth. It is important to capture these long-run effects while

investigating short-term fluctuations; therefore the benchmark model is estimated in levels rather than differences.

2.3. International Transmission of Fiscal Shocks

The domestic transmission of fiscal policy shocks has been researched thoroughly while international transmission has been paid relatively less attention.

Earlier theory on transmission of fiscal shocks has a Keynesian flavour, which is developed in the seminal papers by Fleming (1962) and Mundell (1963). The theory is developed further by Dornbusch (1976) who introduces sticky prices into the framework. The Dornbusch sticky price model shows that interest rates are the transmission mechanism through which one economy's fiscal shock affects another. In these models, under a fiscal expansion the exchange rate appreciates, which deteriorates the current account of the home country and improves the current account of the foreign country. Output increases both in the home country (due to partial crowding-out) and the foreign country.

More recent theoretical work is along the lines of dynamic general equilibrium models. Using a two-country dynamic general equilibrium model, Frenkel & Razin (1987) explore international transmission. They introduce the concept that individuals behave as though they have finite horizons, at any given time there is a certain probability of their survival, so rather than acting as though there are infinite horizons, individuals are aware that they will die and act accordingly. This results in a departure from the Ricardian proposition that budget deficits do not matter. The increase in government spending that we expect after a rise in taxes may not be realised within our lifetime.

Also, Bianconi & Turnovsky (1997) use an integrated infinite-horizon intertemporal optimisation of a two-country model. They find that lump sum tax financing leads to increasing output in both the short run and the long run in the home country. It does however lead to decreasing output in both the short run and the long run in the foreign country. These results are reversed with capital income taxes. Their results also show that when there is a permanent increase in government spending this leads to a decrease in wealth which decreases consumption, and leads to an increase in real interest rates and labour input in both home and foreign countries. While domestic output increases, foreign output decreases.

On the empirical side, Kim and Roubini (2004) use US data for the floating exchange rate period. They utilize a semi-structural VAR model in which the ordering of the variables in the basic identification scheme is real gross domestic product, government budget, current account, real interest rate and real exchange rate. They find that U.S. expansionary fiscal shocks improve current account and depreciate the real exchange rate which is contradictive to the theoretical work by Dornbusch (1976).

Further detailed empirical analysis shows that the current account improvement is due to partial Ricardian behaviour of private saving and to a fall in investment while the real exchange rate depreciation is mainly due to nominal exchange rate depreciation. Various components of government budget are incorporated in robustness checks, this is particularly important as literature in domestic transmission shows that different components of the government budget can have different effects on economy as illustrated by Alesina and Perotti (1995) who look at whether an expansion relies more on certain components of the budget. In

their model, growth does not necessarily decline in periods of continued fiscal adjustment.

Arin and Koray (2005) extend further study by looking at how fiscal shocks affect real interest rates and real exchange rates, and how fiscal shocks are transmitted internationally. They also use a semi-structural VAR model to analyse how fiscal shocks in the U.S. affect the Canadian economy with quarterly data from 1961 to 2004. Their results show that a positive shock to U.S. government spending has a temporary positive effect on U.S. output and decreases the U.S. real interest rate. The Canadian interest rate, however, responds positively and Canadian output falls. The results imply that unanticipated increases in the U.S. defense expenditures have a "beggar thy neighbor" effect on Canada. When the benchmark model is extended with different components of GDP, the results show that the decrease in Canadian output can be explained with the decrease in Canadian investment. Shocks to U.S. income taxes, on the other hand, decrease U.S. output, and cause both American and Canadian real interest rates to rise, and the exchange rate to appreciate. The Canadian output does not respond significantly as the decrease in investment is offset by the improvement in the trade balance. This result is consistent with Kim and Roubini (2003).

The findings by Koray and McMillin (2006) also support Kim and Roubini (2003). They use a VAR model with a Choleski Decomposition. Quarterly data is used from the period 1981:3-2005:3. The ordering is similar to Arin and Koray (2005), except they exclude Canadian variables and introduce the trade balance into the model as the last variable in the ordering. They also show that positive fiscal shocks lead to depreciation in the real exchange rate through the real interest rate channel. Not surprisingly, the trade balance improves.

3. Data

The data used to estimate the model consists of quarterly observations for Australia and New Zealand for the period 1974:3-2005:4. The data is obtained from the OECD Economic Outlook database. The model is estimated with the data in levels. Definitions of the variables used are given in Table 1. Descriptive statistics are also given in Table 2.

Table 1 Data

Variable	Definition	Data Source
Income Taxes	Direct Taxes on Households divided by GDP deflator	OECD Economic Outlook
Government Expenditures	Total Government Spending divided by Deflator, Government Consumption of Goods and Services	OECD Economic Outlook
Price Level	Consumer Price Index	OECD Economic Outlook
Real GDP	Gross Domestic Product divided by GDP deflator	OECD Economic Outlook
Interest rate	Interest Rate on Long Term Government Securities minus CPI inflation.	OECD Economic Outlook
Real Exchange Rate	(Nom Ex Rate NZ$ / Nom Ex Rate Aus$) * (Aus CPI / NZ CPI)	OECD Economic Outlook

Table 2 Descriptive Statistics

AUSTRALIAN INCOME TAX		*AUSTRALIAN GOVERNMENT PURCHASES*		*AUSTRALIAN GDP*	
Mean	689.40	Mean	1158.03	Mean	5519.9
Standard Deviation	217.63	Standard Deviation	235.12	Standard Deviation	1751.8
Minimum	339.70	Minimum	743.09	Minimum	3161.6
Maximum	1093.12	Maximum	1661.61	Maximum	9124.7
Observations	134	Observations	134	Observations	13

NEW ZEALAND INTEREST RATE		*REAL EXCHANGE RATE*		*NEW ZEALAND GDP*	
Mean	9.13	Mean	0.09	Mean	879.4
Standard Deviation	4.15	Standard Deviation	0.14	Standard Deviation	216.0
Minimum	2.89	Minimum	-0.17	Minimum	583.1
Maximum	23.03	Maximum	0.46	Maximum	1348.0
Observations	134	Observations	134	Observations	13

NEW ZEALAND CONSUMPTION		*NEW ZEALAND INVESTMENT*		*NEW ZEALAND TRADE BALANCE*	
Mean	1108.10	Mean	311.92	Mean	2.9
Standard Deviation	673.13	Standard Deviation	223.32	Standard Deviation	57.9
Minimum	655.13	Minimum	138.22	Minimum	-362.2
Maximum	3650.10	Maximum	1620.08	Maximum	72.4
Observations	134	Observations	134	Observations	13

Figure 1

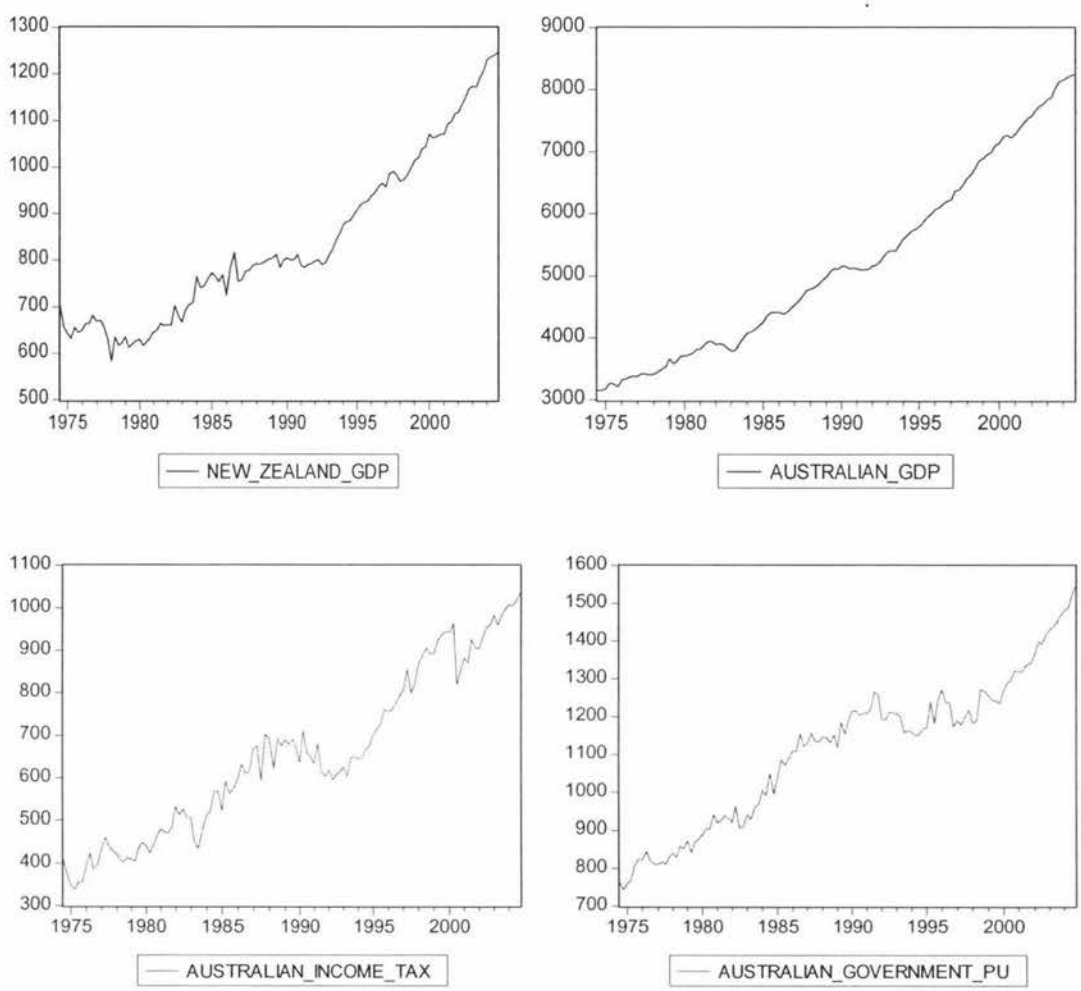


Figure 1 shows the variables in the benchmark model over time. The first two graphs show real New Zealand and Australian output from 1974 through to 2006. These graphs follow a similar pattern over time, with their slope becoming steeper from about 1990 onwards. This illustrates an increasing rate of growth, and could be attributed to economic reform in both countries such as, the adoption of floating exchange rate regime's and a decrease in barriers to trade.

4. Methodology

This study uses a semi-structural Vector Auto Regression (VAR) Model which is estimated using data in levels rather than differences, as the purpose of VAR is to find co-movements in the data rather than parameter estimates, and using levels may discard some of the information. The variance/covariance matrix is identified with a Choleski decomposition. Under a Choleski decomposition the ordering of the variables is important, as variables higher in the ordering effect those lower in the ordering contemporaneously, while those lower in the ordering effect variables higher in the ordering only with a lag.

The ordering used in the benchmark model is as follows: Australian Government Consumption and Investment (G) will be ordered first, followed by Australian output (Y), Australian tax revenues (T) and New Zealand output(Y*). Government Consumption and Investment are ordered before output, as G is one of the determinants of Y, this also follows the ordering of Kim & Roubini (2003) and Arin & Koray (2005) who place government consumption ahead of output. Placing taxes in the ordering after these variables allows for stabilising responses and allows changes in income taxes to effect the economy only with a lag, again as in Kim & Roubini (2003) and Arin & Koray (2005). New Zealand variables are ordered after Australian variables. While New Zealand is a small open economy, due to the close economic links between New Zealand and Australia, New Zealand variables may have some impact on Australian variables. Therefore it is assumed that changes in Australia affect New Zealand contemporaneously and changes in New Zealand could affect the Australian economy only with a lag. Shocks to Government consumption

are examined along with income tax revenues. Different orderings are tried and presented in the robustness checks. All variables are estimated in natural logarithms with the exception of the real interest rate.

When extending the model to explain the effects of tax shocks, components of New Zealand GDP are included in the VAR. Consumption, investment and trade balance, in turn are each included and placed in the ordering after Australian tax revenues and before New Zealand output. This is to examine which components of New Zealand output are being affected by the Australian fiscal shocks, then either New Zealand real interest rate or New Zealand trade balance is included. The inclusion of the trade balance follows Koray & McMillin (2006). In the ordering they are placed after Australian tax revenues and before the components of New Zealand GDP. Again, all variables are estimated in natural logarithms with the exception of the real interest rate and the trade balance.

A lag length of four is used in the models. However, the benchmark model is re-estimated with alternative lag lengths, and results are presented in section 5.3.1. The statistical significance of impulse response functions (IRF's) are determined with the help of one-standard deviation Monte Carlo bands.

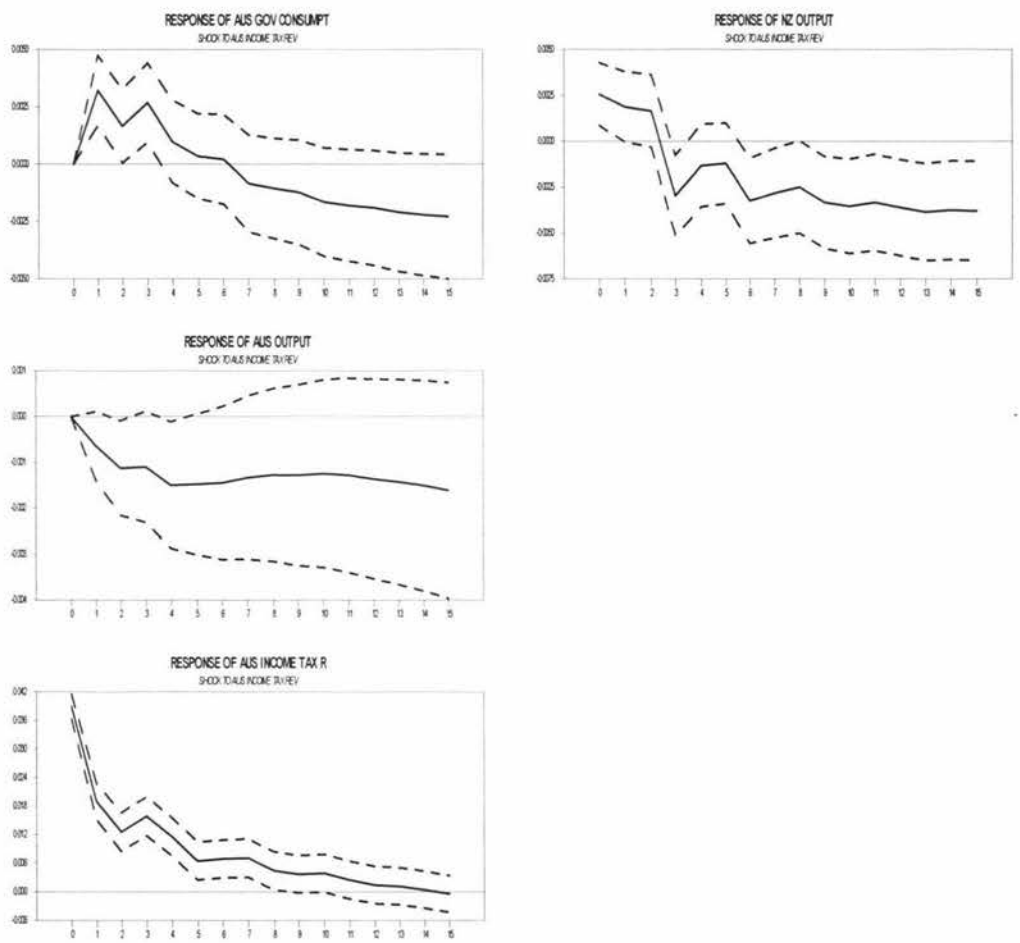
5. Results

5.1. Benchmark Model

5.1.1. Shock to Australian Income Taxes

The IRF's in Figure 2 show the response of model variables to a one standard deviation shock to Australian income tax revenues. This shock is positive and is significant until the eighth quarter. Australian government consumption reacts positively and is significant until the third quarter. Australian output has a significant negative response in quarters two and four, while New Zealand output first shows a significant positive response until quarter one, it then displays a persistent, significant decrease from quarter three. Income tax shocks have a negative impact on Australian output and this negative effect is transmitted to the New Zealand economy. This co-movement in output after a fiscal shock is consistent with the Mundell-Fleming model with sticky prices. These findings differ from those of Arin and Koray (2005) who show an increase in U.S. government consumption leads to a decrease in Canadian output.

Figure 2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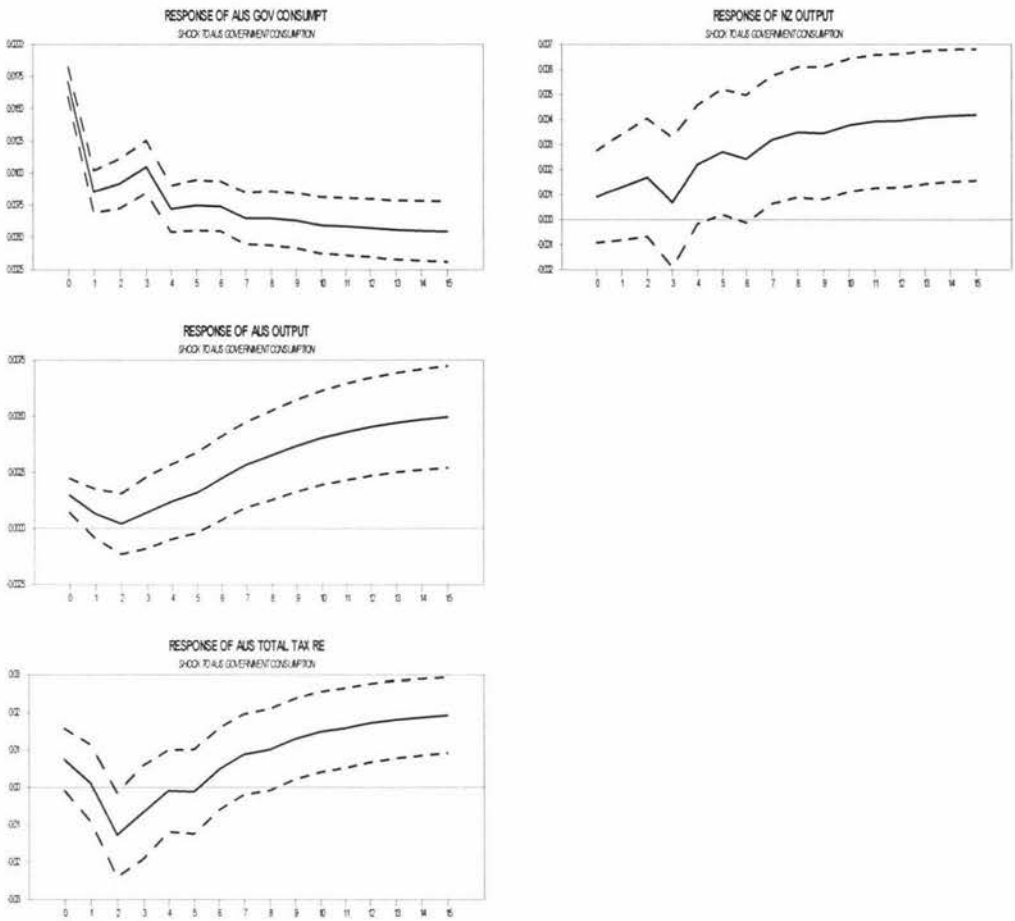
5.1.2. Shock to Australian Government Consumption

A shock in the model to Australian Government Consumption and the response is shown in the IRF's in Figure 3. The shock is positive and remains significant as expected, when the Australian government increases consumption, it results in a persistent increase in Australian output. Output is initially significantly positive, then from quarter one to quarter five the response is not significantly different from zero. From quarter six the response is significant and remains significantly different from zero. Australian total tax revenue is significantly negative in quarter two, then from quarter nine is significantly positive, this positive response is persistent. The positive response of tax revenues reflects a need for an increase in government consumption to be financed by taxes. There is also a positive and persistent response in New Zealand output from quarter six. Again, this co-movement is consistent with the Mundell-Fleming model with sticky prices and is in contrast to the findings of Arin and Koray (2005). The model is now extended to investigate the channels through which these shocks are transmitted from the Australian economy to New Zealand.

Figure 3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5.2. Extended Models

5.2.1. Income Taxes

In this extended model the New Zealand real interest rate is added to examine the transmission of a positive tax innovation. The New Zealand real interest rate is ordered after the Australian variables and before the components of New Zealand output. A change in the real New Zealand interest rate will effect consumption and investment contemporaneously while a change in consumption may affect the real New Zealand interest rate only with a lag. As shown in Figure 4 there is a significant positive response in the model from the New Zealand real interest rate following a shock to Australian income tax revenue. The IRF shows that Australian income tax revenues are significantly positive until the fifth quarter. Australian government consumption is initially positive until quarter one. After quarter four it is significantly negative and remains so. There is no significant response in Australian output in the fifteen quarters. From quarter three, until quarter five, there is a significant, positive movement in the real New Zealand interest rate. This rise in the New Zealand real interest rate is in accordance with the principal of real interest rate parity. New Zealand consumption decreases initially, the response is then insignificant until quarter three, when it is again significantly negative, this response is only transitory. New Zealand output is significantly negative at quarter three, it is then insignificant until quarter nine, after which the negative response is persistent. The difference between the findings here and those of Arin and Koray (2005) is explained by the response of the New Zealand interest rate. The New Zealand real interest rate rises following a shock to Australian income tax revenues.

Figure 4

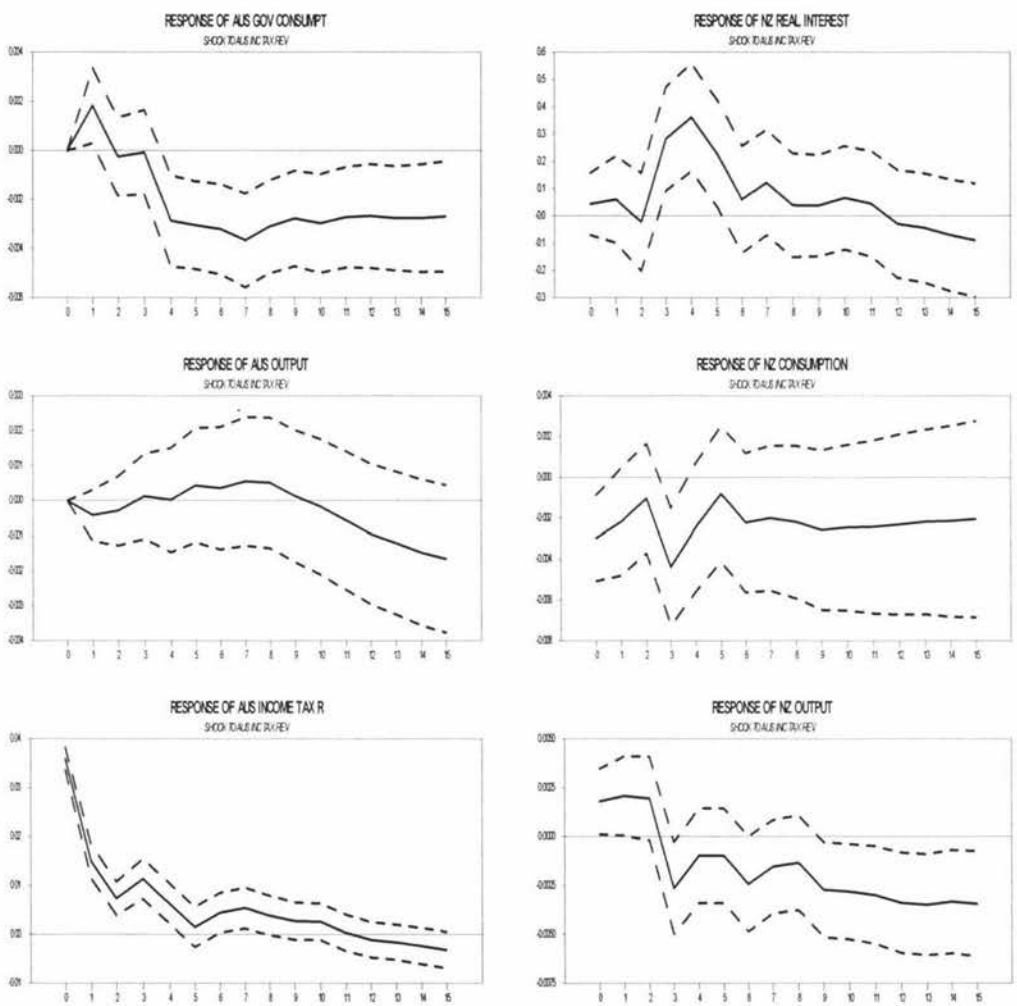
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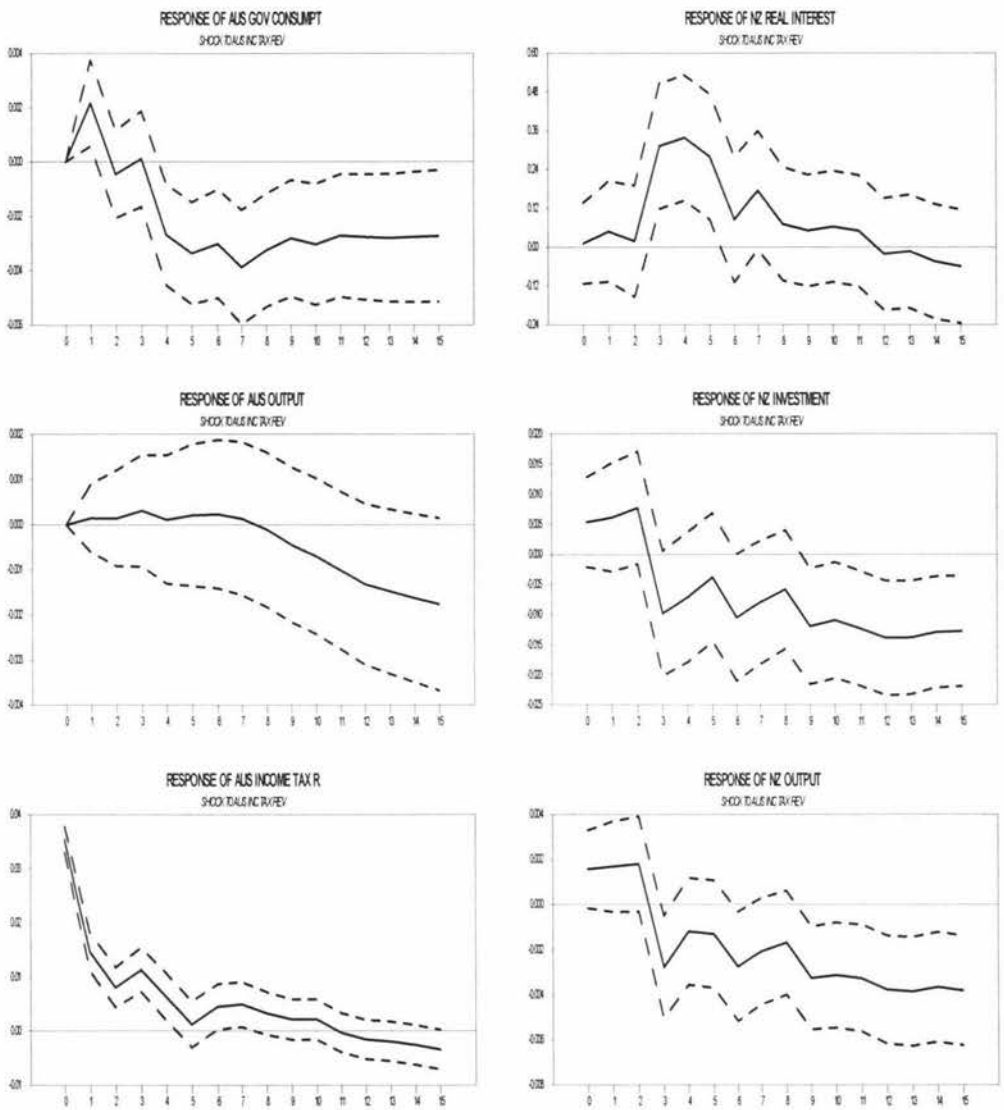
Figure 5 shows the responses to a positive shock to Australian income tax revenues. The response of Australian Income tax revenues is significantly positive until the fourth quarter. Australian government consumption initially increases, then after quarter four the response is significantly negative and remains negative. The real New Zealand interest rate is significantly positive from quarter three to quarter five. This increase in the interest rate is then followed by a decrease in New Zealand investment. New Zealand investment is significantly negative from quarter nine and this effect is persistent. New Zealand output reacts negatively, the response is significantly different from zero in quarter three and quarter six, and then from quarter eight the negative response is persistent.

Figure 5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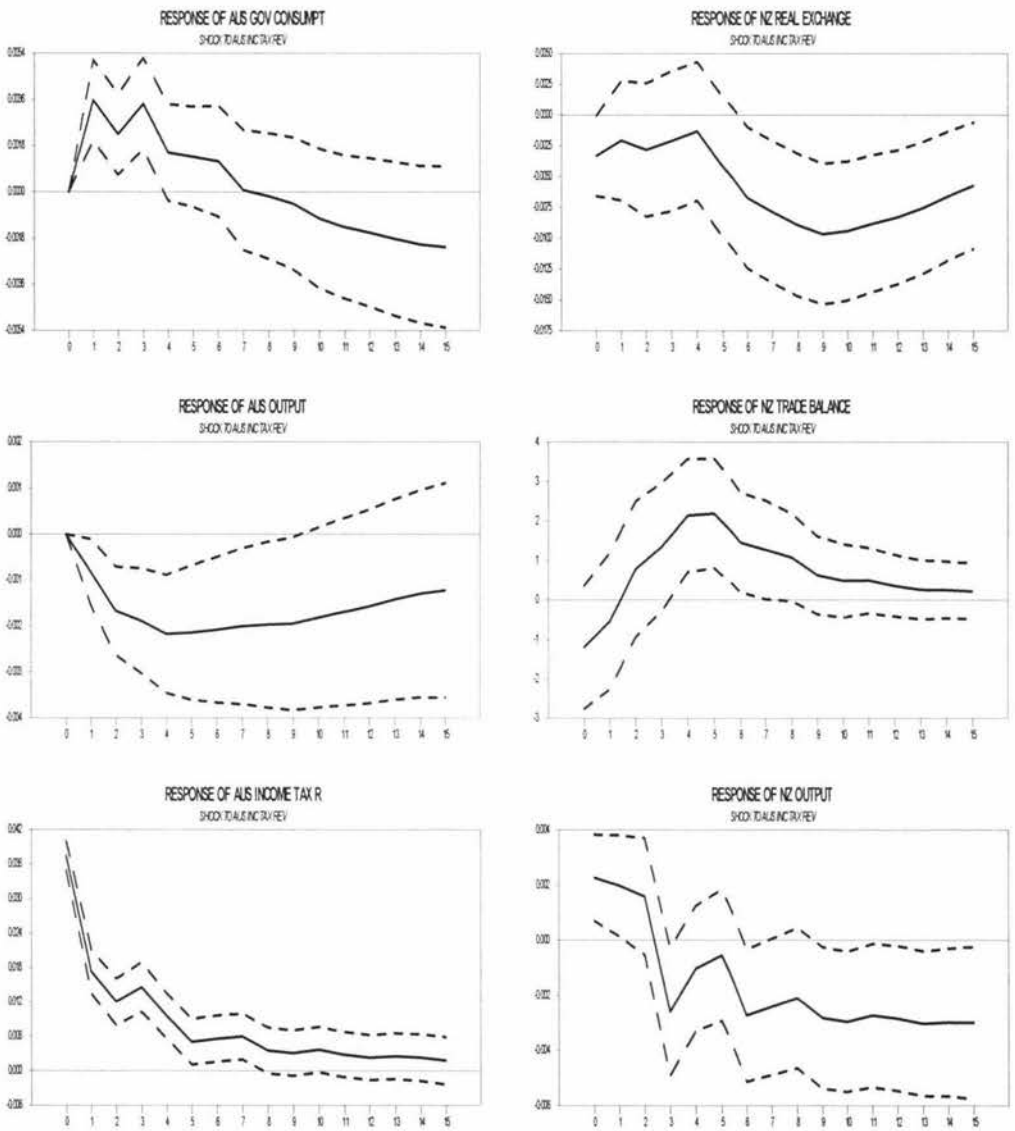
The real interest rate is then replaced with the real exchange rate. This is followed in the ordering by the New Zealand trade balance. As shown in Figure 6 the shock to Australian Income tax revenues is significantly positive until quarter eight. The response of Australian government consumption is significantly positive until quarter four. Australian output responds negatively, this response is significant from quarter one until quarter nine. The real New Zealand exchange rate responds negative from quarter six. This decrease represents a depreciation of the New Zealand dollar and an appreciation of the Australian dollar. This change in the exchange rate leads to an increase in the New Zealand trade balance. This improvement in the trade balance is significant from quarter three to quarter six. New Zealand output however, decreases and the decrease is significant in quarter three, quarter six and persistently from quarter nine. This shows that the interest rate effect, which leads to decreases in consumption and investment, is greater than the exchange rate effect that leads to an improving trade balance. Using the IRF's elasticity can be calculated. These show that an increase in Australian Income tax revenues of 1% leads to a 0.10% decrease in NZ output. This co-movement in output is consistent with the Mundell-Fleming model with sticky price, and is in contrast to Arin and Koray (2005) who find that an income tax shock leads to an increase in foreign output when looking at U.S. and Canadian data.

Figure 6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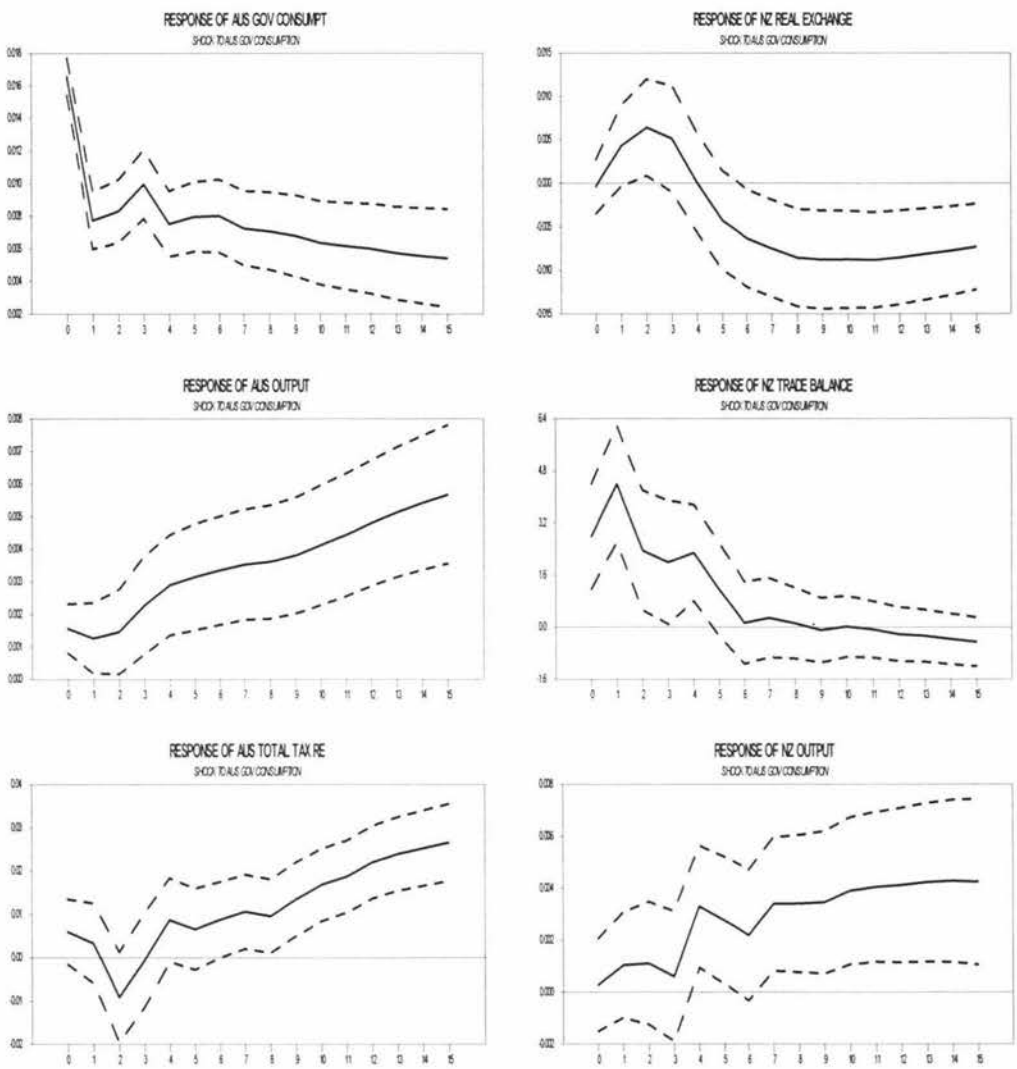
5.2.2. Government Consumption

To investigate the transmission of Australian government consumption, the real exchange rate and the New Zealand trade balance are added to the model. The real exchange rate is ordered before the New Zealand trade balance as changes in the real exchange rate are expected to effect the trade balance contemporaneously while changes in the New Zealand trade balance may only affect the real exchange rate with a lag. The IRF's are shown in Figure 7. A shock to Australian government consumption is significant in the model for all fifteen quarters. The response of Australian output is significant immediately and persistently. Australian total tax revenue responds positively and is significant from quarter six, this effect is persistent. This is expected as an increase in government consumption will require an increase in tax revenue to fund the spending. The New Zealand real exchange rate initially increases, significantly in quarter three. It then is significantly negative from quarter six and this response is persistent. The decrease represents a depreciation of the New Zealand dollar and an appreciation of the Australian dollar. The New Zealand trade balance increases significantly until quarter five. New Zealand output also increases, this increase is significant in quarter four and quarter five, and then persistently from quarter seven. An explanation of this could be that as the Australian and New Zealand economies are closely linked by trade, an increase in Australian output would lead to an increase in demand for New Zealand exports. In the absence of a change in the real interest rate, this would improve the New Zealand trade balance and explain the increase in New Zealand output in response to a positive innovation in Australian government consumption.

There is no significant effect on the real New Zealand interest rate, consumption or investment following a shock to Australian government consumption. Again, calculating the elasticities we see that an increase in Australian Government spending of 1% leads to a 0.23% increase in NZ output. As with income tax revenues, a shock to Australian Government Consumption leads to co-movements in output of Australia and New Zealand.

Figure 7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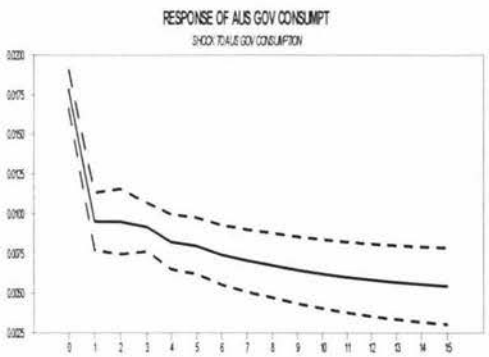
SHOCK TO AUS GOV CONSUMPTION

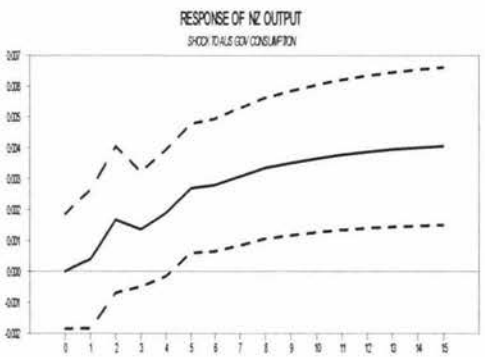
5.3. Robustness Checks

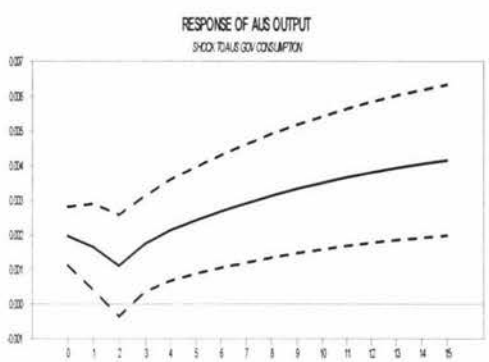
5.3.1. Alternative Lag Lengths

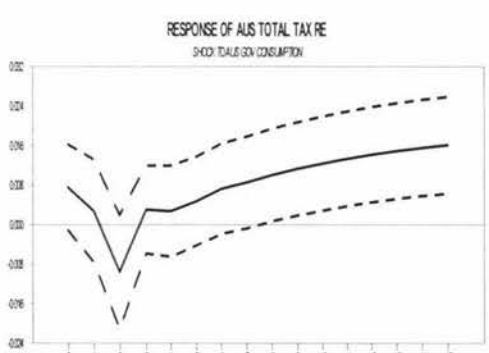
Figure 8 shows the IRF's for a shock in the model to Australian government consumption, with a lag length of three. Government consumption is significantly positive for fifteen quarters. Australian output increases and this response is immediately and significant. It is insignificant in quarter two, then from quarter three it is significant again and this effect is persistent. Australian total tax revenue responds positively, this response is significant from quarter eight and is persistent. New Zealand output also responds positively, and this response is significantly different from zero from quarter four, and then on is persistent. With a lag length of three, the model again shows co-movements in Australian and New Zealand output in response to a shock to Australian government consumption.

Figure 8


RESPONSE OF AUS GOV CONSUMPT
SHOCK TO AUS GOV CONSUMPTION

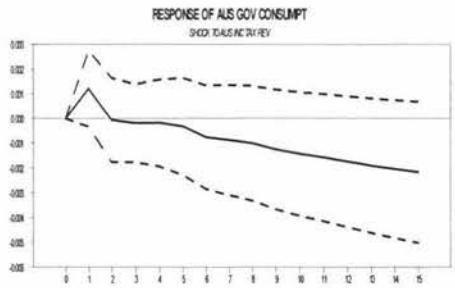

RESPONSE OF NZ OUTPUT
SHOCK TO AUS GOV CONSUMPTION

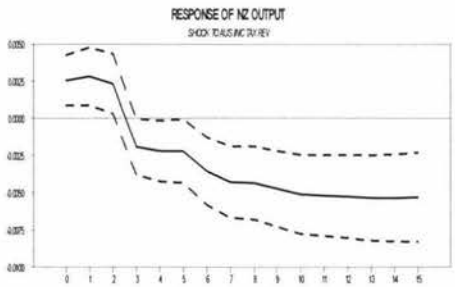

RESPONSE OF AUS OUTPUT
SHOCK TO AUS GOV CONSUMPTION

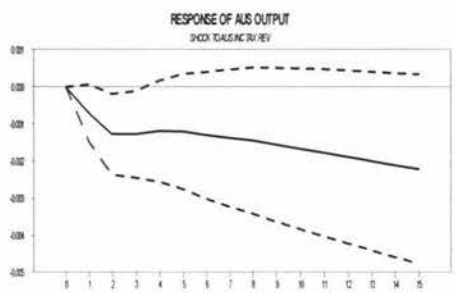

RESPONSE OF AUS TOTAL TAX RE
SHOCK TO AUS GOV CONSUMPTION

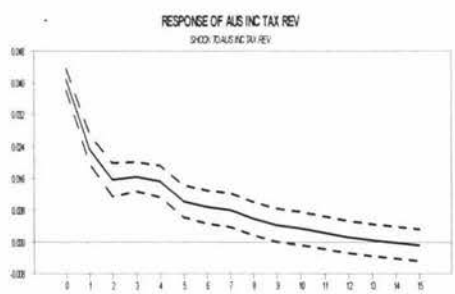
The IRF's in Figure 9 represent the response to a shock to Australian income tax revenues with a lag length of three. The shock to Australian income tax revenues is positive and significant until quarter ten. Australian government consumption is negative but not significantly different from zero. Australian output decreases; this response is significant from quarter two to quarter four. The IRF for New Zealand output shows an initial increase, this increase is significant until quarter two, from quarter three onwards New Zealand output decreases; this decrease is persistent in the model. Estimating the model with two standard deviations shows the same response in New Zealand and Australian.

Figure 9


RESPONSE OF AUS GOV CONSUMPT
SHOCK TO AUS INC TAX REV


RESPONSE OF NZ OUTPUT
SHOCK TO AUS INC TAX REV


RESPONSE OF AUS OUTPUT
SHOCK TO AUS INC TAX REV


RESPONSE OF AUS INC TAX REV
SHOCK TO AUS INC TAX REV

5.3.2. Alternative Orderings

Some previous studies have used different orderings in their VAR models. Arin & Koray (2006) order taxes before output, followed by government consumption. The benchmark model is re-estimated using this alternative ordering and the results are presented below. The results remain essentially the same when Government Consumption and tax revenues are swapped in the ordering of the VAR.

Figure 10 shows the response of the model variables to a shock to Government consumption with an alternative ordering. Government consumption and tax revenues are swapped in the ordering. The shock variable, Australian government consumption is significantly positive until quarter fourteen. Australian total tax revenue initially decreases and is then significantly positive from quarter eleven, this response is then persistent. Australian output initially decreases and is then significantly positive from quarter eight; again this is a persistent response. New Zealand output reacts positively and the response is significant from quarter nine onwards. The alternative ordering has essentially no effect on the response of the model variables, following a shock to Australian government consumption both Australian and New Zealand output increases.

Figure 10

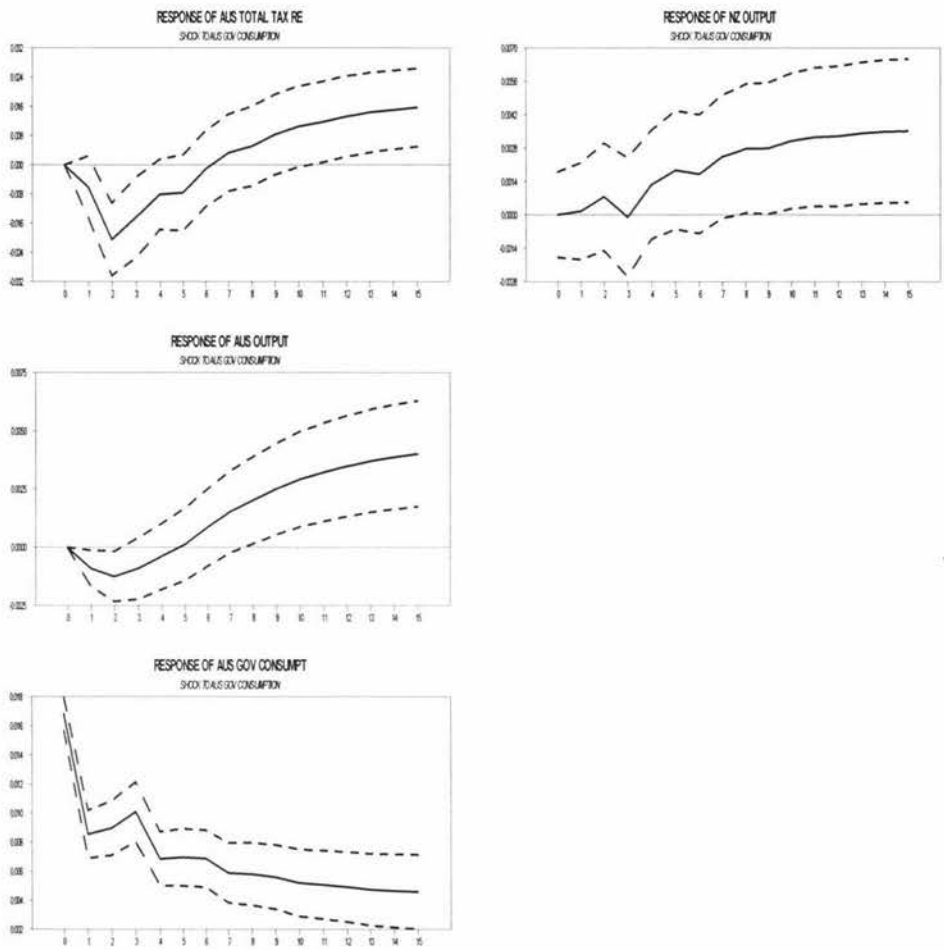
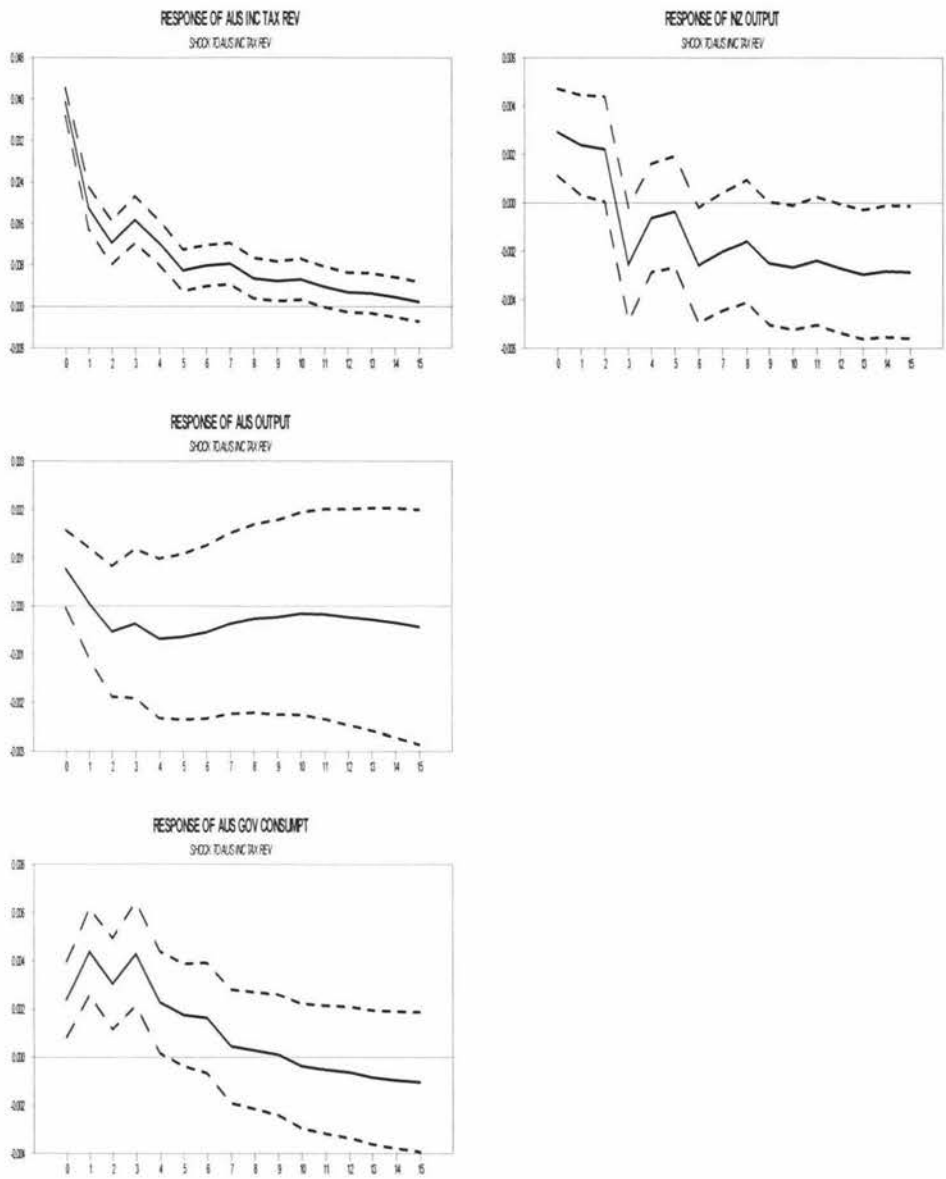

RESPONSE OF AUS TOTAL TAX RE
SHOCK TO AUS GOV CONSUMPTION
RESPONSE OF NZ OUTPUT
SHOCK TO AUS GOV CONSUMPTION
RESPONSE OF AUS OUTPUT
SHOCK TO AUS GOV CONSUMPTION
RESPONSE OF AUS GOV CONSUMPT
SHOCK TO AUS GOV CONSUMPTION

Figure 11 shows the response in the model with the alternative ordering, this time with a shock to Australian income tax revenues. Income tax revenues are significantly positive until quarter eleven. Australian output decreases although this response in not significant. Australian government consumption increases after an increase in income tax revenues; this response is transitory and only significant until quarter four. New Zealand output initially responds positively, this positive response is significant until quarter two. New Zealand output then decreases, this negative response is significant in quarters three, six, ten, and from quarter thirteen onwards. This alternative ordering shows that following an increase in Australian income tax revenue, New Zealand output decreases.

Figure 11


RESPONSE OF AUS INC TAX REV
SHOCK TO AUS INC TAX REV
RESPONSE OF NZ OUTPUT
SHOCK TO AUS INC TAX REV
RESPONSE OF AUS OUTPUT
SHOCK TO AUS INC TAX REV
RESPONSE OF AUS GOV CONSUMPT
SHOCK TO AUS INC TAX REV

5.3.3. Average Tax Rate

It may be argued that the average tax rate is a better measure to identify fiscal shocks in comparison to tax revenues. The benchmark model therefore is re-estimated using the average tax rate, the results are presented below.

In this regression the Australian average tax rate is used to replace tax revenues. Figure 12 shows the response of the model to a shock to Australian government consumption. This shock is immediate and significant for all fifteen quarters. Australian output responds positively and this response is significant with the exception of quarter two. The Australian average tax rate decreases initially and this effect is significant from quarter one to quarter three. There is no persistent effect as was found with tax revenues, this is logical as revenues would increase as output increases, while the average tax rate will remain proportional. New Zealand output also increases, with the effect being significant and persistent from quarter four. As with the benchmark model there is co-movement in Australian and New Zealand output in response to a shock to Australian government consumption.

Figure 12

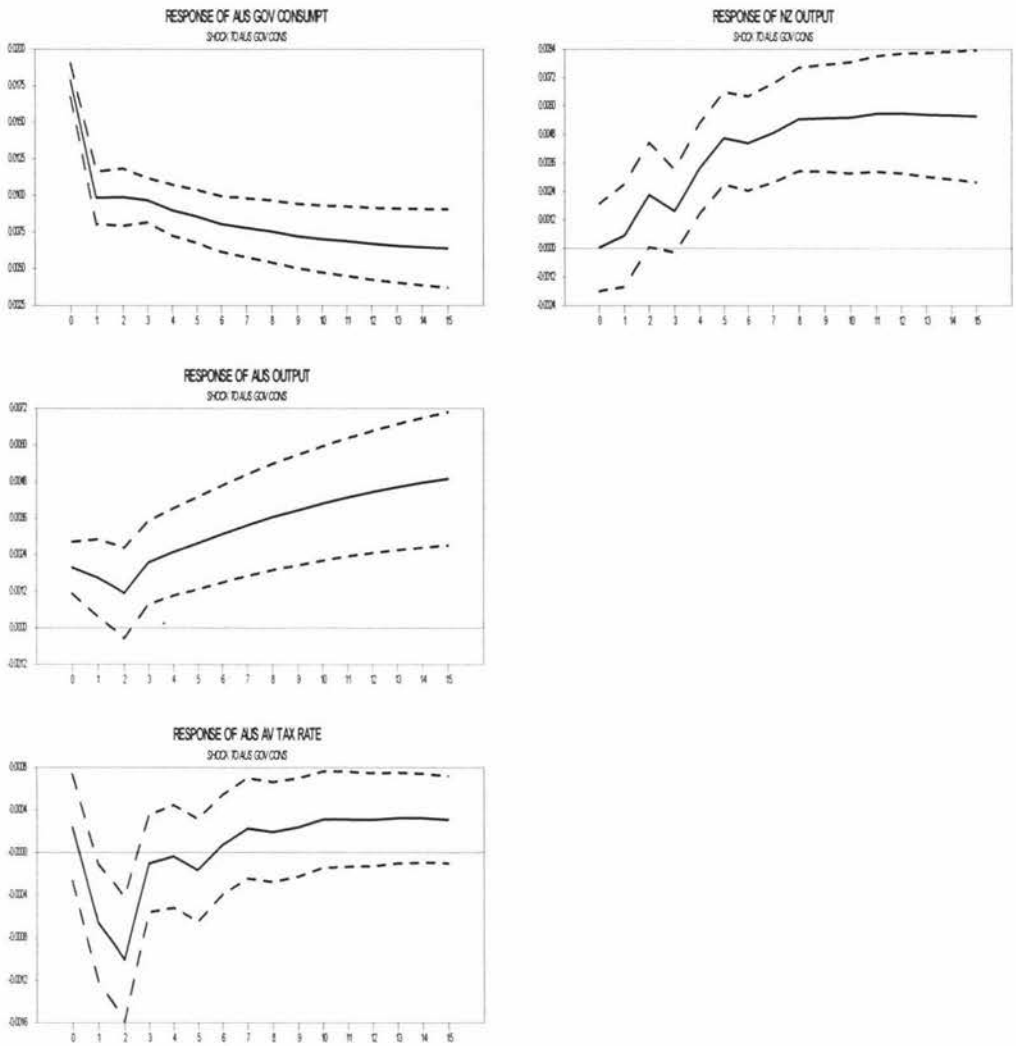
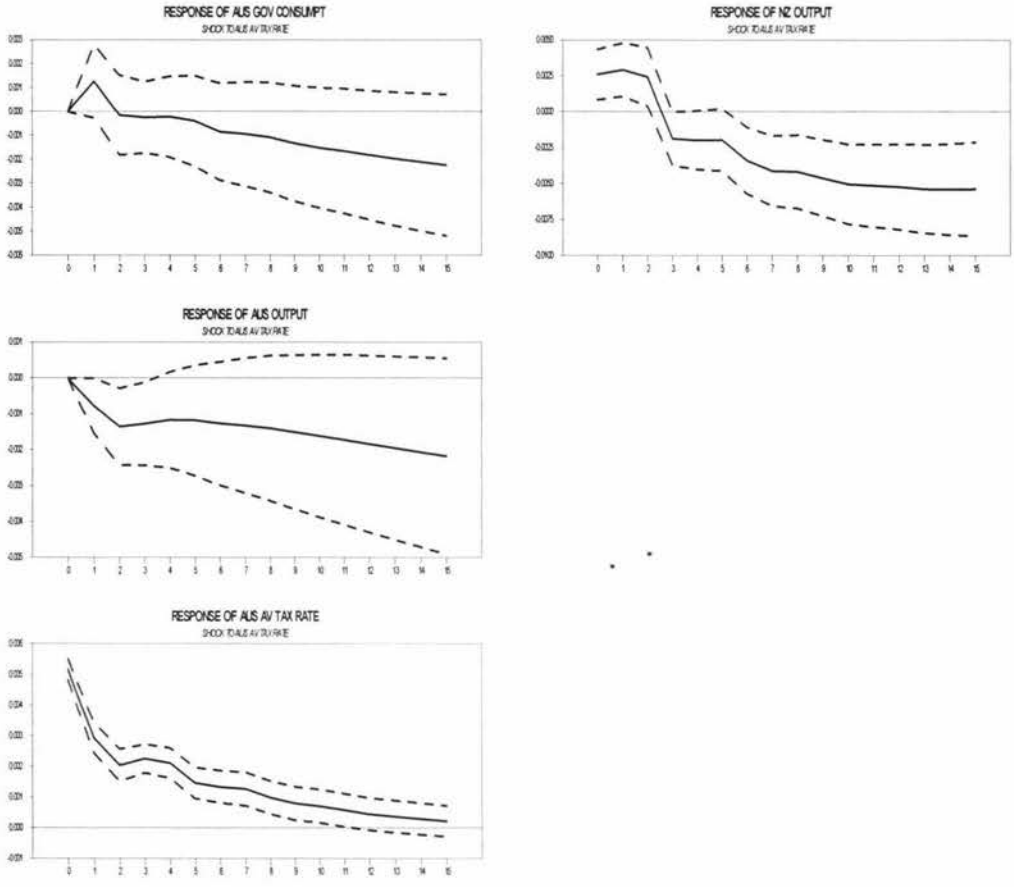

RESPONSE OF AUS GOV CONSUMPT
SHOCK TO AUS GOV CONS
RESPONSE OF NZ OUTPUT
SHOCK TO AUS GOV CONS
RESPONSE OF AUS OUTPUT
SHOCK TO AUS GOV CONS
RESPONSE OF AUS AV TAX RATE
SHOCK TO AUS GOV CONS

Figure 13 represents a shock to the Australian average tax rate. The shock is positive and remains significant until quarter eleven. The response of Australian government consumption is not significant. Australian output decreases following a shock to the average tax rate. This response is significant from quarter one to quarter four. New Zealand output also responds negatively. The response is significantly different from zero after quarter six and is persistent.

Figure 13


RESPONSE OF AUS GOV CONSUMPT
RESPONSE OF NZ OUTPUT
RESPONSE OF AUS OUTPUT
RESPONSE OF AUS AV TAX RATE

6. Conclusion

This paper investigates how fiscal policy shocks in Australia affect the New Zealand economy and through what channels the fiscal policy transmission takes place. The results show that a shock to Australian income tax revenues leads to a decrease in Australian output and a decrease in New Zealand output. The New Zealand dollar depreciates and the New Zealand trade balance improves, this channel however is not as strong as the interest rate channel. Following an income tax shock, the New Zealand real interest rate increases, followed by a decrease in both New Zealand investment and consumption. This decrease in investment and consumption then leads to the decrease in New Zealand output.

Following a shock to Australian Government Consumption, Australian output increases and there is no significant change in the New Zealand real interest rate or New Zealand Consumption or Investment. The Australian Government spending shock is however, followed by depreciation in the New Zealand dollar. This then improves the New Zealand Trade Balance and leads to an increase in New Zealand output.

Where the interest rate channel is active, it appears to be a stronger channel of transmission between the Australian and New Zealand economies. These results remain essentially the same with different lag lengths and different orderings in the model.

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