

DOES SIZE MATTER? COMPARING GLOBAL LIQUIDITY SPILLOVERS IN OPEN
ECONOMIES

by

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(Under the Direction of William Lastrapes)

ABSTRACT

This paper analyzes the international transmission of monetary shocks with a special focus on the effects of foreign money (“global liquidity”) on open economies. Structural VAR models are estimated for the countries Australia and New Zealand and the variance decompositions and impulse responses are found. The impulse responses obtained show that a positive shock to global liquidity results in a decrease in output and price level for both countries over a three-year horizon. Similar reductions in the money supply were also discovered. Moreover, this analysis discovered that economies of different sizes do, in fact, respond differently to innovations in global liquidity.

INDEX WORDS: Structural VAR, Monetary Policy, Global Liquidity, Impulse Response, Variance Decomposition

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DEDICATION

To my parents, for helping me on my path and giving me direction. To my sister, Sarah, for showing me there is more than one way. To my friends, for making it fun.

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I'd like to thank the economics faculty at the University of Georgia for allowing an otherwise unremarkable (graduate) economics student the opportunity to take classes he was truly interested in and enjoyed. It was a very humbling experience, and I hope one day to put the instruction I received into something worthwhile.

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1 INTRODUCTION

Recently interest has peaked regarding the sources of international business fluctuations, and the roles played by international spillovers of monetary policy shocks. Ample evidence exists to suggest that cross-country transmission of these monetary shocks plays an important role in the business cycle and influences the movement of macroeconomic financial variables in other countries¹. This paper will build on previous research on policy shocks and global liquidity spillover by comparing and contrasting the international transmission of monetary shocks in both small and large open economies. Notably, this paper focuses on the effects of foreign money (“global liquidity”) on the economies of Australia and New Zealand. The choice of Australia and New Zealand is motivated by the geographic, cultural, and economic similarities between the two countries. Respectively, one of the only major differences between these two nations is the size of their economy²

The expansionary monetary policies of the US, Western Europe, and Japan for most of the previous decade combined with foreign exchange interventions by many Asian countries (specifically China) to contribute to a significant increase in global money balances (Belke and Orth, 2007). These policies, in combination with today’s highly integrated financial markets, affect monetary growth and asset returns on a global scale. Consider that within the first channel of transmission (the “push” channel), “high monetary growth in one area may lead to capital

¹ There have been many different approaches to this type of spillover effect. Early attempts focused on spillovers to the Euro area (Beyer, Doornik, and Hendry; 2001 and Sousa and Zaghini; 2004). However, recent contributions have taken a more global perspective (Dees, Di Mauro, Pesaran, and Smith; 2005, Pesaran, Scheuermann, and Smith; 2008)

² In 2009, in terms of GDP, the IMF listed Australia and New Zealand as the 13th and 52nd largest economies in the world. Similarly, Australia and New Zealand have the 10th and 33rd highest GDP per capita according to the IMF. This paper will follow previous research and only consider the *absolute* size of these two economies to truly see if there is a difference between large and small economies- not large and small populations.

flows into foreign countries, thus resulting in strong monetary growth and higher asset returns abroad” (Sousa and Zaghini, 2004). However, in the “pull” channel high domestic monetary growth may lead to domestic asset price inflation that attracts foreign capital and depresses asset prices in the country where monetary growth originated³.

This paper is concerned with investigating the impact of a liquidity shock on open economies of different sizes and their ability to absorb such shocks. As suggested by a number of previous authors,⁴ interactions between liquidity shocks and domestic macroeconomic variables (output, prices, money supply, interest rates, and the exchange rate) will be considered. This analysis takes place within the context of structural vector autoregressions (SVAR). The SVAR methodology was chosen because it accounts for endogenous relationships, and without placing too many restrictions on the data, also summarizes empirical relationships. First, a benchmark model is proposed that uses only the aforementioned domestic macroeconomic variables for both Australia and New Zealand. Through this benchmark model, over the period 1987-2008, it is possible to identify exogenous monetary shocks. Next, a block endogenous aggregate global liquidity variable will be added to the model. This variable will consist of a weighted aggregation of money from major world economies expressed in US currency. The new model will be used to examine how Australia and New Zealand (the large and small open economies) respond to a global liquidity shock.

³ Baks and Kramer (1999) addressed these “pull” and “push” channels when they tested their excess liquidity hypothesis, and found that a “liquidity glut” might have been a more important driver of financial imbalances in the 2000s than the so-called “savings glut”.

⁴ See Baks and Kramer (1999), Sousa and Zaghini (2006), Rüffer and Stracca (2006), and Belke and Orth (2007)

2 OVERVIEW OF THE LITERATURE

The first reference study is Rüffer and Stracca (2006). They estimate a global vector autoregression with aggregated G5 data using the same macroeconomic variables discussed in this paper's benchmark model with the exception of a few domestic variables from the US, Euro area, and Japan. These authors identify and address the "price puzzle", and conclude that they cannot solve it by applying an asset price index. They also augment their model with a real asset price index that includes real property and equity prices. Rüffer and Stracca find that the price level is very responsive to shocks in liquidity. However, they find that the real asset price index does not respond significantly to global liquidity.

Sousa and Zaghini (2006) estimate a SVAR model with the same variables in the present benchmark model, and also include a liquidity variable of the G5. However, Sousa and Zaghini use only the standard Cholesky identification scheme in their benchmark model (other papers offer different identification schemes in their benchmark models). They estimate another SVAR with novel restrictions on their structural equations, and find a significant long-lasting response of the price level to a global liquidity shock in the Euro-area. It is significant to note that Sousa and Zaghini's results must be taken within the chronological framework of their model which used a sample that ends in 2001. Clearly, the relationship between money and prices has become less stable after the 2001 and 2007 recessions. Nonetheless, Sousa and Zaghini's paper remains a useful comparison as it is the closest conceptually to this analysis.

Greiber (2007) uses a standard VAR technique for G5 data on a benchmark specification that is then augmented with house prices, and stock and commodity prices. The response of the

price level to impulse responses on global liquidity is significant. The results with the inclusion of the asset variables are also very similar to Belke and Orth (2007). The house price indices display significant appreciation in the wake of loose monetary policy. This realization is to be expected as there is a correlation between housing appreciation and money holdings. Belke and Orth (2007) also find that, at the global level, monetary aggregates may convey useful information about assets which influence aggregate demand and inflation. They conclude claiming that policy makers and economists should give global liquidity attention as they would interest rates in the ongoing debate concerning the savings versus liquidity problem.

3 THE ARGUMENT FOR GLOBAL LIQUIDITY

The global liquidity aggregate used in this paper is constructed as the sum of monetary aggregates of the United States, Euro zone, Japan, Canada, and the United Kingdom using exchange rates to convert currencies into US dollars. Without weighting each country's aggregate money, the differences in importance of each country may not be properly reflected. As such, each country's weight was determined by the share of its GDP relative to the other four countries used in the aggregate.⁵ The global liquidity variable, GL, has the following formula:

$$GL_t = \sum_{i=1}^5 \frac{GDP_{i,t}}{GDP_{agg,t}} M_{i,t} E_{i,t} \quad (1)$$

where $GDP_{i,t}$ is country i 's real GDP at time t , $GDP_{agg,t}$ is the sum of all the nominal GDP's (in US dollars) for all five countries used in this study at time t , and $M_{i,t}$ and $E_{i,t}$ are country i 's quarterly average monetary aggregate⁶ and exchange rate (domestic currency per USD).

Figure 1 plots the growth rate of global liquidity, as measured above, with an aggregate of Australian and New Zealand GDP deflators from 1982 to 2008.⁷ There appears to be little co-movement between the two variables, however, both exhibit the same trend. This suggests that there is some correlation between money growth in the five aggregated countries and growth in Australian and New Zealand.

⁵ The use of trade flows between the five countries and Australia and New Zealand was also considered in this paper. However, it was concluded that due to various international restrictions (past and current) on exports from Australia and New Zealand abroad, weights would be more accurately reflected using conventional GDP measures.

⁶ See Appendix 1, Data Summary, for a more detailed overview of the data presented

⁷ Data availability issues allowed for the earliest observations in 1982.

Real global liquidity also appears to be correlated with the real economic activity in both Australia and New Zealand as shown in figures 2 and 3. This points to the possible interaction between the international monetary aggregate and domestic macroeconomic financial variables.

4 EMPIRICAL FRAMEWORK

The structural VAR method has been widely used in economic literature on monetary policy with a significant degree of success. The SVAR allows for the prediction of “interventions”- deliberate policy actions, or changes in the economy of known types. To make such predictions the model must explain how the intervention corresponds to changes in some elements of the model (i.e. parameters, equations, observable or unobservable random variables), and it must be true that the structural model is an accurate characterization of the behavior being modeled after the intervention. Moreover, the SVAR “addresses the problem of the interpretation of contemporaneous correlations among disturbances in the traditional reduced-form VAR analysis” (Belke and Orth, 2007). Consider first an n -vector stochastic process Y_t representing endogenous variables in an economic model. Assume the model is consistent with a linear dynamic structure. Then, the VAR model with p lags may be represented as:

$$A_0 Y_t = A_1 Y_{t-1} + \dots + A_p Y_{t-p} + u_t \quad (2)$$

$$E u_t u_t' = I \quad (3)$$

where Y_{t-i} is the $(n \times 1)$ vector of endogenous variables, and u_t is white noise.

Now define $B_i = A_0^{-1} A_i$, and pre-multiply equation (2) by A_0^{-1} . Then the reduced form of the model, which presents the dependent variables as functions only of their previous lagged values and innovations is represented by:

$$Y_t = B_1 Y_{t-1} + \dots + B_p Y_{t-p} + \epsilon_t \quad (4)$$

$$\Sigma = E \epsilon_t \epsilon_t' \quad (5)$$

where $\epsilon_t = A_0^{-1}u_t$. Here Σ , the covariance matrix of the reduced form errors is symmetric but does not have to be diagonal (to allow for contemporaneous correlation). Note here the reduced form is the VAR representation of the stochastic process Y_t . As such, the reduced form model may be estimated using available data. However to estimate the model, and avoid identification problems, theoretical restrictions on the structural model (2) must be made since the number of free parameters exceeds the number of estimated parameters. This paper will follow Sims (1980), and many others, approach and only use A_0 for identifying restrictions. To fully understand this consider the final form of equation (2), the vector moving average (VMA) representation:

$$Y_t = D(L)u_t \quad (6)$$

where $D(L)$ is the matrix polynomial in the lag operator L for which $D(L) = \sum_{i=0}^{\infty} D_i L^i$, allowing for p lags. The VMA representation shows the dynamic responses of the variables to structural innovations.

However, these D-matrices are not directly estimable because they depend on the coefficient matrices found in equations (2) and (3). As such, factoring the lagged polynomial above and noting the definition of B_i the structural VMA may be expressed as:

$$Y_t = C(L)\epsilon_t. \quad (7)$$

Here by expanding equation (7) it is clear that $D_0 = A_0^{-1}$, and we can solve the identification problem and estimate our model by imposing restrictions on A_0 or A_i . As mentioned above, however, this paper will use Sim's (1980) approach and impose restrictions on A_0 only (or, equivalently D_0).

By making D_0 lower triangular, the mapping from structural to reduced form is determined by the Cholesky decomposition of the covariance matrix, Σ , which just-identifies the

model. The Cholesky decomposition allows the construction of orthogonal innovations from the moving average representation of the system. This is the cornerstone of the impulse response function and error variance decomposition that will be performed later.

A caveat to using the Cholesky decomposition is that the ordering of variables in the system considerably influences the results of the analysis. The use of the Cholesky decomposition implies a recursive identification scheme which restricts the contemporaneous relationships between the different variables. This is a rather important critique of the Cholesky decomposition especially if theory does not conform with the restrictions.

5 THE BENCHMARK MODEL

In this section, two benchmark models are estimated to analyze the monetary policy transmission system for both Australia and New Zealand. An examination of transmission mechanisms allows one to consider the responsiveness of the economic variables to policy shocks, and the speed of adjustment. This is particularly important in the formation of currency unions, and has recently received considerable attention in Europe.⁸ Here, as indicated in chapter 4, both benchmark models are based on a recursive identification scheme based on the Cholesky Decomposition. As such, A_0^{-1} is lower triangular, and the SVAR is represented by:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{bmatrix} \begin{bmatrix} u_t^Y \\ u_t^P \\ u_t^{SR} \\ u_t^M \\ u_t^{ER} \end{bmatrix} = \begin{bmatrix} e_t^Y \\ e_t^P \\ e_t^{SR} \\ e_t^M \\ e_t^{ER} \end{bmatrix} \quad (8)$$

where Y is the real GDP, P is the consumer price index, SR is the short-term interest rate, M is the broad money aggregate, and ER is the real exchange rate. Here, the first two equations indicate that the real sector reacts slowly to monetary policy shocks in the short-run interest rate. That is, these shocks have no contemporaneous affects on output, prices, and money. Rather, they affect the money supply and exchange rate. However, both the money supply and exchange rate have no contemporaneous affect on the short-run interest rate. Here, only innovations in the interest rate are considered. As such, increases in the short-run interest rate (a contractionary monetary policy shock) have no immediate effect on price-levels or output. Rather, these

⁸ See Clements, Kontolemis, and Levy (2001)

variables are influenced on the horizon. Alternatively, following the monetary policy decision (an increase in the short-run interest rate), money supply and exchange rates respond instantaneously. This identification is typical and correctly follows the policy response of both Australia and New Zealand.

Impulse responses provide a useful summary of the relationship implied by the coefficients in the SVAR. While, the impulses can be constructed for any variable in the model, in this section only monetary policy shocks to the short-term interest rate will be considered⁹. An alternative method of interpreting the properties of the model is through utilization of variance decomposition. This analysis reports the proportions of the error of forecasts, generated by the SVAR, that are attributable to shocks to each other variables in the model. For all models presented here, variance decompositions for 4 different horizons (1 year, 2 year, 3 year, and 4 year) are presented.

All following estimations are based on quarterly data from 1987 to 2008.¹⁰ Data are expressed in logarithmic form and are seasonally adjusted except for interest rates. To determine the optimal lag length for the estimated SVAR the Akaike (AIC), Schwarz-Bayesian (BIC), and Hannan-Quinn (HQ) information criteria were used. For both Australia and New Zealand, the optimal lag length was found to be 2.

5.1 THE AUSTRALIAN MONETARY POLICY TRANSMISSION MECHANISM

Figure 4 displays the estimated impulses¹¹ to an unexpected, temporary, monetary policy shock in the Australian economy. A one-time standard deviation increase in the short-term interest

¹⁰ New Zealand adopted an inflation targeting monetary policy in 1987. See Appendix 1, Data Annex, for a more detailed overview of the data presented

¹¹ The 95% confidence bands are obtained using the bootstrap method with 200 draws and a seed of 55.

rate, a contractionary monetary policy shock, is followed by an immediate, persistent depreciation of real GDP. The effect on output reaches its peak shortly after the monetary policy shock in the 5th or 6th quarter- at this point output has contracted approximately 5% and remains so over the four-year horizon.

Price levels, following the shock, appreciated initially in the year following the innovation in interest rates resulting in a price puzzle. This unusual result was first noticed in Eichenbaum (1992) and Sims (1992). Sims (1992) hypothesized that this response reflects the fact that the monetary authority has some indicator of inflation in its reaction function that is missing from the SVAR underlying the monetary policy shock measure. However, after the first year, price begin behaving as expected and depreciate over the remaining three-year horizon eventually settling almost 2% lower than their pre-shock level.

Money responds similarly to output following an innovation in interest rates. Following the impulse, money supply depreciates steadily for nearly a year and a half. However, at the start of year two, money supply levels stabilize and begin a slight upward trend over the next two years. Following a statistically significant instantaneous decrease in the exchange rate, the exchange rate steadily rises to a level above its baseline over the following two years. On the horizon, the exchange rate remains roughly 1-2% higher than its pre-shock level. Interest rates, following the innovation, increase for approximately two quarters before declining for the next two years. Following the continued depreciation, interest rates begin rising towards their baseline level over the four-year horizon.

Here it should be noted that the bootstrapped confidence intervals are quite wide, especially for output and the exchange rates and are not statistically significant for these two variables in the conventional *statistical* sense. Alternatively, the confidence intervals for money

supply and price level remain significant on the entire time horizon. In any case, the point estimates for all four variables are economically plausible.

The forecast error variance decomposition of the five variables of the model due to shocks of both the short-term interest rate and money supply are reported in table 1. As in most of the VAR literature, the contribution of unexpected shocks in the short-term interest rates to developments in output and price are somewhat limited. For the model, the contribution of an innovation in interest rates to output fluctuation is no greater than roughly 6%, while an innovation in interest rates to price fluctuation is no greater than 3.22%. This result is lower than that reported by Berkelmans (2005) and slightly lower than findings of similar reports concerning the Euro Area¹².

Notice however- that the contributions of innovations in money supply to output fluctuations are higher than those of interest rates accounting for up to 2%. This result is much lower than similar studies done on the Euro Zone. Innovations in the money supply, as structured, only have a contemporaneous effect on the exchange rates. That is, an increase in the money supply does not affect output, price level or short-run interest rates contemporaneously. The contribution of an innovation in money supply in price level fluctuation is, undoubtedly very low. This result is somewhat unexpected.

5.2 THE NEW ZEALAND MONETARY POLICY TRANSMISSION MECHANISM

Figure 5 displays the estimated impulses¹³ to an unexpected, temporary, monetary policy shock in the New Zealand economy. Overall, the responses are similar to those of the Australian economy. However, whereas in the Australian economy following the impulse the economy

¹² See Peersman and Smets (2003) and Kim (1999).

¹³ The 95% confidence bands are obtained using the bootstrap method with 200 draws and a seed of 55.

sees no increase in output, the New Zealand economy briefly experiences a very small increase in output during the first two quarters. As expected though, following the brief expansion, New Zealand output declines in a similar manner to that of Australia. Interestingly, the magnitude of the reduction in output in New Zealand is almost half of the reduction in output in Australia.

The price puzzle in the New Zealand economy is much larger than that of the Australian economy. In Australia the model noted that prices only increased in year following the innovation in interest rates. However in the New Zealand economy prices remain above their pre-shock baseline level for nearly three years. Only after three years do prices begin depreciating as one would expect following a contractionary monetary policy shock. Similarly, while the appreciation of prices in both countries is similar, the price level in Australia falls much lower over the four-year horizon than that of New Zealand

Money supply responds much with much more volatility in New Zealand than in Australia. Following a negligible instantaneous increase in the money supply at the time of the monetary policy shock, money supply drops in New Zealand as it does in Australia albeit more rapidly. However following the drop, over the next year money supply behaves in a somewhat volatile fashion before smoothing out over the four-year horizon and remaining permanently lower than its pre-shock level. Note that the percentage drop in money supply in New Zealand is nearly half as large as the drop in Australia.

Exchange rates between the two countries behave in similar fashions. In the New Zealand economy however, the exchange rate continues to fall following the innovation to interest rates after its initial instantaneous drop. In Australia, exchange rates appreciated following their instantaneous reduction. Nonetheless, after nearly two years the exchange rate, like that of Australia, crosses the baseline and remains permanently higher for the horizon's remaining two

years. Likewise interest rates between the two countries behave in a similar fashion. After the impulse, both see an additional short-lived increase in their rates, followed by a sharp decline below baseline levels. However, as with output and money supply, the magnitude of the change in New Zealand is much smaller than that of Australia.

The examination of the transmission mechanisms between Australia and New Zealand tentatively suggests that they are quite similar. That is, when each country faces the identical contractionary monetary policy shock to interest rates, similar adjustments seem to occur to the financial variables explored. As was expected, output responded more in the Australian economy (in terms of magnitude), which may be attributed to the larger size of its economy. Similarly the response of both money supply and interest rates was larger in the Australian economy. Interestingly, the observed price puzzle in New Zealand was much greater than that of Australia. The explanation for this has thus far proven elusive.

As was for Australia, table 2 reports the variance decomposition of the five variables due to shocks of both the short-term interest rate and money supply. For the New Zealand economy, the contribution of an innovation in interest rates to changes in output lower than that of Australia. This contribution coincides with the observation that New Zealand output responds less to monetary policy shocks than Australia as reported in by the impulse responses. Also noted, is the observation that innovations in money supply have a much smaller influence on changes in output in the New Zealand economy. The opposite was observed in the Australian economy, where impulses to the money supply account for up to almost 2% of the variation in output on the four-year horizon. It is also observed that innovations in interest rates influence changes in the price level more than innovations in money supply for the New Zealand economy, which was the same observation in Australia. In general, it appears as though New Zealand

output responds more to monetary policy shocks involving interest rates, while Australian output is more responsive to monetary policy shocks involving money supply (at least in the long-run horizon).

6 GLOBAL LIQUIDITY SPILLOVERS

To investigate the possible effect of foreign liquidity on open economies the “marginal” approach used by Kim (2001) will be used by introducing a sixth variable to both benchmark models in chapter 5. The variable (GL) is a measure of global liquidity outside of both Australia and New Zealand weighted by each country’s share of global GDP.¹⁴ The variable will be expressed in logarithmic terms, and all estimates were obtained from quarterly observations.

The GL variable is ordered as the most exogenous variable in the system. Under this assumption, it is implicitly assumed that developments in the Australian and New Zealand economies do not have a contemporaneous effect on global monetary developments, rather only a delayed one. The identification scheme for both models now becomes:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 \end{bmatrix} \begin{bmatrix} u_t^{GL} \\ u_t^Y \\ u_t^P \\ u_t^{SR} \\ u_t^M \\ u_t^{ER} \end{bmatrix} = \begin{bmatrix} e_t^{GL} \\ e_t^Y \\ e_t^P \\ e_t^{SR} \\ e_t^M \\ e_t^{ER} \end{bmatrix} \quad (9)$$

Figures 6 and 7, shown below, contain the impulse responses to a one-time shock in *global liquidity* per output. 95% Confidence bands for these figures were obtained using the bootstrap method with 200 runs.

¹⁴ Again, only the United States, euro zone, Japan, Canada, and the United Kingdom money supply’s are included in the GL variable.

6.1 EXPLORING LIQUIDITY SPILLOVERS WITH IMPULSE RESPONSES

The dynamics of the responses between Australia and New Zealand are quite similar in the immediate short-run. A positive shock to global liquidity leads to an initial *significant* instantaneous decrease in output, price levels, and money supply in both economies. In New Zealand, a one-time positive shock to global liquidity results in an instantaneous decrease in output of nearly 10%. This drop is then followed by roughly a year of volatility before gradually increasing over the four-year horizon to a level 8% below output's pre-shock level. Similarly in Australia, there is also an instantaneous drop in domestic output of nearly 10%, however output gradually recovers and by the end of the fourth year is approximately 10% above its baseline level. This suggests that the larger Australian economy more easily absorbs the excess international money.

Price levels for both countries fall immediately after the innovation to global liquidity by 8%. However, in the Australian economy prices continue to fall for three years (remaining significant for two) to nearly 15% below their pre-shock level before beginning an upward trend. However, New Zealand prices continue to fall for only a year and a half before beginning a gradual trend towards baseline levels. This is somewhat interesting considering the relative speed at which Australian output recovered from the liquidity shock.

The two economies' money supplies react most differently to innovations in global liquidity. The Australian money supply, following an instantaneous drop in money supply of nearly 5%, continues to fall before beginning its recovery after the first year. On the other hand, New Zealand money supply quickly recovers above its baseline level from its initial drop within half a year before gradually falling over the four-year horizon to a level permanently 3% below

the baseline. This result is opposite those of the Euro area where increases in global liquidity lead to increases in domestic money supplies.

In both countries, the interest rates do not instantaneously respond to the innovation in global liquidity. In Australia, following the liquidity shock interest rates decrease for nearly two years before returning to a level slightly above their baseline over the four-year horizon. In New Zealand interest rates only fall for half a year before behaving somewhat sluggishly while returning to the baseline after three years and remaining slightly above for the horizon's duration. Overall the interest rates for New Zealand are much less responsive than those of Australia. The exchange rate for both economies behaves nearly the same. Following an initial instantaneous increase the exchange rate falls over the following six quarters below the baseline before returning to the baseline over the four-year horizon.

Overall, there is limited evidence to suggest a "push" channel exists in the Australian and New Zealand economies through which an increase in foreign money supplies increases domestic demand for assets leading to both increases in domestic money supply and output (in the short-run). However, the evidence that does present itself indicates that the larger economy, Australia, is somewhat more responsive to this transmission in the long-run as suggested by the earlier response of output and money.

6.2 EXPLORING LIQUIDITY SPILLOVERS WITH VARIANCE DECOMPOSITION

Table 3 displays the forecast error variance decomposition of money, prices, and output. First consider the variance decomposition of money supply. In the Australian economy, the figure suggests that besides shocks to the money supply itself, shocks to the price level are the most important source of fluctuations in the monetary aggregate over the four-year horizon. However,

shocks to global liquidity and output have similar impacts on the variability of money within the first year. However, while shocks to the price level and output increase in influence over the four-year horizon, shocks to global liquidity decrease in their contribution in the variability of money over this extended period.

Here however, the New Zealand economy behaves differently than the Australian economy. Shocks to output and price level influence changes in money supply considerably more than shocks to any other macro variable, in this model, in the New Zealand economy. Price level increases its influence on changes in the money supply considerably- accounting for nearly 70% of money's variability at the end of the 16-quarter horizon. Unlike in Australia, the variability in money is not too responsive to shocks to itself after the 1st year- in the Australian economy at the end of four years shocks to money still account for over 40% of money's variability. Subsequently, the impact of a shock to global liquidity on the variability of money is quite small over the four-year horizon in New Zealand. This is certainly not the case in Australia, where it accounts for over 2% of the variability in money. Nonetheless, this result suggests that global liquidity, in the short and long-run is less influential in New Zealand than it is in Australia in explaining the variability in money supply. This also might explain some of the sluggishness seen in money's response to the innovation in global liquidity in New Zealand.

The price levels of both Australia and New Zealand respond quite similarly to these shocks. In the short-run, neither economy is very responsive to any shocks besides shocks to the price level. However, after the first year shocks to global liquidity and output begin to influence the variability of the price level. In the New Zealand economy, however, shocks to output are considerably more important to the variability in price level than in the Australian economy- accounting for over 8% of price variability. However, as first proposed after viewing the

impulse responses, global liquidity is nearly twice as influential in the Australian economy as it is in the New Zealand economy. Note however, that global liquidity is still only marginally influential in explaining these variations.

Finally, consider the forecast error variance decomposition for output. In general, shocks to international liquidity are not very influential to changes in Australian output. In fact, they are the 2nd least influential shocks for the entire four-year horizon. Contrarily, although not expected, shocks to global liquidity are more influential in both the short-run and long-run in the New Zealand economy. In the short-run, global liquidity is the most influential variable in explaining output fluctuations outside of output itself, however in the 3rd and 4th years, price levels become more important (global liquidity is still the 3rd most important variable). Also note that in the Australian economy on the four-year horizon price levels become the most important variable in explaining changes in output.

The forecast error variance decompositions does not yield much conclusive evidence to suggest that global liquidity does, in fact, have different effects on economies of different sizes. After viewing the impulse responses in the previous section it was suspected that global liquidity influenced the larger Australian economy more than the small New Zealand economy. This was true for changes in Australian money supply and prices, but not for Australian output. However, for all three variables, the contribution of international money to their variability was quite small. Unusually, changes to the short-run interest rate have no affect on the variability of money prices and output in this model. This result was entirely unexpected and does not agree with existing literature.¹⁵

¹⁵ While the contributions of changes in interest rates to money supply and prices are quite small in some papers, the contribution to the variability in output is significant in most literature. See Stracca and Rüffer (2006) and Sousa and Zaghini (2004).

7 CONCLUSION

This paper uses structural VARs to construct a benchmark model for two open economies of different sizes whereby monetary policy transmission mechanisms for the two countries are observed. It was noted that the behavior of the macro-financial variables used in these models, real GDP, aggregate nominal price levels, quarterly averaged short-term interest rates, money supply, and exchange rates (in USD), found in the impulse responses was economically plausible and consistent with expectations. Next, macroeconomic developments within these two economies were examined using an endogenous global monetary aggregate weighted by each nation's share of their GDP in a recursive SVAR system.

It was determined, through an examination of both the Australian and New Zealand impulse responses that a one-time increase in international money, global liquidity, results in significant instantaneous reductions in output, price levels, and money supply for both Australia and New Zealand. The impulse responses did also indicate that output in the larger economy recovered to its baseline level at a much faster rate than output in the smaller economy, and eventually increased by 10% over its baseline on the four-year horizon (as opposed to the smaller New Zealand economy whose output never recovered). It was observed in both economies that exchange rates remained, after the shock, permanently higher in the long run.

International business cycle literature suggests that the cross-country transmissions of shocks is crucial in understanding and explaining fluctuations in output. Previous research in the Euro area also suggests that a similar channel for transmission exists for monetary aggregates. As such, changes in global liquidity may have important monetary policy

implications on domestic economies. This paper suggests that sudden and unexpected influxes of foreign money have very different affects on economies of different sizes (albeit the magnitude of these effects need be researched more)- that is, different economies may be forced to respond differently to increases in global money.

As indicated by the forecast error variance decomposition, in the year following a global liquidity shock, global liquidity is more influential in explaining the variability of output for the smaller economy than in the larger economy- this suggests that there is some other variable driving Australia's output recovery (most likely prices). On the other hand, in the larger economy, global liquidity appears only marginally important in explaining changes in output. Rather, changes in the price level and money supply are the most important factors in outputs variability. However, global liquidity is the most important variable in explaining fluctuations in the price level in the large economy (excluding the price level itself) over the entire four-year horizon. This result was expected, however in the smaller economy, global liquidity has an almost smaller effect on the variability of the price level. Subsequently, there is considerable evidence to suggest that global liquidity impacts economies of different sizes in very different manners. Clearly, it is quite difficult to draw concrete conclusions on global liquidity's spillover effect on these two economies given this analysis; however this analysis has shown that the response to global liquidity is not homogeneous across different nations and the need to understand its affect is strong.

One possible drawback to this paper is the exclusive use of the recursive system in the models presented. Future studies comparing the impact of global liquidity on various sized economies should consider alternative identification schemes. Similarly, in this paper only two economies were examined. It might be useful to include a larger sample in future studies that

includes a range of different sized economies. Other considerations might include adding additional domestic variables such as a commodity price index or housing index to perhaps fix the price puzzle. Another critique may be the relative isolation of the two countries chosen in this study. Initially, it was thought that comparing two nearly identical countries differing only in economic size would yield the best results. However, the geographic isolation of these economies and their relatively heavy export-based economies may have lessened the impact of the global liquidity variable. Overall the main contribution of this study is the need for policy makers to consider the different impact that global liquidity has on economies of different sizes. As evidenced, there are considerably different reactions to international money fluctuations in small economies than in large economies.

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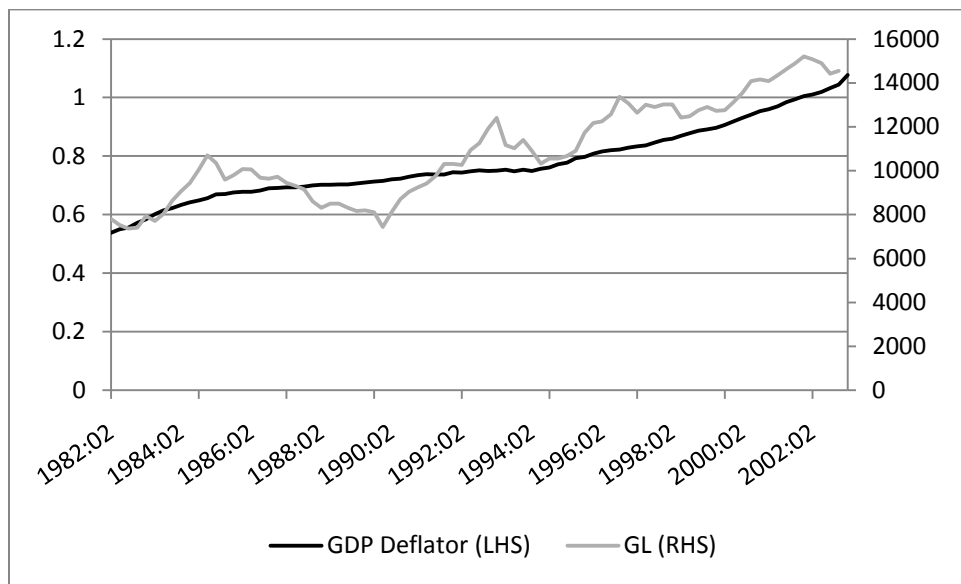


Figure 1
Global Liquidity & GDP Deflator Aggregate (1982-2008)

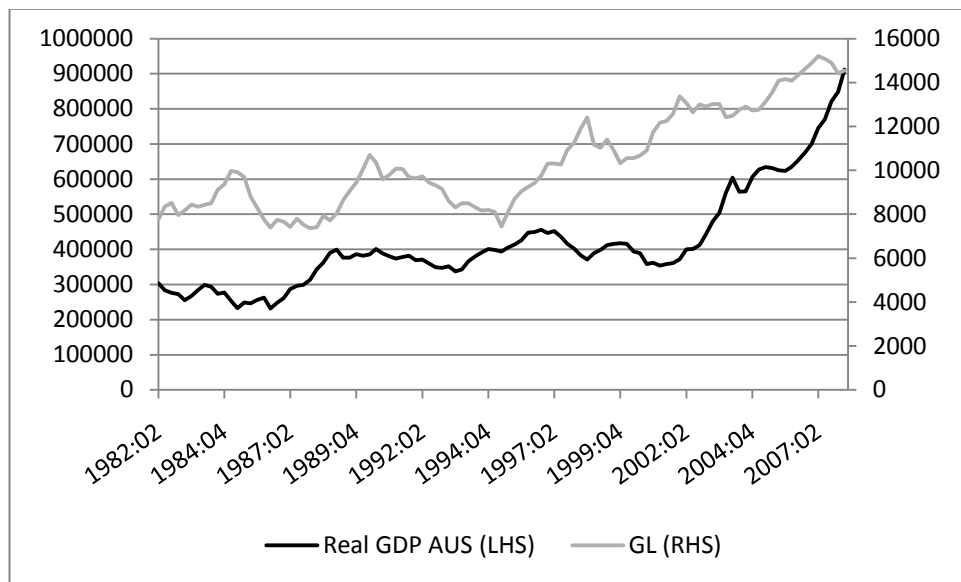


Figure 2
Global Liquidity Real GDP AUS (1982-2008)

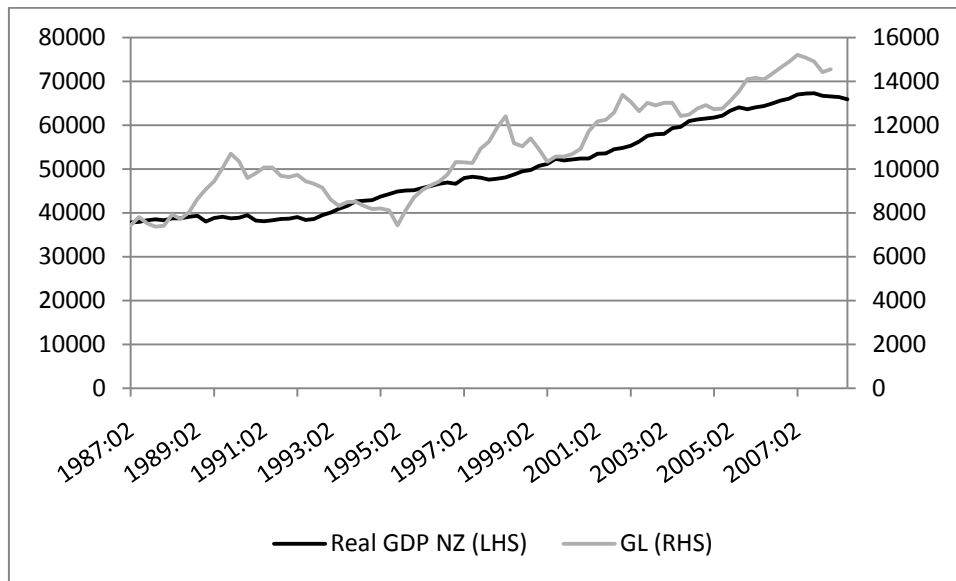


Figure 3
Global Liquidity & Real GDP NZ (1982-2008)

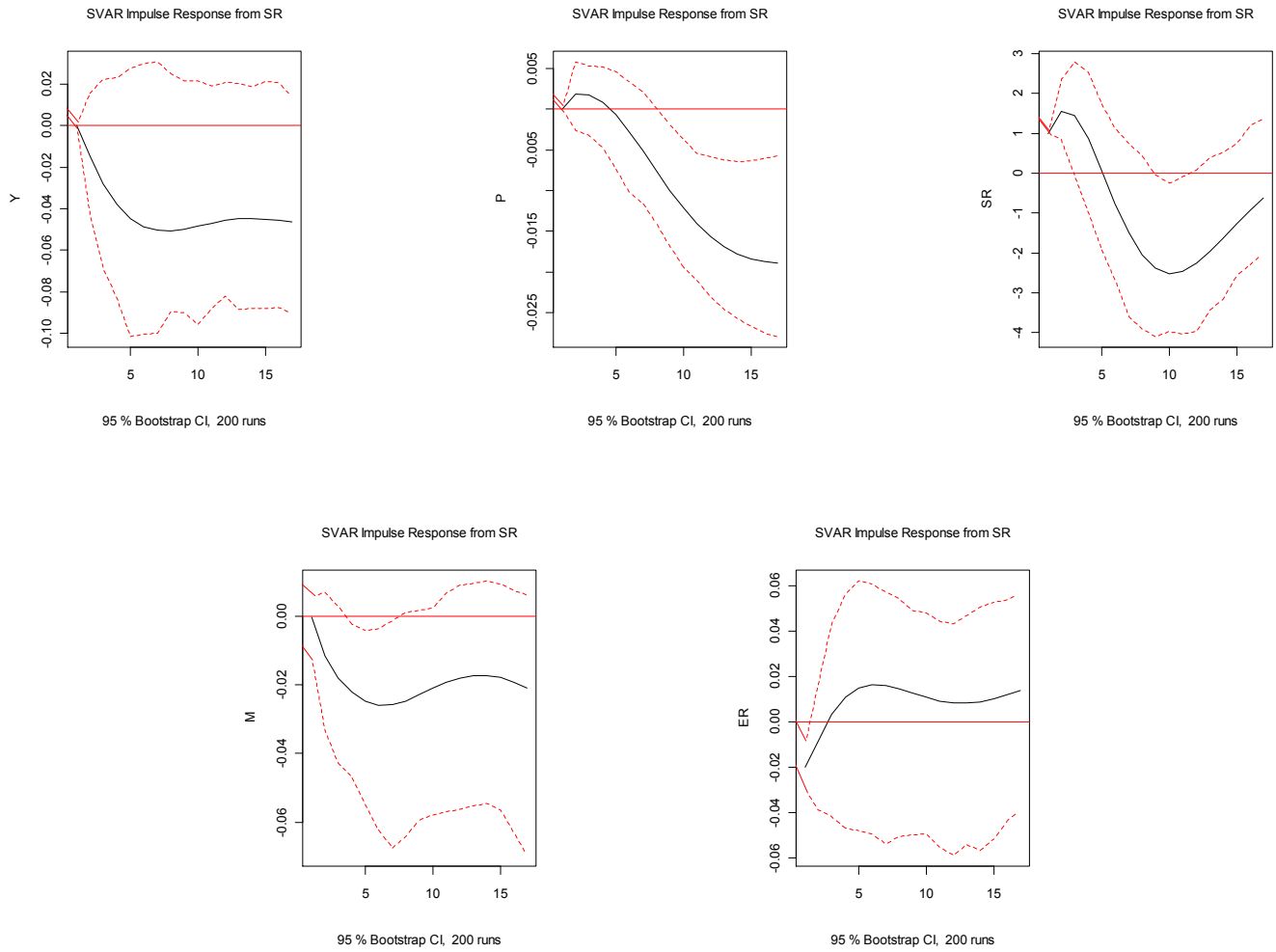


Figure 4
Impulse Responses to a 1-time Std. Deviation Positive Shock to SR (AUS)

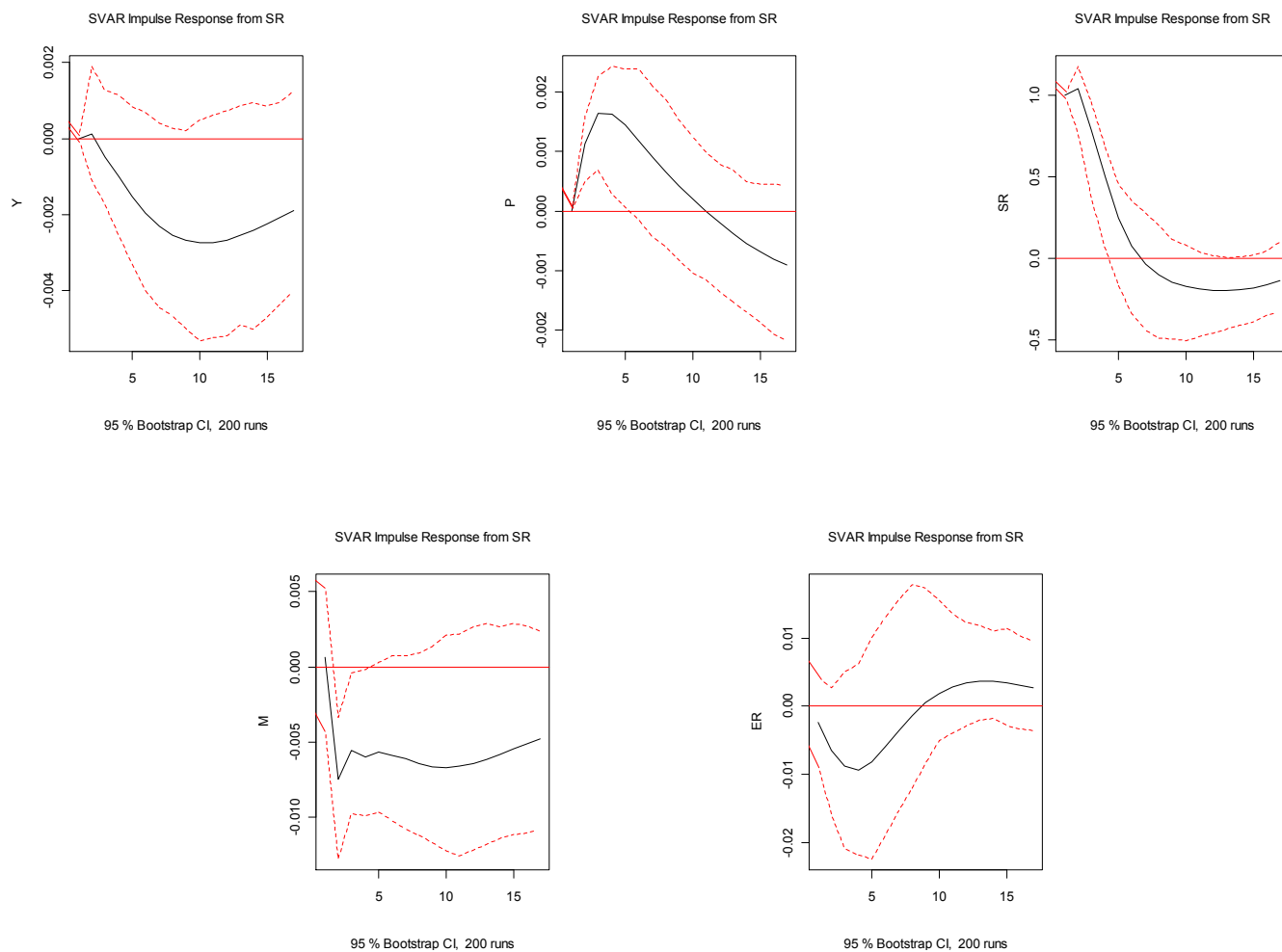


Figure 5
Impulse Responses to a 1-time Std. Deviation Positive Shock to SR (NZ)

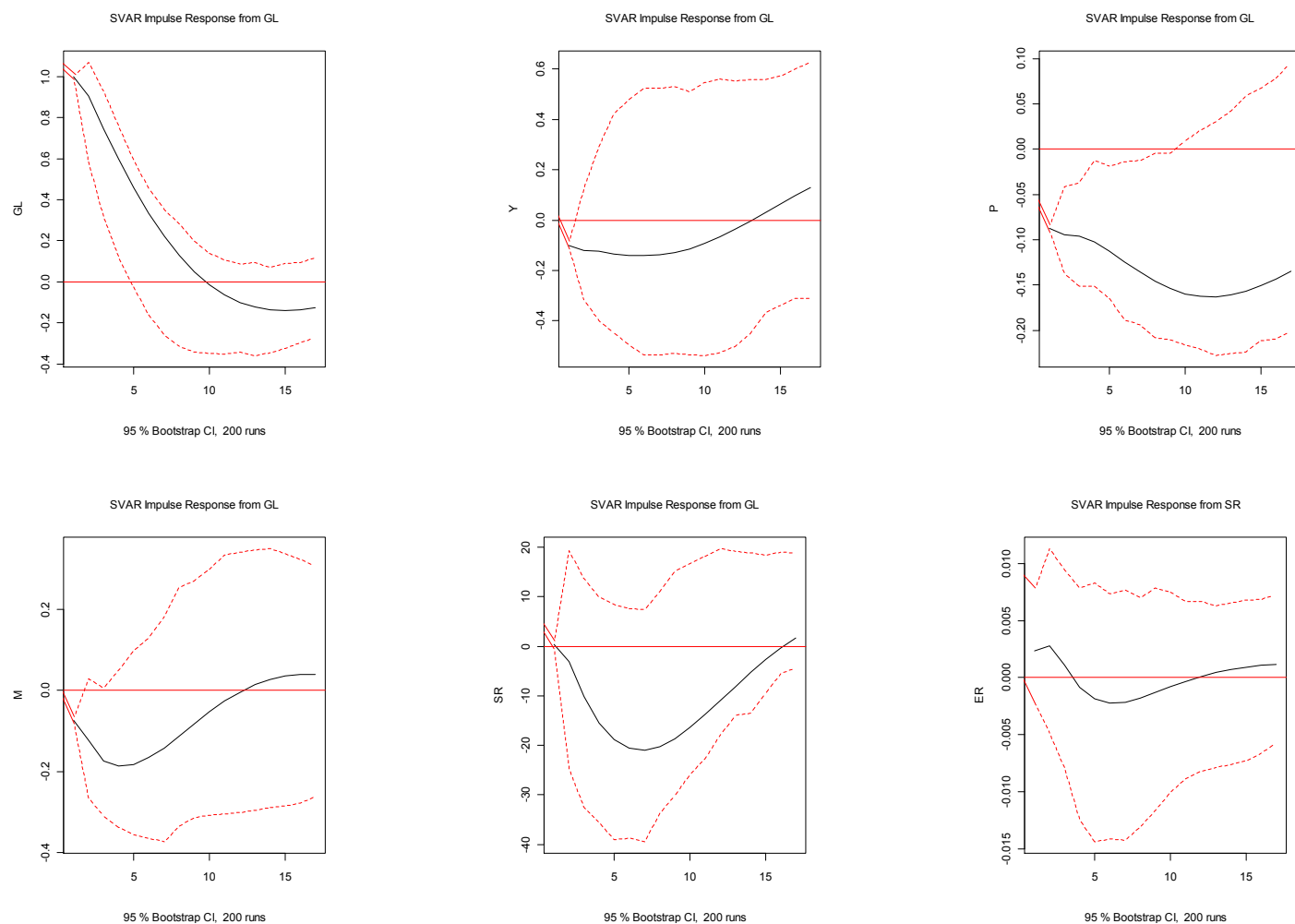


Figure 6
Impulse Responses to a 1-time Std. Deviation Positive Shock to GL (AUS)

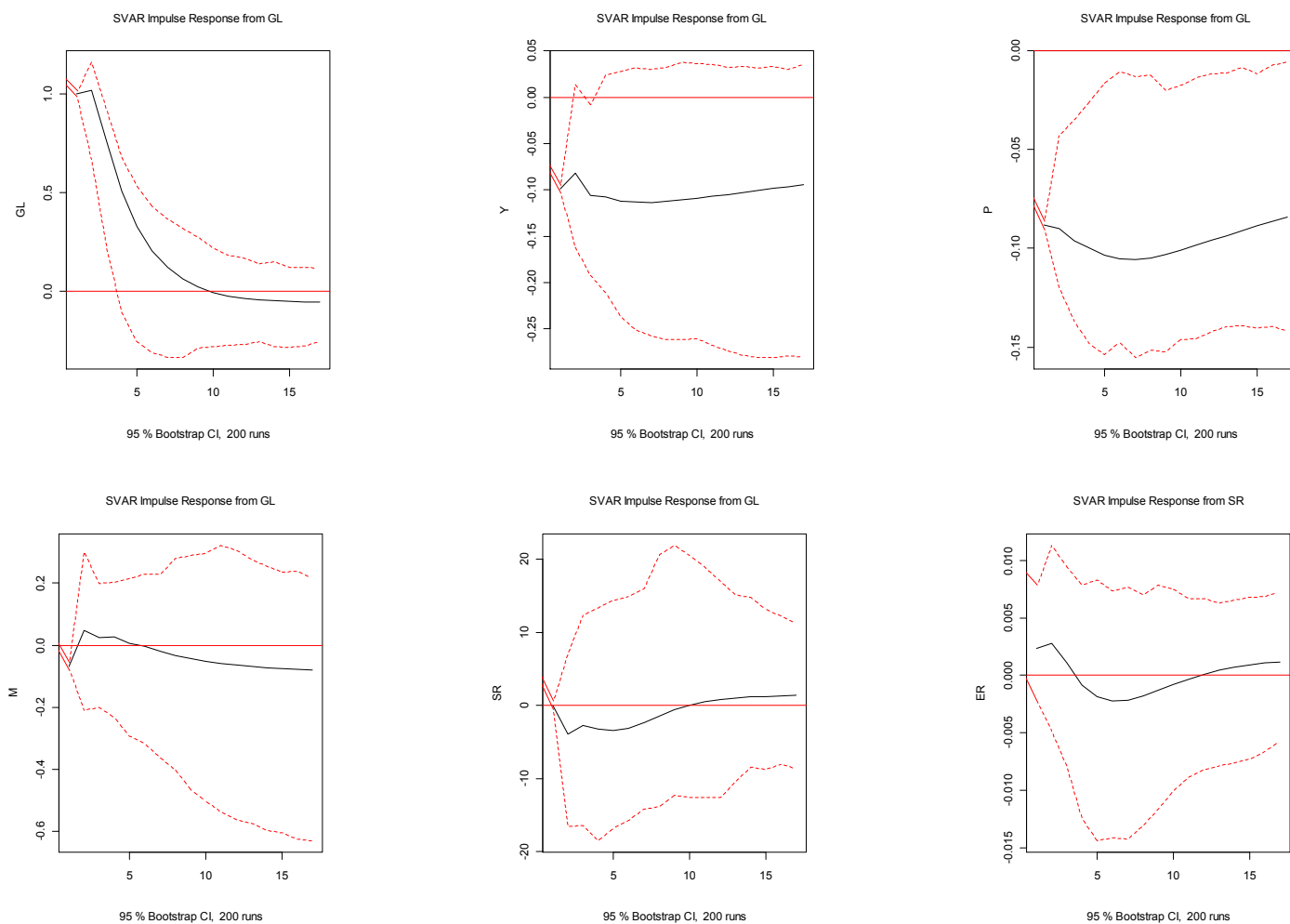


Figure 7
Impulse Responses to a 1-time Std. Deviation Positive Shock to GL (NZ)

Table 1

Contribution of Shocks to SR and M to the Forecast Error Variance (AUS)

	shock to SR				shock to M			
	1 year	2 year	3 year	4 year	1 year	2 year	3 year	4 year
Y	0.01	1.90	5.44	6.02	1.34	2.00	2.15	1.85
P	1.15	3.22	2.24	2.01	0.00	0.01	0.01	0.02
SR	84.70	71.41	69.53	68.88	0.16	0.31	0.33	0.30
M	4.93	8.07	8.22	8.70	47.31	38.90	35.98	29.01
ER	6.20	7.31	7.84	7.89	2.33	6.45	8.36	8.35

Table 2

Contribution of Shocks to SR and M to the Forecast Error Variance (NZ)

	shock to SR				shock to M			
	1 year	2 year	3 year	4 year	1 year	2 year	3 year	4 year
Y	0.36	0.26	0.47	0.58	0.11	0.06	0.27	0.49
P	0.15	0.16	0.14	0.01	0.01	0.07	0.11	0.09
SR	27.92	16.28	12.01	9.77	5.31	2.36	1.14	1.02
M	0.02	0.01	0.12	0.15	25.52	7.02	4.21	3.51
ER	0.02	0.01	0.11	0.28	1.72	1.65	1.43	1.42

Table 3
Forecast Error Variance Decomposition

	Australia				New Zealand			
	Variability of Money							
	1 year	2 year	3 year	4 year	1 year	2 year	3 year	4 year
GL	2.31	2.13	1.59	1.36	0.11	0.03	0.03	0.04
Y	3.63	7.17	9.54	12.15	25.38	28.64	27.70	26.68
P	27.43	41.58	43.42	40.64	54.32	64.12	66.32	67.10
SR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M	66.57	48.27	43.20	42.48	18.64	3.87	1.87	1.36
ER	0.05	0.86	2.25	3.36	1.55	3.34	4.09	4.81
Variability of Prices								
	1 year	2 year	3 year	4 year	1 year	2 year	3 year	4 year
GL	1.02	1.65	2.65	3.53	0.81	1.01	1.20	1.36
Y	0.90	1.08	0.98	0.96	0.37	0.70	3.42	8.15
P	97.76	96.02	93.29	89.73	98.81	98.14	95.11	90.22
SR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M	0.10	0.57	1.37	2.35	0.01	0.05	0.07	0.06
ER	0.22	0.68	1.70	3.43	0.00	0.10	0.20	0.21
Variability of Output								
	1 year	2 year	3 year	4 year	1 year	2 year	3 year	4 year
GL	0.79	0.76	0.46	0.32	1.15	1.30	1.34	1.37
Y	84.58	68.92	50.40	40.29	97.77	97.76	95.54	92.33
P	9.19	22.39	41.49	52.45	0.60	0.60	2.40	4.70
SR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
M	3.44	6.43	6.86	6.46	0.01	0.06	0.19	0.35
ER	2.00	1.50	0.79	0.50	0.46	0.29	0.52	1.25

A DATA SUMMARY

Australia		
<i>Variable</i>	<i>Summary</i>	<i>Source</i>
Y	Real gross domestic product reported in US dollars	Global Insight (via WRDS)
P	Consumer price index- all groups	Global Insight (via WRDS)
M	Money Supply: M1	Global Insight (via WRDS)
SR	Interest rate: 3-month treasury bills	Global Insight (via WRDS)
ER	Australian exchange rate in Australian dollars per US dollar	Global Insight (via WRDS)
New Zealand		
<i>Variable</i>	<i>Summary</i>	<i>Source</i>
Y	Real gross domestic product reported in US dollars	Global Insight (via WRDS)
P	Consumer price index- all groups	Global Insight (via WRDS)
M	Money Supply: M1b	Global Insight (via WRDS)
SR	Interest rate: 13-week treasury bills	Global Insight (via WRDS)
ER	New Zealand exchange rate in New Zealand dollars per US dollar	Global Insight (via WRDS)
Aggregate		
<i>Variable</i>	<i>Summary</i>	<i>Source</i>
GL	An aggregate of US M1, Euro Zone M1, Japanese M2, and UK M4. All money levels are reported in their domestic currency and then transformed into USD via their respective exchange rates with the US	Global Insight (via WRDS)