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International Shocks and the Role of Domestic Policy in Australia

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CONTENTS

	Page
Abstract	**iii**
1. Introduction	**1**
2. The Literature	**4**
3. VAR Models	**5**
4. The 1990s Re-examined	**9**
5. International Shocks Transmitted to the Domestic Economy	**15**
6.The Role of Monetary Policy in the Economy	**20**
7. An International Crisis: The Example of East Asia	**30**
8. Conclusion	**33**
References	**35**

ABSTRACT

In the presence of large international disturbances small open economies are faced with difficult policy choices. International conditions impact on domestic outcomes. Using a structural VAR model of the Australian economy I explore the ways in which domestic monetary policy contributes to the output outcomes experienced in the economy. The focus is on the impact of international shocks. Monetary policy is modelled using a cash rate response to GNE, inflation and real exchange rate shocks. The results show that removing the focus on either GNE or inflation leads to lower GDP outcomes for the economy. The challenge for domestic policy is to recognise and respond to international and domestic shocks to the maximum benefit of the domestic economy.

Keywords: VAR, open economy, monetary policy

JEL Classifications: C52, E52

1. Introduction

The Australian economy has almost all the features of a classic small open economy; it is open to trade, capital flows, and (albeit limited) migration. It possesses virtually no pricing power in international markets, although occasionally conditions in primary markets can have an influence on international prices. It has also maintained a floating exchange rate since late 1983, and operates with very limited regulations on international or domestic capital allocation.

A consequence of Australia's lack of impact on international economic conditions is that the economy is perceived as widely influenced by external factors. This has been empirically verified in a number of influential studies, many of which originate from policy-making bodies such as the central bank and Treasury. A common way of proxying external influences on the Australian economy has been as a simple relationship between either the US economy or an OECD average and domestic factors – for example, Gruen and Sheutrim (1994), Beechey et al (2000), The Treasury Model and The Murphy Model (MM2) where the small open economy assumption is invoked[1].

However, although external conditions play a large part in determining Australian economic outcomes, the role of domestic policy is crucial. The domestic policy settings of the economy can cause international shocks to be either dampened or amplified – this is an important role for domestic policy in economies heavily influenced by external events over which they have minimal influence. In fact, this may mean that small open

[1] There are also a number of studies that do not invoke the small open economy assumption, such as Summers (1999), Weber (1994), Smith and Murphy (1994) and Moreno (1992).

economies need to devote proportionately *more* rather than fewer resources to domestic policy than do influential economies. Domestic policy setting may actually be more difficult in this situation, in ways that are not yet well understood (Fraser (2001), Ball (2000), Taylor (2000), Fagan and Weber (1994)). Not only do domestic policy settings have to be constructed for effective domestic operations in times of calm, they also need to be able to both handle and disburse the turmoil which can arise from international events. However, this is not a debate limited to small or developing economies, as the empirical debate as to the appropriate role of the US Federal Reserve in muting the 1974 oil price shock shows; see Bernanke, Gertler and Watson (1997) and Hamilton and Herrera (2001).

In this paper I examine the influence of external conditions on the Australian economy in the 1990s using an updated version of the structural VAR model given in Dungey and Pagan (2000). This model uses the US economy as the proxy for external conditions. The conclusions are similar to those from a model including a larger range of external economies, Dungey and Fry (2001). The influence of external conditions is almost equivalent to that of domestic influences in contributing to prevailing domestic economic outcomes. In more detailed decompositions, however, the importance of domestic conditions becomes more evident, particularly around turning points in the world economic cycle.

As evidence of the importance of domestic policy settings the Australian economy's response to the East Asian crisis is considered. A significant proportion of Australia's direct trading partners experienced periods of negative growth following the crisis. How, then do we explain the relatively good Australian experience? One answer may lie with the management of the domestic economy – allowing the shock absorbers of a developed and liquid financial sector to adjust and cushion the real economy, and providing fiscal relief to aid the redistribution of resources required by this external shocks. It also seems likely that good luck had some part in the outcome, with asset price rises cushioning the impact. Gruen (2000) notes that monetary policy was allowed more 'latitude' in this period than earlier incidents.

This is not an unmitigated applause of domestic monetary and fiscal policy during this period – however, it does demonstrate that domestic policy has an important role to play in managing the domestic economy in the face of dominant external shocks. A counter example of unsuccessful domestic policy response in the face of external shocks would be to adopt the attitude that the influence of international events is so overwhelming that there is no gain from domestic policy. This point is distinct from a deliberate policy of inaction, which has been given due consideration. Recently, The Economist (2001) has accused East Asian economies of something similar in their lack of banking sector reform; see also Summers (2000).

The remainder of the paper is structured as follows. Section 2 discusses the literature on external influences on the Australian economy. Section 3 outlines the basic components of the models to be used, although the detail is contained in the source papers. In Section 4 we decompose the contributions of domestic and international shocks on Australian economic performance in the 1990s particularly. Some simulations then illustrate the effects of a number of external shocks based on this past experience in Section 5, and with some modifications to the model we examine the composition of domestic policy settings in more detail in Section 6. The construction of the models means that the focus is on monetary policy. Section 7 examines in more detail the East Asian crisis experience for Australia and Section 8 concludes.

2. The Literature

The influence of international economic conditions on the domestic economy is quite substantial. Some examples of the literature on this issue are contained in the volumes by Perkins (1968), Veale (1980) and Meredith and Dyster (1998). However, in this paper we concentrate on the financially deregulated environment of the 1980s onwards, and for policy purposes mainly on the 1990s.

Australia has long been a producer of structural macroeconomic modelling, including models run by the Treasury (the NIF series, and currently TRYM) and the RBA (the RBA series of models and relatively recently the re-emergence of modelling documented first in de Brouwer and O'Reagan (1997) and most recently Beechey et al (2000)). There are also a number of non-government models, the Monash model (formerly ORANI), and the Murphy Model suite of models (the basic structure of which can be found in Murphy and Powell (1996)). In these models the international economy is exogenous – and its influences are imported directly into the Australian economy. In contrast, the models associated with Warwick McKibbin contain interdependent models of economies.

A number of single equation studies of the influence of international activity on Australian output also exist. The most influential have probably been those originating from the Reserve Bank of Australia. In particular, the output equation in Gruen and Sheutrim (1994) which uses OECD output. The current RBA model also includes a single equation estimation of Australian output evolution involving exogenously determined international activity.

Complementing the single equation and structural models are a number of VAR models. The first Australian VAR seems to be an early attempt by Trevor and Thorpe in 1988. However, subsequent research on the economy wide scale was hampered by the massive structural change to the economy as a result of the financial deregulation of the early 1980s. Not until the mid-1990s were there enough data points to make this method more useful for economy-wide modelling in Australia. Since then a number of studies have been undertaken, including Moreno (1992), Weber (1994), Fisher (1996), Huh (1999), Brischetto and Voss (1999), Summers (1999, 2001), Dungey and Pagan (2000), Suzuki (2001),Willard, Voss and Zha (2001).[2]

In this paper we examine the impact of international economic conditions on the Australian economy using results derived from the VAR literature. In particular we take an updated version of Dungey and Pagan (2000) to decompose the influences on the Australian economic cycle over the 1990s and examine the role of domestic monetary policy. The model is then used to examine the results of international shocks from a series of experiments changing domestic policy settings.

3. VAR Models

The basic tools of VAR modelling are well documented elsewhere, see Hamilton (1994) for example, and are beyond the scope of this paper. However, for clarity it is worth restating that VAR model relates variables through their data characteristics rather than structurally. Hence we can write a vector of variables, y_t, in reduced form as:

$$y_t = A(L)y_{t-\ell} + e_t \tag{1}$$

where e_t is a vector of reduced form errors, uncorrelated across equations. Equation (1) can then be rewritten as an autoregressive process in the error term.

$$y_t = C(L)e_{t-\ell} + \text{initial conditions} \tag{2}$$

where C represents the impulse response functions and the initial conditions depend on the lag structure of the model. Equation (2) provides a number of useful ways of decomposing the final result including the impulse response functions and the historical decomposition, which will be used in section 4 below.

The models used in this paper are slight variations on the basic VAR model outlined above. In the most basic structural VAR (SVAR) a Wold ordering is imposed on the contemporaneous variables in addition to normalization. This system will be exactly identified. Alternatives are then to exactly identify the model using some other schematic. One alternative is to have overidentified models. In the models presented here the Wold ordering of the standard SVAR analysis is retained, but some elements of that matrix are set to zero - that is extra restrictions are imposed. In addition, some structure is placed on the matrices of coefficients on the lagged variables. For details on the exact identification see Dungey and Pagan (2000).

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[2] There are many other VAR studies on Australian data; here I have concentrated on those which have attempted to model the entire economy. I have deliberately excluded all two and three variable models as irrelevant to the current discussion.

The Dungey and Pagan model contains two sectors, international and domestic. The former contains 5 variables- US real output, the Australian terms of trade, US real 90 day interest rates, a Tobin's Q variable for the US and Australian exports – the domestic sector includes a Tobin's Q variable for Australia [3] real GNE, real GDP, inflation, the cash rate and the real trade weighted index of the Australian dollar (real TWI). All data is quarterly, all variables except the Tobin's Q, interest rates and inflation rates are in logarithms and with the exception of the domestic inflation rate have been detrended. The estimation approach is standard and a range of impulse response functions are reported in Dungey and Pagan.

The structure of the model relates to empirical and theoretical results previously existing for Australian data. The full details are given in Dungey and Pagan, but a broad overview of the restrictions relating to the interaction between international and domestic economies is beneficial here. A small open economy assumption is applied in the model by imposing block exogeneity on the international sector, so that Australian economic conditions do not impact on the US economy. The literature is somewhat divided here; earlier VAR models of Australia such as Weber (1994), Smith and Murphy (1994) and Moreno (1992) had full recursivity. More recently, Suzuki (2001) finds that the empirical evidence does not support the small open economy restriction and Summers (1999, 2001) reports feedbacks. Brischetto and Voss (1999) and Willard, Voss and Zha (2001) both impose the small open economy restriction. Although there may well be feedbacks, they

[3] The USQ is constructed as the Dow Jones Index deflated by the Consumer Price Index, and AUSQ as the All Ordinaries Index deflated by the Investment Price Deflator series from the National Accounts data – see Dungey and Pagan (2000) for exact data definitions.

are likely to be relatively small, and the lack of an exogeneity restriction has led to some odd responses in the models (as acknowledged in Suzuki (2001), see also Weber (1994)).

The international sector of the model has a number of restrictions. Importantly, the US economy does not to respond to the Australian terms of trade, although the terms of trade reacts to the US economy. This reflects the differing structures of the two economies. Australian exports are deemed to react to the real US economy, but not directly to the US financial variables of USQ and the real US interest rate.

The domestic economy has a restricted path of reaction to changes in the US economy. The transmission mechanism for US GDP shocks to the Australian economy comes directly through Australian GDP and investment and financial market conditions as represented by AUSQ and the real TWI. Similarly, exports enter only into Australian GDP. The US financial sector enters directly only into AUSQ via USQ, and to the real TWI via USQ and the real US interest rate. Neither US financial sector conditions, nor the real economy directly impact either Australian inflation, GNE or the cash rate. This is not to say that contemporaneous effects of shocks to US variables will not be felt in those domestic variables, but rather that they are transmitted through their relationship with contemporaneous Australian GDP. Changes in the terms of trade, however, impact contemporaneously on all Australian variables with the exception of the cash rate. The lag structure is somewhat less constrained, but retains the restriction that the Australian cash rate does not respond to international variables directly (inflation, however, has a direct link with the terms of trade).

The other important feature of the model is the constraint on the impact of changes in the cash rate. To capture the lags between monetary policy action and changes in economic conditions, alterations in cash rates do not impact Australian GNE, GDP or inflation for two periods after they are enacted. They do, however, affect the exchange rate immediately.

A selection of results from this model was reported in Dungey and Pagan (2000). The following reports results from an updated data set and expands the analysis of the impact of the international sector on the Australian economy.

4. The 1990s Re-examined

Dungey and Pagan (2000) report results from a data period spanning 1980 to September 1998. In this paper the data period is extended to June 2000. A standard result often reported in VAR studies is the forecast error variance decomposition for the variables of interest. This decomposition aims to illuminate which shocks were on average responsible for the observed variance in a particular variable over differing forecast horizon. The variance decomposition for Australian GDP is presented in Table 1.

The results in Table 1 support the primary importance of domestic shocks in determining the outcome for Australian GDP, particularly the importance of GDP shocks themselves. However, the strong influence of international shocks is also evident. At the one year forecast horizon these account for around 30 percent of total variance in GDP, and almost 45 percent at a 3 year horizon. The decompositions also show that the reclassification of the RTWI as an international rather than domestic variable makes little difference to the overall tenure of the results. Given that the exchange rate has a role as a stabilising influence this result is expected.

Table 1: Forecast Error Variance Decomposition for Australian GDP

Shock	Contributions at forecast horizons			
	1	4	8	12
USGDP	0.015	0.116	0.208	0.228
TOT	0.012	0.031	0.047	0.045
RUS	0.000	0.007	0.053	0.061
USQ	0.000	0.026	0.060	0.052
EXP	0.185	0.141	0.073	0.061
Total Internat	***0.212***	***0.321***	***0.441***	***0.447***
AUSQ	0.011	0.031	0.024	0.020
GDP	0.571	0.545	0.421	0.364
GNE	0.206	0.071	0.036	0.030
INF	0.000	0.010	0.008	0.007
CASH	0.000	0.002	0.055	0.120
RTWI	0.000	0.019	0.015	0.012
Total domestic	***0.788***	***0.678***	***0.535***	***0.553***
International with RTWI	0.212	0.340	0.456	0.459
Domestic with no RTWI	0.718	0.659	0.520	0.521

Unfortunately, the forecast error variance decomposition can be quite misleading. In the presence of over-identifying restrictions in the VAR, such as in this model, the assumption that the individual error terms are orthogonal is usually violated. It is difficult to know what effect this has on the decomposition. In addition the average nature of the statistic detracts from information about the dynamics of the decomposition over the business cycle. A more informative alternative is to decompose the estimated fitted value for the series of interest into its component shocks, as per equation (2). Figure 1 represents the decomposition of detrended Australian GDP over the estimation period, with the shocks broadly classified into domestic and international as above. The horizontal zero axis represents the trend in Australian GDP, so that observations above the line represent above trend Australian GDP. The vertical bars represent the total contributions of the international and domestic components of the model to making up the GDP figure (that is the sum of the columns represents the value of the line on the chart). Hence, for example, in 1985-86, the domestic factors (which are black) contribute positively to GDP, but the GDP outcome is reduced by the negative international effects (which are given in grey). This decomposition provides a useful tool for analysis.

The course of the last two decades provides some interesting outcomes. The early 1980s recession is clearly primarily a domestically driven problem, the contribution of international shocks is relatively less – perhaps reflecting the impact of the drought conditions at the time. Domestic shocks continued to impact negatively on growth in the mid-1980s, so that the slowdown in 1986 was due to a lower positive contribution from international factors than previous years. This is consistent with the definition of the terms of trade as an international shock, and if the decomposition is further refined the 1986 slowdown is clearly associated with the terms of trade (see for example figure 23 in Dungey and Pagan (2000)).

In the late 1980s and early 1990 domestic factors were the driving force for the higher than trend GDP, while international factors were acting against this trend. Both international and domestic factors contributed to the slowdown in the early 1990s, and international factors did not cumulatively make a positive impact to Australian GDP until the late 1990s. The recovery of GDP to above trend growth again in 1997 was mainly due to domestic factors (mainly due to GNE shocks in the model), but particularly from late 1998 onwards, international factors played an important role in sustaining the boom in domestic output.

Although this decomposition provides an interesting story it also disguises some of the detail of how the economy was behaving in this period. Figures 2 and 3 provide the individual contributions of the international factors to detrended Australian GDP in the 1990s. Figures 4 and 5 give the contributions of the domestic factors. From Figures 2 and 3 it is apparent that the predominantly negative international effect until the mid-1990s was broadly based across the international indicators, with the exception of the real US interest rate, which was contributing to higher domestic output. In the late 1990s domestic output is sustained by USQ shocks, representing the rapid growth in US share markets in particular, and US GDP, following a period of strong international output growth.

However, it is apparent from a comparison of Figures 2 to 5 that the largest single contributors to the detrended GDP decomposition in the late 1990s are domestic GNE and GDP. In the summation of the domestic forces their contribution is diminished by the small negative contributions of the remaining domestic variables. This more detailed story is consistent with our experience of the recovery from the 1990s recession.

Figure 1:

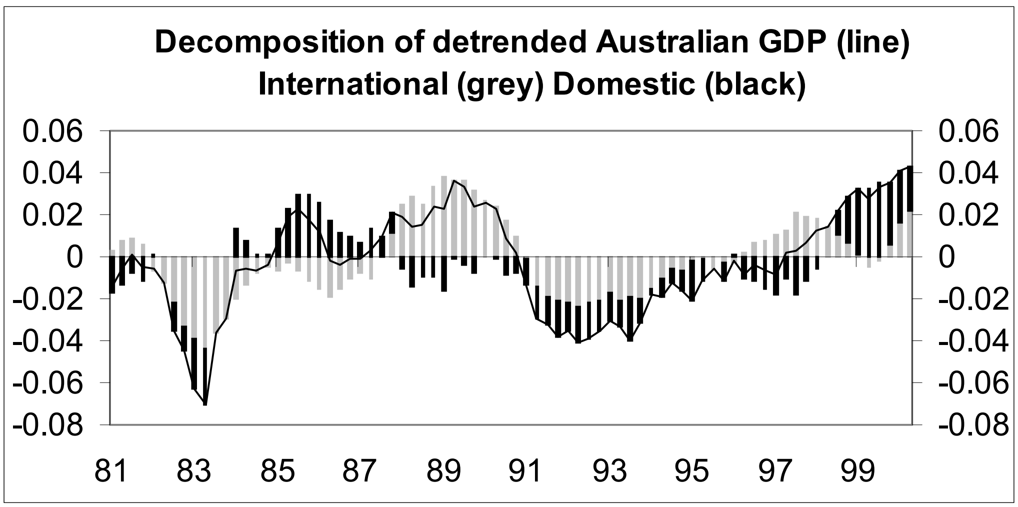


Figure 2:

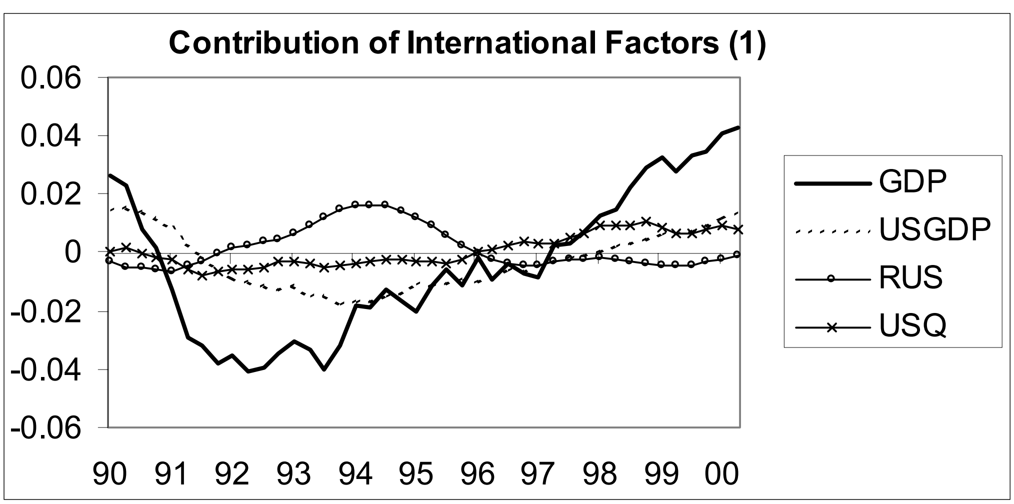


Figure 3:

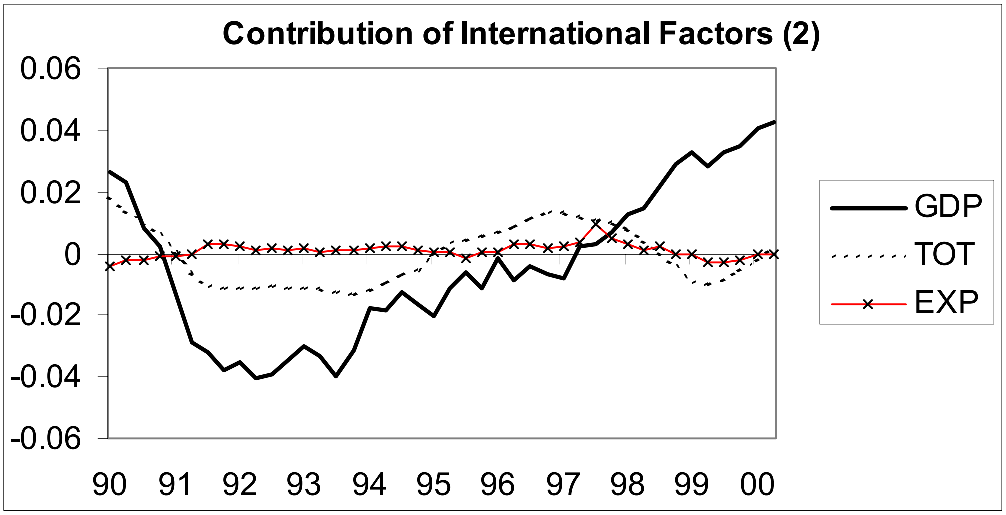


Figure 4:

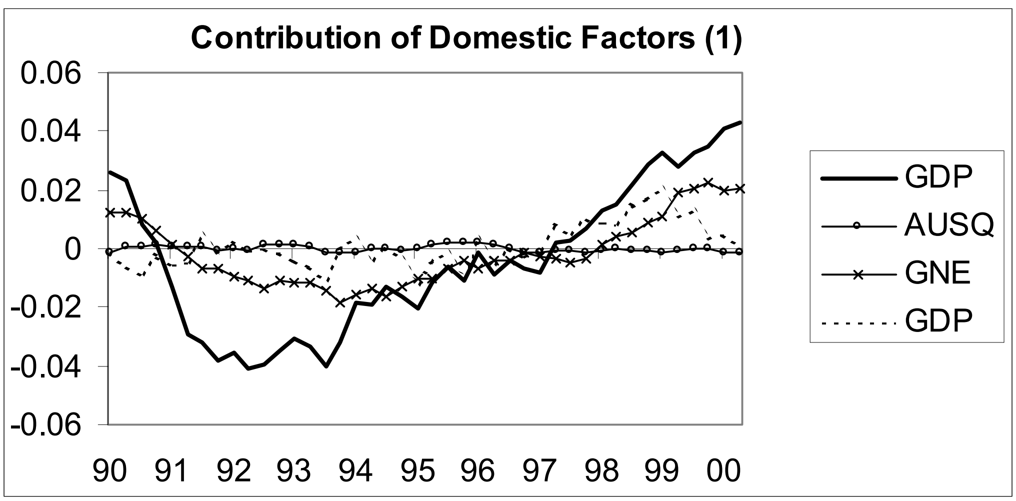
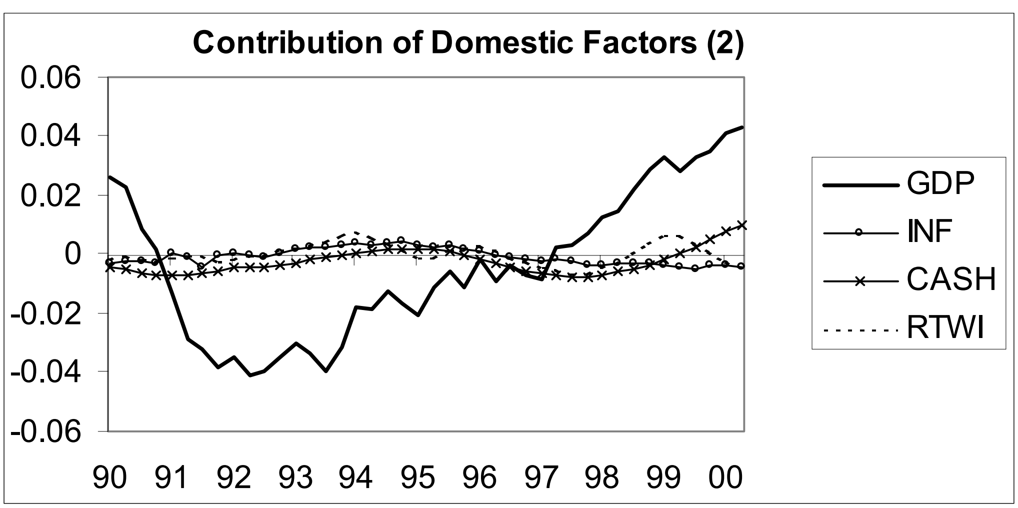


Figure 5:



Having characterised the path of Australian output over the past 20 years, and established that international effects have an extremely important role to play in determining the outcomes for domestic output we turn now to the impact of international shocks on the economy. Using the characteristics of the model outlined in this section we examine the resulting paths for the Australian economy, focussing particularly on domestic output and inflation. In the following section we examine the implied monetary policy responses to these shocks, and experiment with alternative response functions to analyse the impact of domestic monetary policy on the Australian economy.

5. International Shocks Transmitted to the Domestic Economy

Table 2: One standard deviation shocks

Variable		Variable	
USGDP	0.78%	USQ	8.08%
TOT	2.21%	EXP	3.99%
RUS	118 basis points		

There are five potential international shocks to the Australian economy in this model, associated with USGDP, the terms of trade, real US interest rates, USQ and exports. This section deals with each in turn. However, we note initially that the structure of the model is such that much of the initial impact will be felt through the relationships between the domestic variables and US GDP. Contemporaneous relationships between the domestic variables and the international variables are relatively limited. The real TWI is the least restricted, relating to all contemporaneous variables except exports. Australian GDP is related directly to US GDP, the terms of trade and exports contemporaneously and AUSQ is related to US GDP, the terms of trade and USQ contemporaneously. Of the other domestic variables GNE and inflation only respond to the terms of trade contemporaneously and the cash rate is constrained to relate only to domestic variables (this is in contrast to other VAR literature for Australia such as Suzuki (2001)). Given this structure it is of interest to see how strongly the international shocks are transmitted to the domestic economy. Table 2 gives the size of the one standard deviation shocks applied in the analysis.

Figure 6:

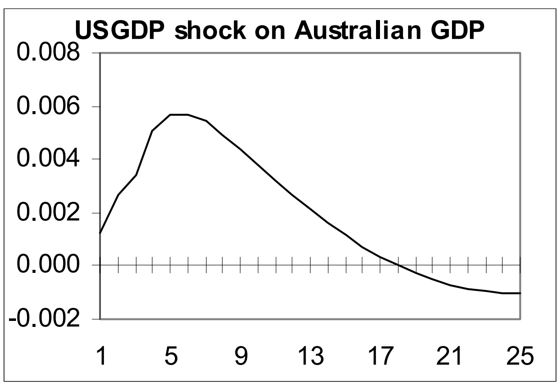


Figure 7:

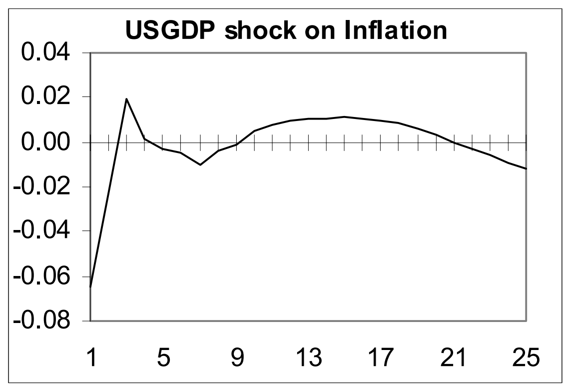


Figure 8:

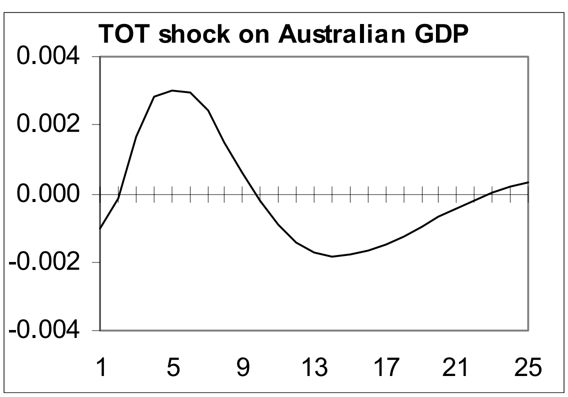
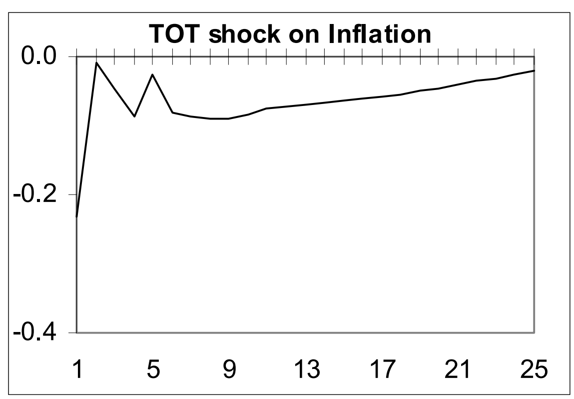


Figure 9:



Figures 6 and 7 represent the impact of a USGDP shock on Australian output and inflation. The impact of a 0.78% shock in USGDP on Australian GDP is initially a 0.1% contemporaneous increase. Four quarters after the shock the cumulative impact on Australian GDP has been for a 1.2% increase in output. The shock results in increases in Australian GDP for some 4.5 years, before returning below trend. The results for inflation are initially perverse, a feature also in Dungey and Pagan (2000) but found to be insignificant[4]. Despite the higher growth, inflation is restrained by the actions of the monetary authority in increasing the cash rate, by 250 basis points in the first 3 years following the shock.

A positive terms of trade shock could be associated with either an increase in export prices or a decrease in import prices. Here, the associated appreciation of the Australian currency supports the view that the shock is driven by export price increases rather than increased demand for imports. The appreciation of the currency also leads to a lower inflationary outcome (Figure 9). It will be of some interest to see if this feature is maintained in future updates of the model, given that there seems to have been far less exchange rate pass through in recent years than in the early part of the estimation period (Dwyer and Leong (2001)).

The role of a shock to real US interest rates is more difficult to analyse as the variable comprises a composite of US interest rates and inflation. A rise in real interest rates may be achieved by tighter US monetary policy, or by decreased US inflation. The real US interest rate does not enter directly into any domestic variable except the real exchange

[4] As with most VAR applications the confidence for the impulse response functions are wide. They are not presented here in the interests of preserving space.

rate. However, the responses shown in Figures 10 and 11 are consistent with the rise in the US real interest rate, which causes a decline in US output. Australian output and inflation are consequently lower. This is despite a fall in the Australian real interest rate; notwithstanding the initial fall in the domestic inflation rate, the cash rate is lowered to combat the decline in the economy and the real interest rate falls.

Figure 10:

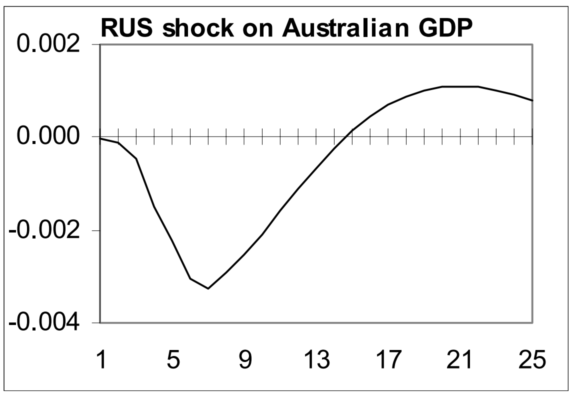


Figure 11:

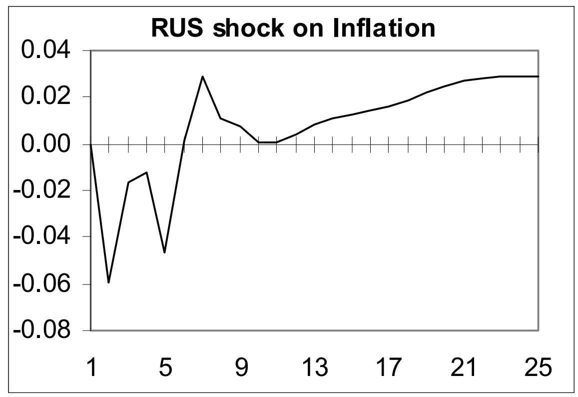


Figure 12:

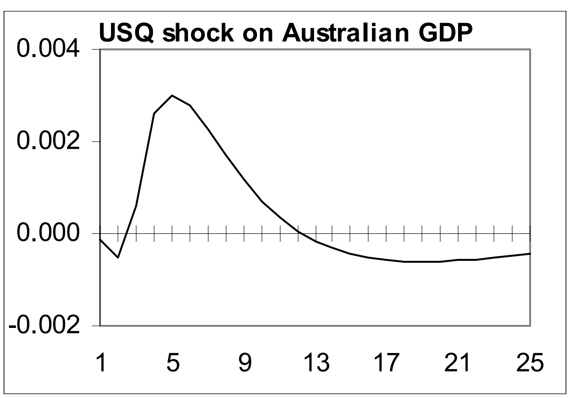
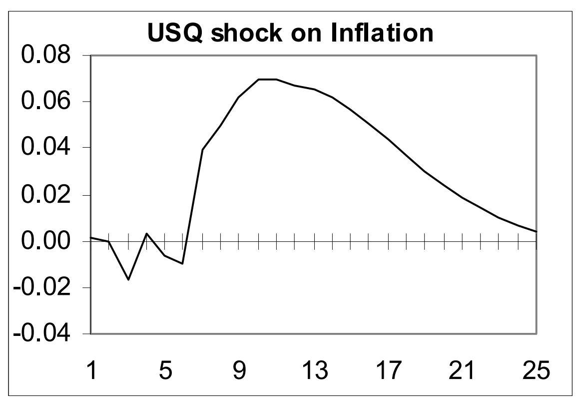


Figure 13:



The transmission of shocks to the domestic economy via the financial sector is a vital characteristic of modern economics. In this model there is some scope to capture this through the relationship between AUSQ and USQ, however, it would be desirable to vastly extend these linkages to include other asset prices. This may particularly help to analyse the performance of the Australian economy in the 1990s. A shock to USQ is transmitted almost one for one into the domestic variable AUSQ. There seem to be strong relationships between the financial sectors, reflecting the developed nature of the markets and strong financial integration. The result is that Australian output and inflation rise. These are accompanied by a strong rise in the domestic cash rate, but insufficient to keep the inflation rate from rising above its trend value. The responses are shown in figures 12 and 13.

Figure 14:

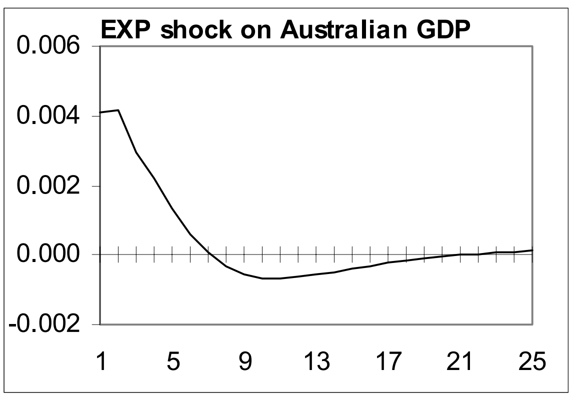
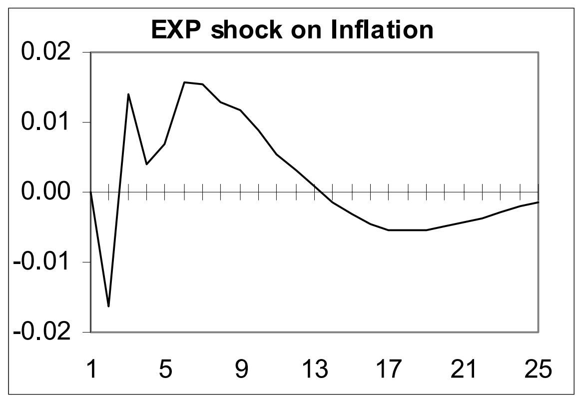


Figure 15:



The final international shock to consider is that of an export shock. This can be conceived of as an independent increase in demand for Australian exports, due perhaps to a shift in tastes. It differs from an increase in export demand induced by generally higher activity in the US economy. The export shock induces an appreciation in the domestic currency, which is initially transmitted to lower inflation in the domestic economy. However, the strong positive effect of higher exports on domestic GDP runs counter to this and inflation returns to above trend after the initial period. See figures 14 and 15. The domestic cash rate is lifted in order to counter the inflationary pressures in the economy.

The impulse responses for the international shocks shown in Figures 6 to 15 indicate the transmission of these shocks to the domestic economy. In the next section we consider how domestic policy responds to these shocks, and the mitigating role that policy can play in protecting the domestic economy from the full impact of these shocks.

6. The Role of Monetary Policy in the Economy

The monetary policy variable in this model is the Australian cash rate[5]. However, unanticipated shocks to the cash rate do not include the feedback effects of the rest of the economy on cash rates. Here we construct a monetary policy index that includes both the feedback and unexpected components as in Dungey and Pagan (2000).

Formally, the decomposition of GDP in the 11 variable model can be represented as:

$$y_t = \text{initial conditions} + \sum_{j=0}^{t-1}\sum_{k=1}^{11} c_{jk} e_{k,t-j} \tag{3}$$

The decomposition when all feedback effects are repressed in the model, that is when all coefficients relating to variables other than lags in the cash rate are set to zero, is expressed as:

$$y_t^* = \text{initial conditions} + \sum_{j=0}^{t-1}\sum_{k=1}^{11} b_{jk} e_{k,t-j} \tag{4}$$

[5] Unlike other studies we do not find it necessary to include the money supply to obtain appropriate monetary policy responses in this model. See for example, Brischetto and Voss (1999) for Australia.

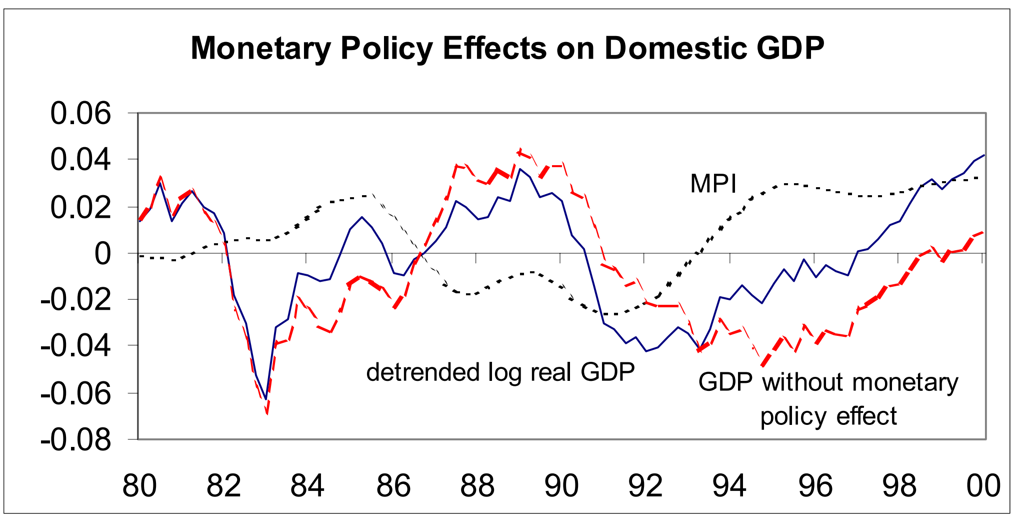
As in Dungey and Pagan (2000) the MPI is constructed as result of subtracting (5) from (4) and adding back the effects of the cash rate shocks themselves,

$$MPI_t = \sum_{j=0}^{t-1} b_j e_{CASH,t-j} + \sum_{j=0}^{t-1} \sum_{k=1}^{11} (c_{jk} - b_{jk}) e_{k,t-j} \tag{5}$$

where e_{CASH} represents the cash rate shock. The results are shown in Figure 16. The solid line represents the detrended log GDP, which is the actual data for the period, and the lightly dotted line is the monetary policy index. The longer dashed line is the implied GDP without the impact of monetary policy over the period. Hence, when the MPI series is positive monetary policy is acting to increase output, so that the GDP without monetary policy effect would have been lower than the outcome observed. Consider, for example, according to Figure 16, that monetary policy in 1994-1995 was acting to increase output; the MPI is positive and the GDP without monetary policy line is below that of the detrended GDP (roughly speaking the 'observed data'). This is an interesting period as it corresponds with a tightening of monetary policy with a 275 basis point rise in the cash rate from mid-1994 to the end of 1995, and a contraction in the MPI may have been anticipated. From Figure 16 it is evident that the MPI ceases to rise at the rate prior to 1994, and instead adopts a relatively constant stance. That is the policy action seems to settle at some expansionary level. The decomposition implies that if this action had not been undertaken then the monetary policy index would have been higher and the contribution of monetary conditions to GDP output greater. As a caveat to this analysis it is worth noting that the model can only capture aspects that are specifically modelled, shocks that are not specifically included will be forced into the error terms. And the error terms are a component of this decomposition – a point I will return to below.

For the period to 1995 the monetary policy index shown in Figure 16 is very similar to that in Dungey and Pagan (2000). As in that paper, there is evidence that monetary policy acted to reduce output in the latter half of the 1980s, and that this negative impact was sustained somewhat longer than is desirable in the early 1990s recession. For the updated data period, the decomposition shows that in the last 5 years of the sample monetary policy acted to keep output growth above trend. Although this is probably contrary to what many analysts considered the outcome of the policy stance would be, the GDP without monetary policy line shows that output would have been clearly below trend until 1999 in the absence of the policy effects.

Figure 16:



In order to present further evidence on the role and composition of monetary policy over the period we perform a number of experiments. The experiments involve altering the response function of the cash rate, which is the monetary policy instrument in this model. It is worth noting at this point that these are designed to deepen our understanding of how policy has been acting in the economy, rather than to investigate the effect of alternative policies. Alternative policies have been investigated in a somewhat similar manner in Bernanke, Gertler and Watson (1997) who note also the importance of the Lucas critique for this style of analysis. This experiment is designed to throw some light on the output effects of changing the response function in the VAR. It is not the usual way in which researchers usually investigate the impact of inflation targeting, which focuses on the outcomes for output and inflation variability rather than level effects as we do here (see Gruen (this volume) for comments and de Brouwer and O'Reagan (1997) for an example of the more usual style for Australia). Incorporating that style of analysis in the VAR structure here is scope for further work. However, this experiment instead throws light on the decomposition effects of altering the response parameters – that is the relative flow through effects of components when the response function is altered.

In the current VAR structure the cash rate equation looks as follows:

$$CASH_t = \sum_{i=1}^{3} a_i CASH_{t-i} + \sum_{i=0}^{3} b_i GNE_{t-i} + \sum_{i=0}^{3} c_i INF_{t-i} + \sum_{i=1}^{3} b_i RTWI_{t-i} + \varepsilon_t \quad (6)$$

where ε_t is a white noise error term. The estimated coefficients for the model presented here are given in Table 3[6], in considering these it is worth noting again that the data are in log form (with the exception of interest rates and inflation rates) and detrended (with the exception of domestic inflation). The recursive order of the system means that the exchange rate does not enter contemporaneously into the interest rate equation, something which Willard, Voss and Zha (2001) consider may be important in producing a good policy reaction function. However, in this analysis the reason for including

[6] Real cash rate shocks ensue from nominal cash rate shocks in the model as the sum of the coefficients on cash (0.254) exceeds that on inflation (0.182).

exchange rates is as an indicator of import inflation pressures, and the lag structure represents the effect of delays in pass through. Recently, pass through has become more difficult to see in the Australian data, and although the Reserve Bank has urged caution on the inflationary front on the grounds of anticipated inflation from the depreciation of the Australian dollar, this does not seem to be eventuating (see also Mishkin and Schmidt-Hebbel 2001:10 for other international evidence on pass through). In this event it seems unlikely that the contemporaneous exchange rate would have a strong influence on the monetary policy reaction. Further investigation of this issue is scope for future work.

Table 3: Parameter estimates for equation (4).

	CASH	GNE	INF	RTWI
t		7.752	0.089	n.a.
t-1	1.042	8.760	-0.085	-1.164
t-2	-0.362	7.855	0.728	2.686
t-3	0.154	-10.019	-0.550	-2.476

The means of constructing the MPI shown in Figure 16 is basically to examine the responses from a system estimated with the parameter estimates for the lagged values of $CASH_t$ shown in Table 3, and all other parameters in that equation constrained to zero. For the purposes of the new experiments we take the parameter estimates from Table 3 as given, and then impose the constraint that one variable at a time is constrained to have zero parameters. The addition of the feedback effects direct from lagged cash rate changes results in a restricted monetary policy index.

Formally, to obtain the effect of suppressing the response to a particular variable in the monetary policy reaction function we set those parameters to zero and re-express the effects in similar forms to equations (5) and (6) as shown in equations (8) and (9), where y^R represents the estimate under the restriction.

$$y_t^R = \text{initial conditions} + \sum_{j=0}^{t-1}\sum_{k=1}^{11} g_{jk} e_{k,t-j} \tag{7}$$

$$MPI_t^R = \sum_{j=0}^{t-1} b_j e_{CASH,t-j} \quad + \sum_{j=0}^{t-1}\sum_{k=1}^{11} (g_{jk} - b_{jk}) e_{k,t-j} \tag{8}$$

The difference between the two MPI indices is clearly given as (9) and represents the effect of the change in the reaction function.

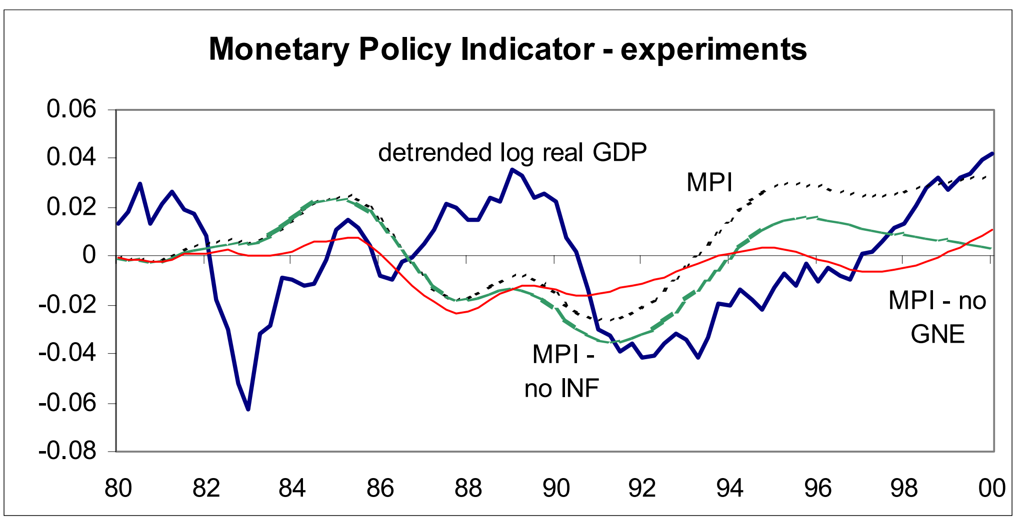
$$\Delta_t = MPI_t - MPI_t^R = \sum_{j=0}^{t-1}\sum_{k=1}^{11} (c_{jk} - g_{jk}) e_{k,t-j} \tag{9}$$

Positive values of Δ_t show that more attention to the suppressed variable would have resulted in a higher output outcome for the economy.

This analysis is applied to restricting the system firstly, to not respond to domestic GNE and secondly to not respond to domestic inflation.

Figure 17 shows the MPI indices for the cases where the cash rate is presumed not to respond to GNE, denoted MPI^G and where cash does not respond to inflation, denoted MPI^P. The gap between the horizontal line and the MPI shows the extent to which the policy was contributing to move GDP. MPI observations that are close to the horizontal line are making little direct contribution. The decompositions of the MPI into MPI^P and MPI^G suggest that the majority of the contribution to GDP from monetary policy comes from attention paid to GNE. The attention paid to inflation has a lesser effect on output (recall the MPI with zero coefficients on inflation is denoted MPI^P). This is in fact consistent with the forecast error variance decomposition of Table 1, the largest contributor to the short term GDP decomposition other than its own shocks is shocks to GNE. The inflation rate makes very little contribution to explaining variance in GDP across all horizons. In fact, the MPI^P reflects that there is in fact a substantial role that monetary policy controls on inflation have towards explaining the GDP outcome. Unsurprisingly the contribution from GNE is higher.

Figure 17:



To illustrate the importance of examining the historical decompositions (such as presented by the MPIs shown above) the impulse response functions of the VAR with restrictions are presented below, in figures 18 to 24. The solid line represents the impulse response functions from the unrestricted system as discussed in Section 5. The dashed line represents the impulse response function for the system with the loadings on inflation in the cash equation set to zero, and the hatched line represents the functions for the system with the loadings on GNE set to zero in the cash equation.

Figure 18:

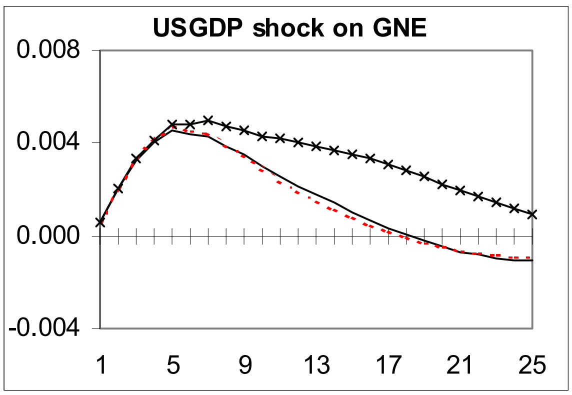


Figure 19:

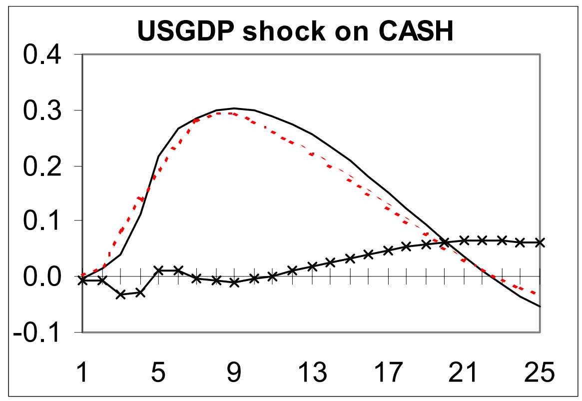


Figure 20:

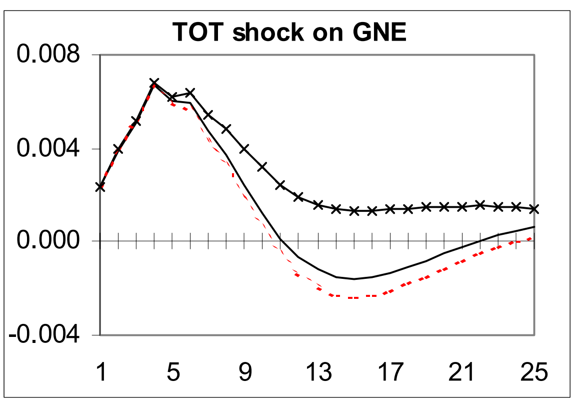


Figure 21:

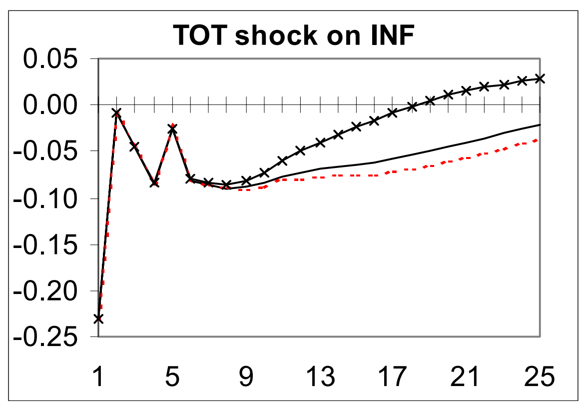


Figure 22:

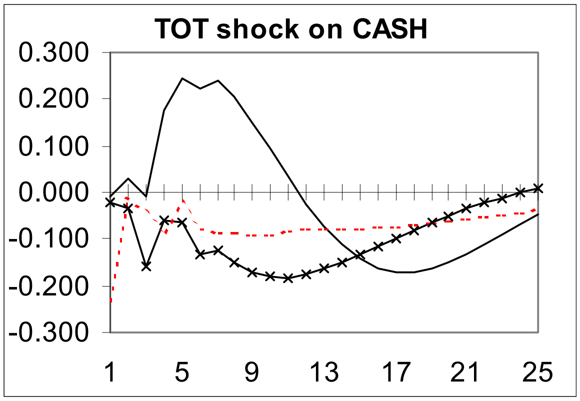


Figure 23:

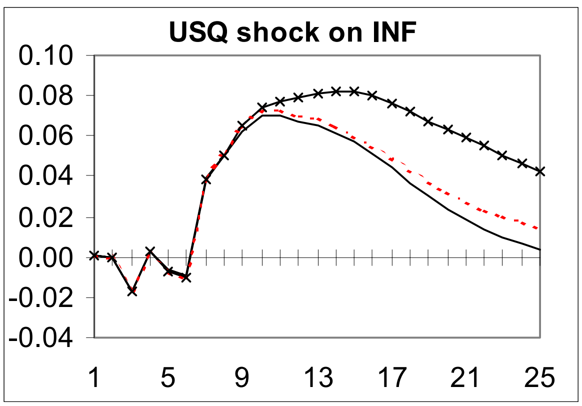
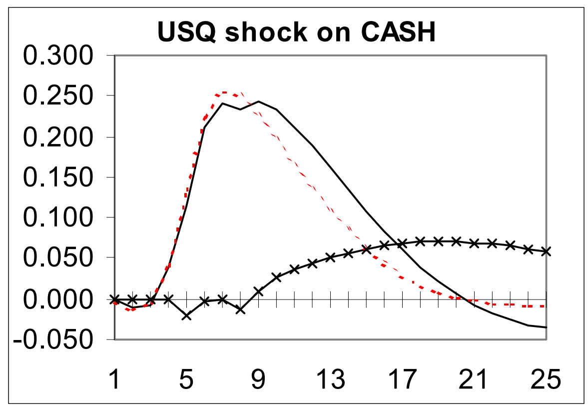


Figure 24:



A clear feature of these charts is that there are relatively small differences in the impulse response functions for the unrestricted system and the system with zero loadings on inflation, but relatively large differences with zero loadings on GNE. The reason for this is readily apparent from the coefficients reported in Table 3. The coefficients on inflation are relatively small, and those on GNE relatively large. This is important in understanding the impulse response functions because they represent the response to shocks to the error terms in the system only – the derivatives depend on the coefficient estimates. So, for example for a three variable, one lag system such as:

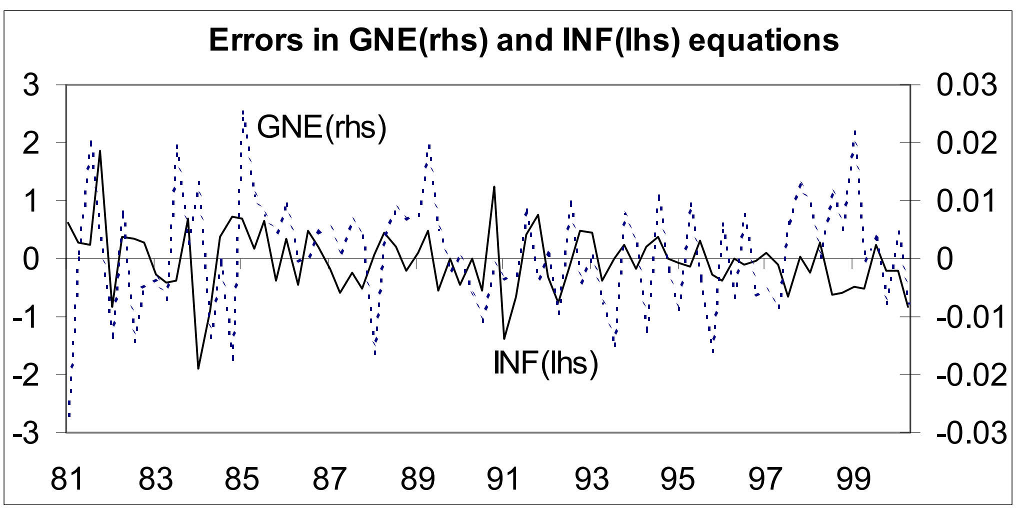
$$y_{1t} = \alpha_1 y_{1t-1} + \alpha_2 y_{2t-1} + \alpha_3 y_{3t-1} + \varepsilon_{1t}$$
$$y_{2t} = \alpha_4 y_{1t} + \alpha_5 y_{1t-1} + \alpha_6 y_{2t-1} + \alpha_7 y_{3t-1} + \varepsilon_{2t}$$
$$y_{3t} = \alpha_8 y_{1t} + \alpha_9 y_{2t} + \alpha_{10} y_{1t-1} + \alpha_{11} y_{2t-1} + \alpha_{12} y_{3t-1} + \varepsilon_{3t}$$

the impulse response for the third variable in the system (y_{3t}) with respect to a shock in the error term for the first equation (ε_{1t}) at period t is given by:

$$\frac{dy_{3t}}{d\varepsilon_{1t}} = \alpha_8 \frac{dy_{1t}}{d\varepsilon_{1t}} + \alpha_9 \frac{dy_{2t}}{d\varepsilon_{1t}} = \alpha_8 + \alpha_9 \frac{dy_{2t}}{dy_{1t}} \frac{dy_{1t}}{d\varepsilon_{1t}} = \alpha_8 + \alpha_9 \alpha_4$$

Hence if the value of, say, α_4 is small, constraining it to zero will have a relatively small effect on the impulse response function. However, if α_4 is relatively large then the response function will look considerably different.

Figure 25:



The historical decompositions, however, contain further information to the impulse responses as they also include the structural error terms from the estimation, see equations (3) to (9) above. They therefore include the effect of the unanticipated movements in these variables – as de Brouwer and O'Reagan (1997) note, the smoothing, rather than elimination, of fluctuations is the realistic aim of policy. In this case, the parameters on the inflation in the cash equation are relatively small and those on GNE relatively large. However, the errors in the inflation equation and GNE equation, which represent the unexpected shocks, are relatively large and relatively small respectively, as shown in Figure 25 (note that each error is on a separate scale). The interaction of these shocks with the factor loadings is what results in the analysis of the impact of focussing monetary policy more or less on GNE or inflation.

7. An International Crisis: the Example of East Asia

The ability of the Australian economy to largely avoid the ravages of the East Asian financial crisis of 1997/98 and continue with relatively strong growth has led some to label it an apparent 'miracle' (Bean (2000)). The adjustment was not without pain for Australian companies and those exposed to the trading sector. However, in general the outcome was strong – so much so that the recent RBA volume on the Australian economy in the 1990s (Gruen and Shrestha (2000)) finds it unnecessary to devote much space to analysing its effects relative to those of internal changes. There was probably an element of luck in the timing of this crisis from the Australian point of view. The New Zealand economy was entering a recession, which was exacerbated by tighter domestic monetary policy in order to protect the exchange rate. In Australia, the rapid depreciation of the exchange rate was accommodated. Mishkin and Schmidt-Hebbel (2001) and Ball (2000) critically review the two countries' experiences. The combination of the export shock and the depreciation of the real TWI are not independent in the outcomes for this period, and hence what follows is an illustration using estimates from that data period, rather than an exact interpretation of the Asian crisis.

The effect of a negative exogenous export shock in this model can be seen in Figures 26 and 27. Figure 26 shows the impulse response function for a 0.4% export shock according to the full model. The shock takes about 5 years to dissipate and has a significant negative effect on real GDP for the first 18 months. Figure 27 shows the contribution to real GDP of exports over the period of estimation. The negative impact of exports on real GDP is extremely small, and apparent only in the last few years observations.

Figure 26:

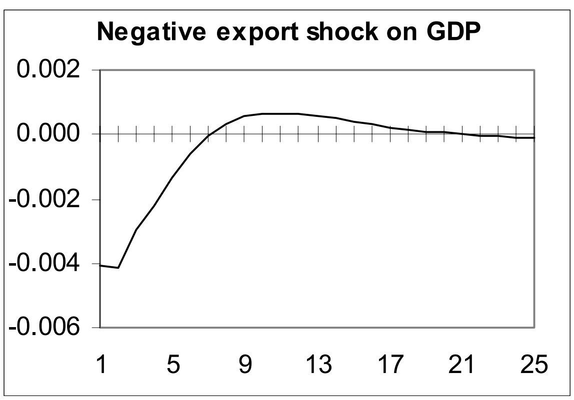
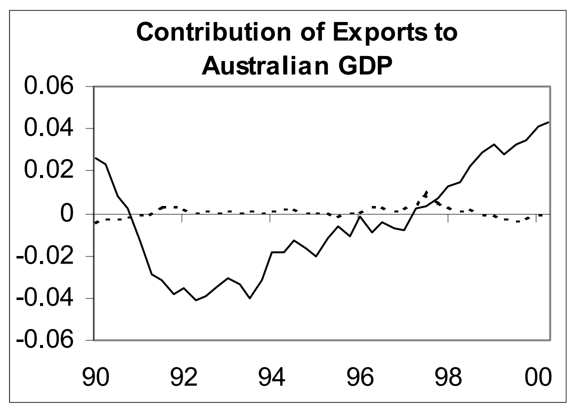


Figure 27:



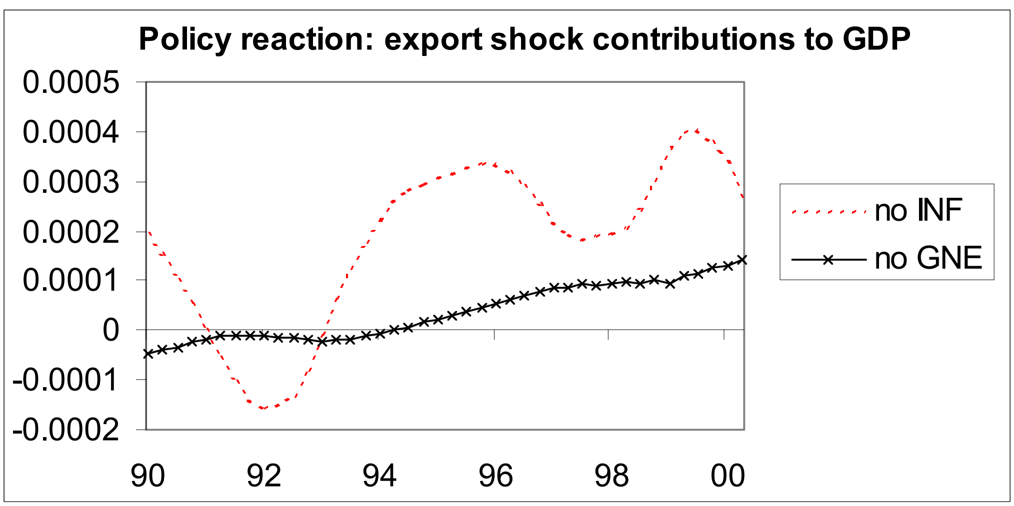
To throw further light on how the monetary policy settings can aid in dissipating the shock to the rest of the economy we consider again the experiments of the previous section. In this instance we consider the impact the export shock would have had on Australian GDP if the cash equation had not had the form estimated for the entire period. Specifically, in separate experiments we set to zero the coefficients in the cash rate equation on the inflation rate, and real GNE. The differences between these responses are relatively difficult to see in the forms presented above. So, figure 28 presents the difference between the contribution exports make to GDP in the original model, and the contribution exports make to GDP in each of the restricted cases. That is: denote the contribution of exports as EXP in the unrestricted case, EXP^P for the case where the cash rate does not respond to inflation, and EXP^G where the cash rate does not respond to GNE. The difference between the restricted and unrestricted cases is as follows;

$$\Delta^P = EXP - EXP^P$$

$$\Delta^G = EXP - EXP^G.$$

The series Δ^P and Δ^G are presented in Figure 28, labelled as 'no INF' and 'no GNE' respectively.

Figure 28:



At the end of the 1990s the contribution of exports to GDP in the unrestricted case was negative. If the restricted case results in a more negative contribution of exports to GDP then the quantities Δ^P and Δ^G will be positive – that is the cash rate response acted to make GDP higher than it would otherwise have been as a result of limiting the negative impact of exports. Alternatively, if Δ^P and/or Δ^G are negative then the cash rate responding to those components of the economy resulted in a smaller GDP outcome through exports. In the event both Δ^P and Δ^G are positive, indicating that monetary policy contributed positively by reacting to both inflation and GNE in this instance. Although the reductions shown here may not be large, there is no true counterfactual to assess the policy against (see Hamilton and Herrera (2001) for a discussion of this problem in VARs). The fact that we can obtain results that support the direction of policy here is indicative of the potential strength of these effects.

9. Conclusion

The Australian economy is demonstrably affected by international economic conditions and unexpected shocks. Economies in this situation have a number of choices. The first, and least appealing is to assume that there is nothing that can be done and regard domestic policy as ineffective. This has not been the recent Australian experience. More attractive is the option of domestic policy designed to recognise the impact international shocks can have. And further, to work in such a way as to dissipate those shocks in the most favourable way for the domestic economy. This may mean both minimising the impact of negative shocks, and also maximising the benefits from favourable shocks. Two recent examples stand out in the Australian context. An example of the second is the strong favourable impact of declining international prices on domestic inflation over the 1990s – although it is not clear that this was recognised by policy makers at the time it is now apparent this was the case (Beechey et al (2000), Dungey and Pitchford (1998, 2000) and for a contrary view Dwyer and Leong (2001)). A successful dissipation of a negative shock is demonstrated by the negative export shock, similar to that resulting from the East Asian crisis, although without incorporating the accompanying depreciation of the real exchange rate directly in our analysis.

The experiments shown here are not meant to minimise the impact of these shocks on particular segments of the market. Some sectors are disproportionately hit by international shocks. However, domestic policy can act to minimise the damage to the economy as a whole. Domestic policy faces two challenges. The first is to correctly recognise the impact of international conditions, which includes not falsely attributing positive gains to domestic policy, see the discussions in Ball (2000) and Bean (2000) for example. This is of course, by no means an easy task. Having achieved that aim the challenge for the other arms of domestic policy is then to act to best redistribute the impact of international shocks on the individual players, so that the benefits of better relations with international conditions accrue more evenly across the community.

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