Why Does Monetary Policy Respond to the Real Exchange Rate in Small Open Economies? A Bayesian Perspective

Carlos J. Garcia[1]

ILADES Georgetown University and Universidad Alberto Hurtado

Wildo D. Gonzalez

Banco Central de Chile

November 2012

Abstract

To estimate how monetary policy works in small open economies, we build a dynamic stochastic general equilibrium model that incorporates the basic features of these economies. We conclude that the monetary policy in a group of small open economies (including Australia, Chile, Colombia, Peru, and New Zealand) is rather similar to that observed in closed economies. Our results also indicate, however, that there are strong differences due to shocks from the international financial markets (mainly risk premium shocks). These differences explain most of the variability of the real exchange rate, which has important reallocation effects in the short run. Our results are consistent with an old idea from the Mundell-Fleming model: namely, a real depreciation to confront a risk premium shock is expansive or procyclical, in contradiction to the predictions of the balance sheet effect, the J curve effect, and the introduction of working capital into RBC models. In line with this last result, we have strong evidence that only in one of the five countries analyzed in this study does not intervene the real exchange rate, the case of New Zealand.

JEL classification: F33; E52; F41

Keywords: small open economy models; monetary policy rules; exchange rates; Bayesian econometrics.

[1] Corresponding author: cgarcia@uahurtado.cl, Almirante Barroso 6, Santiago, Chile.

1. Introduction

Designing monetary policy is one of the major challenges for small open economies. Some have chosen to implement an inflation-targeting framework to guide their monetary policy toward stabilizing the inflation rate. However, the design of monetary policy in these economies poses important challenges that are not present in closed economies. Small open economies must continuously deal with strong volatility in international financial markets and international trade, especially from the high variability of country risk premiums and commodity prices. Consequently, central banks are often pushed to change their monetary stances.

The real exchange rate is one of the key variables through which international market fluctuations are transmitted to domestic economies. For example, unexpected external shocks that alter the exchange rate may affect the cost of the external debt service, the value of income from commodity exports, the cost of imported inputs, and so on. The change in the real exchange rate may shift the expected path of inflation, leading central banks to adjust their monetary policy.

Much of the literature on monetary policy in open economies focuses on whether central banks respond to the real exchange rate. The evidence obtained from empirical studies indicates that many countries include the real exchange rate in their policy reaction function. The evidence is not conclusive, however, as countries like Australia and New Zealand do not incorporate the exchange rate in their policy reaction function (Lubik and Schorfheide, 2007). The welfare analysis has produced contradictory results, depending on the model proposed (Bergin, Shin, and Tchakarov, 2007). For example, Ball (1999), Svensson (2000), and Batini, Harrison, and Millard (2003) find that including the real exchange rate marginally improves the macroeconomic performance of central banks. Morón and Winkelried (2005) and Cavoli (2009) show that defending the exchange rate may be useful in a context of financial instability or as a response to fear of floating, in contrast to the findings of studies such as Wollmershauser (2006).

Our goal is to estimate empirically how monetary policy works in small open economies and hence to identify its connection with the exchange rate. To do so, we build a model which is sufficiently general to incorporate the basic structures observed in these economies, as well as a wide range of shocks. We are interested in determining the differences in monetary policy between closed economies and small open economies. In particular, we explore how these structures and shocks can influence the design and practice of monetary policy such that central banks are compelled to include the exchange rate in their policy reaction functions.

We build a dynamic stochastic general equilibrium (DSGE) model for a small open economy. This model considers imperfect capital markets (in which the country risk premium depends on the ratio of external debt to GDP), restricted consumers, capital accumulation, the balance sheet effect of exchange rate devaluations, imported inputs, commodity exports, imperfect pass-through of the exchange rate, and wage indexation. In addition to the traditional shocks (namely, monetary, productivity, mark-up prices, an investment shock in the Tobin’s Q equation, wages, and aggregate demand), we include several external shocks: risk premium, commodity price, external demand, foreign interest rate, and foreign inflation. Our sample comprises a group of countries that can be classified as small open economies, inflation targeters, and commodity producers: Australia, New Zealand, Chile, Colombia, and Peru. These countries have been frequently hit by shocks that change the conditions for accessing international financial markets and the prices of their main exports (commodities). Finally, we use Bayesian techniques to estimate all the equations and shocks simultaneously.

The results of our study are the following. First, risk premium shocks can explain most of the variance of the exchange rate. This confirms the importance of these shocks for the exchange rate, as previously found by several authors. For example Calvo and Reinhart (2002) find that a lack of credibility for monetary policy is associated with a higher variance of risk premium shocks and a stronger impact on the exchange rate and prices. Second, changes in the real exchange rate cause significant reallocation of resources across sectors in the short run. Third, monetary policy reacts to shocks in order to stabilize the economy (that is, to return the economy to the steady state). In the case of a risk premium shock, the impulse response function shows that the inflation rate and the growth rate increase simultaneously due to a real depreciation. Therefore, central banks can avoid this excess volatility by raising the interest rate. Fourth, we have strong evidence that only in one of the five countries analyzed in this study does not intervene the real exchange rate, the case of New Zealand.

The inclusion of the exchange rate in the policy reaction function could reflect the fact that in practice, central banks do not face an important trade-off between inflation and growth in the presence of risk premium shocks. For instance, García and Gonzalez (2013) use a simpler model without capital to analyze in details the welfare implication of exchange rate intervention by using Ramsey approach. They found that respond moderately by changing the interest rate when the exchange rate is fluctuating is optimal.

The expansionary impact of a risk premium shock on the economy is consistent with the old Mundell-Fleming model prediction: a real depreciation increases gross domestic product (GDP), so risk premium shocks are procyclical. However, this result is inconsistent with some important studies in the field of international macroeconomics on the balance sheet effect, the *J* curve effect, and the introduction of working capital into real business cycle (RBC) models. All of these studies find a countercyclical relationship between GDP and a real depreciation. We argue that the parameters estimated in our model should have had to take values far from plausible priors in order to find countercyclical behavior.

The work is organized as follows. Section 2 provides a detailed description of the model and empirical strategy. Section 3 identifies the econometric methodology used and describes the data and the solution method. In section 4, we present the results of the estimations, including the parameters, variance decomposition, and impulse response functions. Section 5 concludes.

2. The Structural Model

Our model resembles others found in the recent literature, but it has been adapted to capture the essentials of small open economies.[2] General references on this type of model include Woodford (2003), Clarida et al. (1999, 2002), Galí and Monacelli (2005), and Galí et al. (2007). More specifically, the model is similar to the one proposed by Smets and Wouters (2002). Our model also includes restricted consumers (Galí et al., 2007), raw materials, consumer habits, wage indexation, the balance sheet effect of exchange rate changes (Céspedes et al., 2004), and country risk premiums that are dependent on the ratio of external debt to GDP (Schmitt-Grohé and Uribe, 2003). Our structure is also similar to Laxton and Pesenti (2003), since all imports are

[2] García et al (2011a) use a more theoretical version of this model to examine whether explicitly including the exchange rate in the central bank's policy reaction function can improve macroeconomic performance. See also García and Gonzalez (2013).

intermediate inputs. Thus, the model has imperfect pass-through of the exchange rate changes to domestic prices.[3]

2.1 Households

We assume a continuum of infinitely lived households indexed by $i \in [0,1]$. Following Galí et al. (2007), a fraction of households, λ, consume their current labor income; they do not have access to capital markets and thus neither save nor borrow. Such agents have been termed hand-to-mouth consumers. The remainder, 1 – λ, have access to capital markets and are able to smooth consumption, so their intertemporal allocation between consumption and savings is optimal (that is, they are Ricardian or optimizing consumers).

2.1.1 Ricardian household consumption

The representative household maximizes expected utility. Here, the superscript *o* stands for Ricardian households or optimizing agents.

$$E_o \sum_{t=0}^{\infty} \beta^t U\left(C_t^o(i), N_t^o(i)\right), \tag{1}$$

subject to the budget constraint

[3] Several authors build DSGE models to analyze macroeconomic policies in open economies. Those using Bayesian estimation techniques include Adolfson et al. (2007), Castillo et al. (2006), Caputo et al. (2006), Cook (2004), Devereux et al. (2006), Elekdag et al. (2006), García et al. (2011a), García et al. (2011b), García et al. (2013), Hamann et al. (2006), Medina and Soto (2007), and Tovar (2006).

$$P_t C_t^o(i) \le W_t(i) N_t^o(i) + B_t^o(i) - S_t B_t^{o*}(i) + D_t^o(i) - P_t T_t$$
$$-R_t^{-1} B_{t+1}^o(i) + S_t \left\{ \Phi\left(\frac{b_{t+1}^{o*}}{GDP_t}, \frac{b_{t+1}^{o*}}{Q_t K_{t+1}}, u_t^{RK} \right) R_t^* \right\}^{-1} B_{t+1}^{o*}(i) \, , \tag{2}$$

where $C_t^o(i)$ is consumption, $D_t^o(i)$ are dividends from ownership of firms, $\Phi\left(\frac{b_{t+1}^{o*}}{GDP_t}, \frac{b_{t+1}^{o*}}{Q_t K_{t+1}}, u_t^{RK} \right)$ represents the country risk premium, where $b_{t+1}^{o*} = \frac{S_{t+1} B_{t+1}^{o*}}{P_{t+1}}$, S_t is the nominal exchange rate, $B_t^{o*}(i)$ denotes private net foreign assets (we assume that a positive value means external debt), $W_t(i)$ is the nominal wage, $N_t^o(i)$ is the number of hours of work, $B_t^o(i)$ is government debt held by households, R_t and R_t^* are the gross nominal return on domestic and foreign assets (where $R_t = 1 + i_t$ and $R_t^* = 1 + i_t^*$), and T_t are lump-sum taxes.

For all cases, we assume a separable utility function with habit persistence:

$$U(C(i), N(i)) = \frac{(C_t(i) - \gamma C_{t-1}(i))^{1-\sigma} - 1}{1-\sigma} - \psi \frac{N_t(i)^{\varphi}}{\varphi} \, . \tag{3}$$

where 1/σ is the intertemporal elasticity of substitution in consumption and 1/(φ – 1) is the elasticity of labor supply to wages in both cases. The value of ψ is calibrated to obtain a realistic fraction of steady-state hours worked. The first-order condition for consumption is

$$1 = E_t\left(\Lambda_{t,t+1} R_t \left(\frac{P_t}{P_{t+1}} \right) \right), \tag{4}$$

where the stochastic discount factor, $\Lambda_{t,t+1}$,is equal to $\beta\left(MgU^0_{t+1} / MgU^0_t\right)\left(P_t / P_{t+1}\right)$. From the first-order conditions, it is also possible to derive the interest parity condition, where $Q^*_t = S_t P^*_t / P_t$.[4]

$$1 = E_t\left[\Lambda_{t,t+1} \frac{Q^*_{t+1}}{Q^*_t} R^*_t \Phi\left(\frac{b^{o*}_{t+1}}{GDP_t}, \frac{b^{o*}_{t+1}}{Q_t K_{t+1}}, u^{RK}_t\right)\right]. \quad (5)$$

Empirically, equation (5) is unable to generate a hump-shaped response of the real exchange rate after a shock to monetary policy (Adolfson et al., 2008). We therefore assume that the real exchange rate, Q_t (equation 6), is a weighted average between its own lag and the real exchange rate from the interest parity condition, Q^*_t (equation 5). This approach is necessary to produce sensible dynamics in key variables of the model, such as output, inflation, and the exchange rate:

$$Q_t = \left(Q_{t-1}\right)^{\Omega_Q} \left(Q^*_t\right)^{1-\Omega_Q}. \quad (6)$$

2.1.2 Risk premium

The risk premium, $\Phi\left(\frac{b^{o*}_{t+1}}{GDP_t}, \frac{b^{o*}_{t+1}}{Q_t K_{t+1}}, u^{RK}_t\right)$, where $b^{o*}_{t+1} = \frac{S_{t+1} B^{o*}_{t+1}}{P_{t+1}}$, depends on foreign debt, the value of investment, and GDP. The risk premium consists of three elements. The first term in the

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[4] The real exchange rate is obtained from equation (2) by using the following transformation of the external debt in domestic real terms: $S_t B^{o*}_t / P_t = b^{o*}_t$ and

$$S_t \left\{\Phi\left(\frac{b^{o*}_{t+1}}{GDP_t}, \frac{b^{o*}_{t+1}}{Q_t K_{t+1}}, u^{RK}_t\right) R^*_t\right\}^{-1} B^{o*}_{t+1}(i) = \left(Q^*_t / Q^*_{t+1}\right)\left\{\Phi\left(\frac{b^{o*}_{t+1}}{GDP_t}, \frac{b^{o*}_{t+1}}{Q_t K_{t+1}}, u^{RK}_t\right) R^*_t\right\}^{-1} \left(P^*_{t+1} / P^*_t\right) b^{o*}_{t+1}(i)$$

.

The first-order condition for utility maximization is obtained with respect to $b^{o*}_{t+1}(i)$.

equation says that the risk premium is an increasing function of the ratio of external debt to GDP. This friction in the international capital markets is required to ensure stationarity of the external-debt-to-GDP ratio.[5]

The second term in the equation says that the risk premium is an increasing function of the foreign debt to the value of investment, i.e., it captures the adverse impact of currency depreciation on the domestic currency value of external debt—the balance sheet effect. This liability dollarization effect can be modeled in different ways, as described by Céspedes et al. (2004), Cook (2004), Elekdag et al (2006), and Tovar (2006), among others. We decided to follow a simple strategy proposed by Céspedes et al (2004) and Gertler et al (2007), which allows us to measure this effect in just one parameter, μ, measuring the elasticity of the risk premium to the foreign debt.[6] Undoubtedly, this strategy is less structured than others in the literature, but it is straightforward enough, considering that our model is more general than a financial accelerator model, it includes many frictions, and it gives priority to all the possible channels that allow us to measure the impact of the real exchange rate on a small open economy.

The third term is the risk premium shock, which we define as unanticipated changes in credit risk conditions related to external debt. As can be seen in the budget constraint in equation (2), this type of shock directly reduces the resources that families have available for smoothing

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[5] See Schmidt-Grohé and Uribe (2003).

[6] Céspedes et al (2004), following Bernanke et al (1999), assume that the risk premium is given by:

$$1+\eta_{t+1} = F\left(\frac{\breve{Q}_t K_{t+1}}{\breve{Q}_t K_{t+1} - S_t B_{t+1}^*}\right) = G\left(\frac{S_t B_{t+1}^*}{\breve{Q}_t K_{t+1}}\right), \qquad F(1)=1,\ \ F'>0,\ \ Q=\frac{\breve{Q}}{P}$$

We assume that the risk premium can be represented by a similar function to characterize the balance sheet effect:

$$1+\eta_{t+1} = \Phi\left(\frac{b_{t+1}^{o*}}{GDP_t}, \frac{b_{t+1}^{o*}}{Q_t K_{t+1}}, u_t^{RK}\right), \qquad b_{t+1}^{o*} = \frac{S_{t+1} B_{t+1}^{o*}}{P_{t+1}}$$

.

consumption over time, because they must pay a higher interest rate. In other words, in our study the shocks produce a credit spread between R_t^* and $R_t^*\Phi\left(\frac{b_{t+1}^{o*}}{GDP_t},\frac{b_{t+1}^{o*}}{Q_tK_{t+1}},u_t^{RK}\right)$ that reduces households' resources.

With regard to the transmission mechanism, the risk premium shock affects both the real exchange rate and the risk premium simultaneously through equation (5), due to our general equilibrium approach. Because the relevant foreign interest rate for the country is $R_t^*\Phi\left(\frac{b_{t+1}^{o*}}{GDP_t},\frac{b_{t+1}^{o*}}{Q_tK_{t+1}},u_t^{RK}\right)$, an increase in this expression should produce a real depreciation as a result of capital outflows. At the same time, there should be a second effect that reinforces the increase in the risk premium. In fact, the real depreciation raises the risk premium even further through both the balance sheet effect, as captured by the second term in the relevant foreign interest rate and the friction in the international capital markets is required to ensure stationarity of the external-debt-to-GDP ratio, as captured by the first term in the relevant foreign interest rate, since b_{t+1}^{o*} can be expressed as the product between the real exchange rate and the real external debt[7]. Nevertheless, the initial impulse in both variables was originally occasioned by a particular risk premium shock.

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[7] $b_{t+1}^{o*}=\frac{S_{t+1}B_t^{o*}}{P_{t+1}}=\frac{S_{t+1}B_t^{o*}}{P_{t+1}}\frac{P_{t+1}^*}{P_{t+1}^*}=real\ exchange\ rate\times\frac{B_{t+1}^{o*}}{P_{t+1}^*}$

2.1.3 Hand-to-mouth household consumption

The utility of the credit-restricted households is given by

$$U(C_t^r(i), N_t^r(i)), \tag{7}$$

where the superscript *r* stands for hand-to-mouth consumers. We assume that these households neither save nor borrow (Mankiw, 2000). As a result, their level of consumption is given by their disposable income:

$$P_t C_t^r(i) = W_t(i) N_t^r(i) - P_t T_t. \tag{8}$$

2.1.4 The labor supply schedule

Following Erceg, Henderson, and Levin (2000), we assume that households act as price setters in the labor market. There is a representative labor aggregator, and wages are staggered à la Calvo (1983). Therefore, wages can only be optimally changed after some random wage-change signal is received. A continuum of monopolistically competitive households is assumed to exist, and each supplies a differentiated labor service to the intermediate-goods-producing sector. The representative labor aggregator combines household labor hours in the same amount that firms demand, based on a constant-returns technology. The aggregate labor index, N_t, takes the constant elasticity of substitution (CES) or Dixit-Stiglitz form, where ε_w is the elasticity of substitution between any two differentiated households (see equation 11 below):

$$N_t = \left[\int_0^1 N_t(i)^{\frac{\varepsilon_w - 1}{\varepsilon_w}} di \right]^{\frac{\varepsilon_w}{\varepsilon_w - 1}}, \tag{9}$$

where $N_t(i)$ is the quantity of labor provided by each household. The representative labor aggregator takes each household's wage rate, $W_t(i)$, as given and minimizes the cost of producing a given amount of the aggregate labor index. Then, units of labor are sold at their unit cost W_t (with no profit) to the productive sector:

$$W_t = \left[\int_0^1 W_t(i)^{1-\varepsilon_w} di \right]^{\frac{1}{1-\varepsilon_w}} . \qquad (10)$$

Households set their nominal wages to maximize their intertemporal objective function (1), subject to the intertemporal budget constraint (2) and the total demand for their labor services, which is given by

$$N_t(i) = \left[\frac{W_t(i)}{W_t} \right]^{-\varepsilon_w} N_t . \qquad (11)$$

Additionally, we impose two important conditions. First, rule-of-thumb households set their wages equal to the average wage of optimizing households. Second, Ricardian household consumers that do not receive the signal to change their nominal wage can index their wages to past inflation. We measure the level of indexation for δ_W. Thus, the wages of households that cannot reoptimize adjust according to

$$W_t(i) = \left(W_{t-1}(i)\right)^{1-\delta_W} \left(\frac{P_{t-1}}{P_{t-2}}\right)^{\delta_W} . \quad (12)$$

2.2 Firms

We assume a continuum of monopolistically competitive domestic firms, indexed by $j \in [0,1]$, producing differentiated intermediate goods. We take into account not only the role of investment in propagating the shocks that affect the real exchange rate but also the role of including imported inputs in the production function (McCallum and Nelson, 2000). Thus, the production function of the representative intermediate-goods firm, indexed by (j), corresponds to a CES combination of labor, $N_t(j)$, capital stock $K_t(j)$, and import inputs, $I_t(j)$, to produce $Y_t^D(j)$ and is given by

$$Y_t^D(j) = A_t \left[\alpha_1 N_t(j)_t^{\frac{\sigma_s - 1}{\sigma_s}} + \alpha_2 I_t(j)_t^{\frac{\sigma_s - 1}{\sigma_s}} + (1 - \alpha_1 - \alpha_2) K_t(j)_t^{\frac{\sigma_s - 1}{\sigma_s}} \right]^{\frac{\sigma_s}{\sigma_s - 1}}, \quad (13)$$

where A_t is the technology shock, $\boldsymbol{\sigma_s}$ is the elasticity of substitution between capital, imported inputs, and labor, and both are greater than zero.

The firms' costs are minimized, taking as given the price of import inputs, $S_t P_t^*$, capital stock Z_t, and the wage, W_t, subject to the production function technology. The relative factor demands are derived from the first-order conditions:

$$Z_t / W_t = \left[(1 - \alpha_1 - \alpha_2) / (\alpha_1) \right] \left(N_t(j) / K_t(j) \right)^{\frac{1}{\sigma_s}} \quad (14a)$$

$$Z_t / \left(S_t P_t^*\right) = \left[\left(1-\alpha_1-\alpha_2\right)/\left(\alpha_2\right)\right]\left(I_t^*(j)/K_t(j)\right)^{\frac{1}{\sigma_s}} \qquad (14b)$$

or

$$N_t^*(j) = \left[\left(1-\alpha_1-\alpha_2\right)/\left(\alpha_1\right)\right]^{\frac{1}{\sigma_s}} \left\{\left[\left(W_t\right)/Z_t\right]^{-\frac{1}{\sigma_s}}\right\} K_t(j). \qquad (15a)$$

and

$$I_t^*(j) = \left[\left(1-\alpha_1-\alpha_2\right)/\left(\alpha_2\right)\right]^{\frac{1}{\sigma_s}} \left\{\left[\left(S_t P_t^*\right)/Z_t\right]^{-\frac{1}{\sigma_s}}\right\} K_t(j). \qquad (15b)$$

As explained above, to replicate the inertia observed in the hiring of inputs, we assume that total inputs, (equation 16a and 16b), are a weighted average between its own lag and the values from equation 15a and 15b:[8]

$$N_t = \left(N_{t-1}\right)^{\Omega_N} \left(N_t^*\right)^{1-\Omega_N}, \qquad (16a)$$

$$I_t = \left(I_{t-1}\right)^{\Omega_M} \left(I_t^*\right)^{1-\Omega_M}, \qquad (16b)$$

and the marginal cost is given by:

$$MC^D = \left(1/A_t\right)\left[\alpha_1^{\sigma_s}(W_t)^{1-\sigma_s} + \alpha_2^{\sigma_s}(S_t P_t^*)^{1-\sigma_s} + (1-\alpha_1-\alpha_2)^{\sigma_s}(Z_t)^{1-\sigma_s}\right]^{\frac{1}{1-\sigma_s}}. \qquad (17)$$

[8] This approach similar to Laxton and Pesenti (2003).

When firm (j) receives a signal to optimally set a new price à la Calvo (1983), it maximizes the discounted value of its profits, conditional on the new price. Furthermore, we assume that the prices of firms that do not receive a price signal are indexed to the last period's inflation, π_{t-1}, according to the parameter δ_D (that is, complete indexation is when $\boldsymbol{\delta_D}$ equal to one):

$$\max \sum_{k=0}^{\infty} \theta_D^k E_t \left\{ \Lambda_{t,t+k} Y_{t+k}^D(j) \left[P_t^{D*}(j) \prod_{l=1}^{k} \left(\pi_{t+l-1}^k \right)^{\delta_D} - MC_{t+k}^D \right] \right\}, \tag{18}$$

subject to

$$Y_{t+k}^D(j) \leq \left(P_t^{D*}(j) / P_t^D \right)^{-\varepsilon_D} Y_{t+k}^D, \tag{19}$$

where the probability that a given price can be reoptimized in any particular period is constant and is given by $(1 - \theta_D)$, and ε_D is the elasticity of substitution between any two differentiated goods. P_t^{D*} must satisfy the first-order condition, where this price can be indexed to past inflation:

$$\sum_{k=0}^{\infty} \theta_D^k E_t \left\{ \Lambda_{t,t+k} Y_{t+k}^D(j) \left[P_t^{D*}(j) \prod_{l=1}^{k} \left(\pi_{t+l-1}^k \right)^{\delta_P} - \frac{\varepsilon_D}{\varepsilon_D - 1} MC_{t+k}^D \right] \right\} = 0. \tag{20}$$

Firms that did not receive the signal will not adjust their prices. Those that do reoptimize choose a common price, P_t^{D*}. Finally, the dynamics of the domestic price index, P_t^D are described by the following equation:

$$P_t^D = \left[\theta_D (P_{t-1}^D \pi_{t-1}^{\delta_D})^{1-\varepsilon_D} + (1-\theta_D)(P_t^{D*})^{1-\varepsilon_D} \right]^{\frac{1}{1-\varepsilon_D}} . \tag{21}$$

2.2.1 Final goods distribution

There is a perfectly competitive aggregator, which distributes the final good using a constant-returns-to-scale technology:

$$Y_t^D = \left(\int_0^1 Y_t^D(j)^{\frac{\varepsilon_K - 1}{\varepsilon_K}} dj \right)^{\frac{\varepsilon_K}{\varepsilon_K - 1}} , \tag{22}$$

where $Y_t^D(j)$ is the quantity of the intermediate good (domestic or imported) included in the bundle that minimizes the cost of any amount of output $,Y_t$. The aggregator sells the final good at its unit cost, P_t, with no profit:

$$P_t^D = \left(\int_0^1 P_t^D(j)^{1-\varepsilon_K} dj \right)^{\frac{1}{1-\varepsilon_K}} , \tag{23}$$

where P_t is the aggregate price index. Finally, the demand for any good, $Y_t^D(j)$, depends on its price, $P(j)$, which is taken as given, relative to the aggregate price level, P_t:

$$Y_t^D(j) = \left(\frac{P(j)}{P_t}\right)^{-\varepsilon_K} Y_t^D \quad . \tag{24}$$

2.2.2 Optimizing investment firms and Tobin's Q

There are firms that produce homogenous capital goods and rent them to the intermediate-goods firms. Firms are owned exclusively by Ricardian households. Firms invest the amount INV_t so as to maximize firm value:

$$V^t(K_t^o) = Z_t K_t^o - P_t INV_t + E_t\left[\Lambda_{t,t+1} V^{t+1}\left(K_{t+1}^o\right)\right] \tag{25}$$

subject to a capital accumulation constraint that includes an adjustment cost function $\phi(.)$. The parameter η_I measures adjustment cost in the log-linear model.

$$K_{t+1}^o = (1-\delta) K_t^o + \phi\left(\frac{INV_t^o}{K_t^o}\right) K_t^o \tag{26}$$

2.3 Exports

The demand for domestic exports from foreign countries is modeled as follows. There is a demand for each set of differentiated domestic goods, which by assumption depends on total consumption abroad, C_t^{D*}, which is considered as a shock in the estimations, and on the home price of domestic goods relative to its price in the foreign country:

$$X_t^{D*} = \left[P_t^D / \left(S_t P_t^{D*}\right)\right]^{-\eta^*} C_t^{D*} . \tag{27}$$

Nevertheless, we assume that in practice exports, X_t^D, respond more slowly to real exchange rates and foreign demand than the export demand obtained from the model, X_t^{D*}:

$$X_t^D = \left(X_{t-1}^D\right)^{\Omega}\left(X_t^{D*}\right)^{1-\Omega}. \qquad (28)$$

Since we are considering small economies' natural resource exports (commodities), the total value of these products is $S_t P_t^{cu} Q\_c$, where P_t^{cu}. denotes the international price of the commodity, which is considered as a shock in the estimations, and Q_c is the constant quantity supplied. For simplicity, supply is assumed to be price invariant in the business cycle (short-run) horizon.

2.4 Aggregation

The weighted sum of consumption by Ricardian and rule-of-thumb agents makes aggregate consumption

$$C_t = \lambda C_t^r + (1-\lambda)C_t^o = \int_0^{\lambda} C_t^r(i)di + \int_{\lambda}^{1} C_t^o(i)di. \qquad (29)$$

Since only Ricardian households hold assets, these are equal to

$$B_t = (1-\lambda)(B_t^o). \qquad (30)$$

Foreign assets (or debt) include fiscal assets, B_t^{G*}.,and privately held assets, B_t^{o*}:

$$B_t^* = B_t^{G*} + (1-\lambda)B_t^{o*}. \qquad (31)$$

Hours worked are given by a weighted average of labor supplied by each type of consumer:

$$N_t = \lambda N_t^r + (1-\lambda) N_t^o \ . \tag{32}$$

Since only Ricardian households invest and accumulate capital, total investment INV_t is equal to $(1-\lambda)$ times optimizing investment INV_t^o :

$$INV_t = (1-\lambda)(INV_t^o) \tag{33}$$

Likewise, the aggregate capital stock is:

$$K_t = (1-\lambda)(K_t^o) \tag{34}$$

Finally, in equilibrium each type of consumer works the same number of hours:

$$N_t = N_t^r = N_t^o \ . \tag{35}$$

2.5 Monetary policy

The central bank sets the nominal interest rate according to the following rule:

$$IR_t = \overline{R}\left[\left(\Pi_t / \overline{\Pi}\right)^{\phi_\pi}\left(YR_t / \overline{YR}\right)^{\phi_y}\left(Q_t / \overline{Q}\right)^{\zeta_e^1}\left(Q_t / Q_{t-1}\right)^{\zeta_e^2}\right], \tag{36}$$

where $\overline{R}$. is the steady-state nominal interest rate, Π_t total inflation, $\overline{\Pi}$ total inflation in steady state (which is zero in our model), YR_t. GDP excluding natural resources, $\overline{YR}$ its steady-state value, Q_t the real exchange rate, and $\bar{Q}$ the steady state level. Thus, central banks can react to both the level and the change of the real exchange rate.

We assume that central banks do not immediately move the interest rate to its target level (equation 36), but rather take some time to respond to changes in the inflation rate, output, and the exchange rate (equation 37). In addition, there are monetary policy shocks, u_t^{MP}, which are normally distributed.

$$R_t = \left(R_{t-1}\right)^{\Omega_R} \left(IR_t\right)^{1-\Omega_R} e^{u_t^{MP}} . \qquad (37)$$

2.6 Government

The government budget constraint is:

$$P_t T_t + R_t^{-1} B_{t+1}^G + S_t \left\{ \Phi\left(\frac{b_{t+1}^{o*}}{GDP_t}, \frac{b_{t+1}^{o*}}{Q_t K_{t+1}}, u_t^{RK} \right) R_t^* \right\}^{-1} B_{t+1}^{G*} \geq B_t^G + S_t B_t^{G*} + P_t^G G_t \ , \qquad (38)$$

where B_t^G denotes public domestic assets (debt), $P_t T_t$ corresponds to government nominal (lump-sum) tax revenues, and $P_t^G G_t$ is public spending. For simplicity, we assume that $G_t = 0$.

2.7 Market-clearing conditions

The market-clearing conditions in the factor market are total employment by all firms *j*,

$$N_t = \int_0^1 N_t(j)dj \quad , \tag{39}$$

and imported inputs,

$$I_t = \int_0^1 I_t(j)dj \quad . \tag{40}$$

In the goods market, the market-clearing condition is

$$Y_t^D = (C_t + X_t^D + INV_t)\,, \tag{41}$$

where total supply of domestic goods equals total demand of the domestically produced good for consumption and export.

Finally, the economy-wide budget identity can be expressed as

$$P_t C_t + P_t INV_t \leq P_t^D Y_t^D - S_t P_t^* I_t + S_t \left\{ \Phi\left(\frac{b_{t+1}^{o*}}{GDP_t}, \frac{b_{t+1}^{o*}}{Q_t K_{t+1}}, u_t^{RK} \right) R_t^* \right\}^{-1} B_{t+1}^* - S_t B_t^* + (S_t P_t^{cu} Q\_c)\,, \tag{42}$$

which we can define excluding natural resources as the sum of domestically produced goods minus import inputs[9]:

$$P_t YR_t = P_t^D Y_t^D - S_t P_t^* I_t \quad . \tag{43}$$

3. Econometric Methodology: A VAR Prior from the General Equilibrium Model

We proceed with a discussion of our econometric methodology for measuring the effect of monetary policy on macroeconomic variables in different small open economies. We then describe the construction of the data sets that are used for the empirical work and present our choice of prior distributions for the Bayesian analysis.

3.1. Econometric methodology

To measure monetary policy, we use the strategy proposed by Del Negro et al. (2007). Specifically, our empirical strategy consists of using the model presented in the last section to get the prior information for estimating a vector autoregression (VAR) model. First, we use a Bayesian approach to estimate the DSGE model. We define a prior distribution for the vector of parameters $\boldsymbol{\theta}$ of the DSGE model and then use these priors to get the priors for the VAR model: the vector of parameters $\boldsymbol{\phi}$ and the covariance matrix $\boldsymbol{\Sigma}_u$. These new priors are denoted by $\boldsymbol{\phi}(\theta)$ and $\boldsymbol{\Sigma}_u(\theta)$, but we allow deviations from the restrictions imposed by the DSGE model in order to capture potential misspecification. Thus, the accuracy of the prior is measured by a hyperparameter, λ_{DSGE}. This creates a continuum of models, which Del Negro et al. (2007) term a

[9] We are aware that the GDP with natural resource will be in our model this expression: $GDP_t = P_t^D Y_t^D - S_t P_t^* I_t + (S_t P_t^{cu} Q\_c)$, but we consider that the relevant concept for monetary policy is the definition of equation (36).

DSGE-VAR. They show that when the hyperparameter λ_{DSGE} is close to zero, the model converges to an unrestricted VAR, and when the hyperparameter λ_{DSGE} tends to infinity, the model converges to the DSGE model.

In this approach, the parameter λ_{DSGE} is estimated by achieving the highest marginal density. By construction, this estimation attains a better fit and tends to deliver more reliable impulse responses than the restricted model (that is, the DSGE model). The spirit of this approach is to maintain the sequence of autocovariance associated with the DSGE-VAR as close as possible to the DSGE model without sacrificing the ability of the DSGE-VAR model to match historical data.

We use the DSGE-VAR model as a benchmark for evaluating our dynamic general equilibrium models. Strong deviations of the parameters of the DSGE-VAR from the restrictions imposed by the DSGE indicate problems of misspecification in our DSGE model.

3.2 Description of the data and the method of solution

We use quarterly data from 1994 to 2007. The observed variables are real GDP, real consumption, real private investment, inflation, the nominal interest rate, imports, exports, the real exchange rate, real wages, and commodity prices. Commodity prices are measured in real terms. For Chile and Peru, we use the price of copper; for Colombia, the WTI oil price; for Australia, the commodity price index published by the Reserve Bank of Australia; for New Zealand, the soft commodity price index published by the Reserve Bank of New Zealand. The data sources for Chile, Colombia, and Peru are their respective central banks, with the exception of the real exchange rate index, which is published by JP Morgan, and commodity prices, which are from Bloomberg. In Australia and New Zealand, all the data are from their respective central banks, except for real exchange rates, which are from JP Morgan.

External variables are taken from the FRED database maintained by the Federal Reserve Bank of St. Louis. We use real GDP, the GDP deflator as a measure of inflation, and the U.S. Federal funds interest rate.

Given the observed variables, we need thirteen shocks to estimate the model. In section 2, we explicitly defined five shocks: productivity, monetary, price commodity, risk premium, and foreign demand. We then added eight more shocks: a preference shock in the Euler equation, a markup shock in the Phillips curve, a wage shock, an export shock, an import shock, a foreign inflation shock, an investment shock in the Tobin's Q equation, and a Federal funds shock.

The model was estimated in first differences by following the strategy of Smets and Wouters (2007). The estimates, impulse responses, and variance decomposition were obtained with DYNARE.[10] In our study we followed the econometric methodology proposed by the Del Negro and Schorfheide (2004), but with the improvements proposed by Adjemian et al. (2008) for increasing the efficiency of the calculations through a direct estimation of the parameter λ_{DSGE}.

[10] All this information (code and steady state) is available on request.

4. Priors and Results

The values of the priors (table 1)[11] are in line with the earlier literature and incorporate our beliefs about possible ranges based on the nature and behavior of the variables (see Smets and Wouters, 2002; Laxton and Pesenti, 2003). One of the properties of the Bayesian method is that it gives a voice to the data, supplying information about the fit of the parameters to the data and the economic reality. The values of the parameters used in DSGE models in the different countries fall within the literature's typical ranges. Accordingly, almost the same prior values are used for the countries in the sample, and we let the data inform on the degree of fit of these values to the realities of the sample countries. Nevertheless, because priors should reflect the researcher's beliefs about the parameters, we assume that the parameter μ, the elasticity of the risk premium to the real exchange, is higher ($\mu = 0.5$) for Peru and Colombia than for Australia, New Zealand, and Chile ($\mu = 0$). This captures the fact that the first group of countries could be more financially vulnerable to exchange rate fluctuations due to liability dollarization in these economies. (see, for example, Morón and Winkelried, 2005; Levy-Yeyati, 2006).

The estimated parameters are all related directly to the dynamics of the model (habit persistence, fraction of hand-to-mouth consumers, wage indexation, adjustment cost for investment, etc.). Parameters related to the steady state are calibrated to be consistent with each economy (consumption over GDP, exports over GDP, external debt over GDP, etc.).

[11] All tables are in the appendix.

4.1 Parameters

The estimates of the parameters measuring the impact of monetary policy on the economies are presented in table 3. First, the convergence of the Markov Chain Monte Carlo (MCMC) is satisfactory in most cases; the plots are presented in the figure 9. Second, to study the goodness of fit of our estimations as a whole, we compare the posterior odds between our models and a Bayesian vector autoregression (BVAR) for each country by using the Minnesota prior. This is a standard linear time series model with good fit in data analysis that is also estimated with Bayesian techniques. For instance, many authors show that BVARs produce superior macroeconomic forecasts to univariate autoregressive integrated moving average (ARIMA) models and traditional VAR models. Regarding the latter, BVAR models also solve the curse of dimensionality by reducing the number of parameters estimated (Canova, 2007, p. 380). Therefore, a BVAR model is a natural candidate for comparing the goodness of fit of our empirical estimation strategy. As expected, the results are clear: table 2 shows that for each country, the fit of the DSGE-VAR is always similar to the BVAR model for different lags, but the DSGE presents a lower fit than the BVAR. This is an expected result because the DSGE model is a more restricted version than the DSGE-VAR model.

A first important result is that on average the estimation of σ for all countries is around 2.0 for both models the DSGE and the DSGE-VAR. This means an intertemporal substitution elasticity of 0.5, which confirms that the interest rate has a moderate effect on consumption in small open economies (Agénor and Montiel, 1996).[12]

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[12] The real wage elasticity in the labor supply was calibrated; we chose a value for this parameter of 0.75 (Chetty et al, 2011).

Another parameter that is related to the response of consumption to the interest rate is the habit parameter, γ. Our estimations indicate that the presence of habit is more moderate than in closed economies, on average 10% for the DSGE-VAR and around 37% for the DSGE (Christiano et al., 2005). The share of restricted agents, λ**,** is on average 20% of aggregate consumption in small open economies for both models the DSGE and the DSGE-VAR.

Prices, on average, remain rigid, $1/(1 - \theta_D)$, three (DSGE-VAR) and five quarters (DSGE) after the shock, while wages tend to be rigid $1/(1 - \theta_W)$ for around three quarters (both in the DSGE-VAR and the DSGE model). The level of indexation in prices, δ_D, is on average 40% (both DSGE-VAR and DSGE models) and in wages, δ_W, between 40% (both in the DSGE-VAR and the DSGE model). These values are standard in the empirical literature and indicate that these economies are characterized by some degree of connection in the setting of prices and wages, which produces important real rigidities in the labor market. Furthermore, since all imported goods are production inputs in the model, price rigidity also indicates a low pass-through of the exchange rate to domestic prices.

Another result that is relevant for understanding monetary transmission is the elasticity of differentiated goods exports to the real exchange rate, τ_D. The estimated value of the DSGE-VAR is on average 4.5, but the value for the DSGE is lower and around 3.0. This last export elasticity is closer to the estimations found by Imbs and Méjean (2010), around 2.0 for small open economies, and García and Gonzalez (2013), around 2.0 for the same sample of countries of this article.

This last result, together with the rigidity of prices, indicates that the real exchange rate has significant reallocation effects in these economies (Colacelli, 2008). We find that the inertia of domestic exports, Ω, is on average 0.77 for the DSGE-VAR model (and 0.6 for the DSGE model). This confirms the strong impact of the real exchange rate on the economy in the short run both in the DSGE-VAR model (3.4=0.77*4.5= τ_D*Ω) and the DSGE model (1.8=0.6*3.0= τ_D*Ω). In addition, the inertia of imports of inputs, Ω_M, on average is low and around 0.2 (both in the DSGE-VAR and the DSGE model).

The balance sheet effect may be positive or negative, depending on the structure of the economy. In our model, this effect is captured arbitrarily by incorporating the real exchange rate in the risk premium, $\Phi\left(\frac{b_{t+1}^{o*}}{GDP_t}, \frac{b_{t+1}^{o*}}{Q_t K_{t+1}}, u_t^{RK}\right)$ (see footnote 7). Our first result indicates that the parameter μ is small. This parameter has a value on average of 0.004 in the DSGE model and 0.072 in the DSGE-VAR model. However, the estimation of this parameter in the DSGE-VAR model may be imprecise. Indeed, the second result indicates that the value of this parameter is lower in the case of Australia, New Zealand, and Chile than in the cases of Colombia and Peru in the DSGE model, as expected. However, in the DSGE-VAR model, the value of this parameter is slightly higher in first group countries. This result is contradictory since these countries are supposed to be more financially robust to change in the real exchange rate (García et al, 2011). Thus, besides these small differences, our evidence indicates that the balance sheet effect is quite small in this particular sample of countries.

Another important theoretical relationship to be tested is the uncovered interest parity condition. Our results indicate that this parity does not hold in any of the countries, as expected. The persistence of the real exchange rate, Ω_Q, is on average 0.65 for the DSGE model and 0.5 for the DSGE-VAR according to our estimations. This result is similar to the value obtained by Adolfson et al. (2008) in a DSGE model estimated with Bayesian techniques for the case of Sweden.

On the Taylor rule, we find that the parameter for persistence, Ω_R, is on average 0.77 (both in the DSGE-VAR and the DSGE model), while inflation, ϕ_Π, is around 2.0 and output, ϕ_Y, is around 0.5 (Woodford, 2003). These results are very similar to those found for the Taylor rule in other economies.

The fundamental difference is that central banks in these small open economies also respond moderately to the level of the real exchange rate, ζ^1_e, and to its volatility ζ^2_e. We test this hypothesis directly by comparing two models, one in which includes the real exchange rate and another in which it does not (table 2)[13]. Thus, following the criterion of Kass and Raftery (1995) for choosing between two models using bayes factors, we have strong evidence that Colombia and Peru respond to movements in the exchange rate in the DSGE and DSGE-VAR model. In the case of Australia is only positive. But we have contradictory evidence for Chile, depending if we use the DSGE or the DSGE-VAR model, this country could not respond to changes in the real exchange rate. Only in the case of New Zealand, we have strong evidence that this country does

[13] To interpret the Bayes factor in comparing two models, we follow to Kass and Raftery (1995). So, if M1 is the model with the largest marginal likelihood, then there is positive evidence against model M0 if $2*\ln(Bayes\ factor\ between\ M1\ and\ M0)$ is large than six, strong evidence if this expression is larger than six, and definitive if it is larger than ten (page 789). This value is arbitrary in the same sense as a significance level of α = 0.05 is arbitrary in classical statistics, but, just like this value of α, these categories seem to give an appropriate rule.

not respond to movements of the real exchange rate. If we combine the parameters of both models, i.e., the DSGE and the DSGE-VAR, ζ^1_e is on average 0.1 for the group of Australia, Chile, and Colombia, and ζ^2_e is 0.3 for the case of Colombia.

4.2 Variance decomposition

One result that emerges from the decomposition of variance *n* periods ahead (see figure 1[14]**)** is that in addition to the standard shocks studied in closed economies, we need to consider the risk premium shock to explain macroeconomic variables in small open economies. This largely explains the variability of the real exchange rate, in conjunction with the external interest rate. This first shock also explains the GDP fluctuations, the real interest rate, and the variability of inflation. By far, it appears to be the most significant external shock. In contrast, the commodity price shock is only relevant for explaining the volatility of GDP. The external GDP shock and the external inflation shock do not appear to be relevant in the period considered.

Other shocks that are used in the literature to explain the fluctuations are also significant in our results. Preference shocks are important in explaining fluctuations in GDP; mark-up shocks explain the variability of inflation and interest rates; and productivity shocks are significant to explain GDP fluctuations. In contrast, monetary shocks are present in all the variables, but their relevance is small. This does not mean that monetary policy is ineffective; on the contrary, it could work through the response to all other shocks to stabilize the economy.

[14] All figures can be found in the appendix.

4.3 Impulse responses

As we explained above, impulse responses are used to evaluate potential identification problems in DSGE models. The discrepancies between the impulse responses of the DSGE-VAR and DSGE models allow us to detect problems for the identification of shocks in the DSGE model. Thus, if the variable's responses in the DSGE model are outside the confidence bands for the estimated DSGE-VAR, then we have an identification problem in the DSGE. This is crucial because identification problems invalidate the economic analysis (Del Negro and Schorfheide, 2004). According to figures 2–8, the impulse responses from the DSGE are generally very similar to those from the DSGE-VAR, and they are inside the confidence bands. We therefore find that the DSGE model does not present important problems of misspecification in any of the shocks.

The monetary shock produces results in line with the discussion in the literature (figure 2). After a monetary shock, output decreases sharply, and the real exchange rate appreciates in both the DSGE and the DSGE-VAR. The two models present an important discrepancy, however, in explaining the dynamics of the inflation rate. In the DSGE-VAR, the inflation rate returns to its steady-sate level more slowly than in the DSGE, with a hump-shaped response of the inflation rate Australia, Colombia, and Peru.

Also in line with other studies (Galí and Rabanal, 2004), the monetary policy response to a positive productivity shock is a reduction in the monetary policy interest rate (figure 3). This occurs through a strong deflationary effect on the price level and a sharp appreciation of the real exchange rate (both the DSGE and DSGE-VAR model). This happens even though the increase in output growth tends to generate a positive output gap and hence inflationary pressures on the demand side.

In the case of a consumer preference shock (figure 4), we observe a strong increase in consumption and output growth, followed by a minor increase in prices (DSGE-VAR model). This is the result of an important increase in the monetary policy rate that stops inflationary pressures and also causes an appreciation of the real exchange rate in the DSGE-VAR. By contrast, the DSGE model the effects are weaker; so the figure does not show the appreciation of the real exchange rate.

In the case of a mark-up shock on inflation and wages (figures 5 and 6), we find a negative effect on output growth and a positive effect on prices, especially for the mark-up shock on inflation in both models. As expected, the central bank reacts by raising the interest rate, but the real exchange rate does not record a strong response. Our results indicate that the inflation rate reacts the same for both kinds of shocks. With these shocks, the central banks of emerging economies face the same standard trade-off between inflation and growth as in closed economies: if they want to control inflation, they have to reduce output.

The external shocks were significant in the analysis (see section 4.3). In particular, a price commodity shock increases output growth in some countries (figure 7) in both models. The effect of this shock on inflation is small, but tends to appreciate the real exchange rate. The monetary policy response to this shock is a small reduction in the interest rate due to the exchange rate appreciation. Interestingly, the central banks do not respond in the standard way, that is, by increasing the interest rate when output goes up. Instead, they prefer to avoid further appreciation of the exchange rate through smaller reductions in the policy rate.

Central banks make a stronger attempt to smooth the real exchange rate fluctuations in the case of a risk premium shock (figure 8). The monetary policy response to this shock is a sharp increase in the monetary policy interest rate, because this shock generates a strong increase in the real exchange rate, which stimulates exports and growth and increases inflation. In this scenario, increasing the interest rate is not contradictory with the goals of reducing inflation and stabilizing growth and the real exchange rate, as in the case of a mark-up shock.

Finally, in the literature on business cycles in emerging economies, some authors find a countercyclical behavior between output and risk premium (Uribe and Yue, 2006; Neumeyer and Perri, 2005)[15]. Our results are clearly different: after a risk premium shock, the increase in output and inflation causes a strong increase in the interest rate, which produces a sharp reduction in output some quarters after of the shock (figure 8). In other words, the economy only begins to contract after the central bank reacts by raising the interest rate to reduce inflation. Our model confirms the traditional effect of the Mundell-Fleming model: given sticky good prices and a rapidly clearing asset market, the devaluation of the domestic currency is an essential element in the adjustment mechanism following a negative external shock.

In addition, we recall that we have considered in our model two additional effects that are very popular in the traditional open macroeconomics literature for explaining the impact of a real depreciation: the so-called balance sheet effect, in which a real depreciation may be contractionary due to the presence of foreign currency debt (Krugman, 1999; Aghion et al., 2004; Céspedes et al., 2004), and the *J* curve effect, in which a real depreciation may be contractionary

[15] Studies that report a GDP contraction is in the first period all include working capital in the model. Thus, more expensive working capital should have a negative effect on output.

because of imported inputs (Bahmani-Oskooee and Ratha, 2004). In both cases, a real depreciation increases production costs, including financial costs, by causing an initial contraction in GDP. Nevertheless, our evidence indicates that neither effect is stronger than the Mundell-Fleming effect found in our estimations.

To explain this positive impact on GDP in our model to the risk premium shock are crucial two parameters: the elasticity of the risk premium to external debt, μ, and the velocity of the real exchange rate's impact on foreign demand for exports, τ_D. In our estimation, the first parameter is low, instead the second parameter is high as expected. Therefore, a depreciation of the real exchange rate, as we explain in figure 8, is expansive because the exports react stronger than other factors such as the balance sheet effect and *J* curve effect.

5. Conclusion

In this paper, we have used a DSGE model with Bayesian estimation techniques to study monetary policy responses in a representative group of typical small open economies—that is, countries that target inflation, are commodity exporters, and are open to international financial markets. Our results show in these economies, monetary policy responds to productivity shocks, demand shocks, and mark-up shocks in a very similar way to monetary policy in closed economies.

Nevertheless, our results also indicate that these small open economies face more challenges than closed economies in terms of policy design and implementation. For instance, we find that the risk premium shock could explain most of the variability of the real exchange rate. This has important implications on the decision of whether or not to intervene in the exchange rate market, because our results also indicate that the real exchange rate causes significant reallocation of resources across sectors in the short run. In fact, we have strong evidence that only in one of the five countries analyzed in this study does not intervene the real exchange rate, the case of New Zealand.

The paper further shows that monetary policy works actively through its response to the other shocks. In the case of a positive risk premium shock, the response is a sharp increase in the interest rate. This happens because the shock increases the real exchange rate, which stimulates exports and growth and thus increases the inflation rate, as well. In this scenario, there is no trade-off for the central bank between inflation and output, because both variables are increasing simultaneously. Therefore, in practice central banks could respond quickly to this volatility by increasing the interest rate in order to stabilize both variables.

The expansionary impact of a risk premium shock on the economy is consistent with the old Mundell-Fleming model prediction: a real depreciation increases GDP, so risk premium shocks are procyclical. This result contradicts some important studies in the field of international macroeconomic. However, our model considers both financial and real channels to explain the effects of the exchange rate on the economy, and our findings do not support the evidence in favor of the balance sheet effect, the *J* curve effect, or the introduction of working capital into RBC models. All of these studies find a countercyclical relationship between GDP and a real depreciation. The parameters estimated in our model would have had to take values far away from plausible priors in order to find countercyclical behavior, especially for the reaction of foreign demand for domestic intermediate products to the real exchange rate.

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7. Appendix

Tables

Table 1. Prior Distribution for Small Open Economies

Parameters	Distribution	Prior	
		mean	s.e.
η_I	gamm	1.04	0.50
Ω_N	beta	0.37	0.10
σ	gamm	2.00	0.10
Ω_M	gamm	0.25	0.05
τ_D	gamm	5.00	0.75
Ω	beta	0.20	0.05
γ	beta	0.10	0.05
λ	gamm	0.35	0.05
Ω_R	beta	0.50	0.05
φ_Π	gamm	2.00	0.10
φ_Y	gamm	0.50	0.10
$\zeta^1{}_e$	gamm	0.25	0.10
$\zeta^2{}_e$	gamm	0.25	0.10
$\mu(*)$	unif	0.00	0.50
Ω_D	beta	0.60	0.10
θ_D	beta	0.65	0.05
δ_D	beta	0.45	0.05
θ_W	beta	0.65	0.05
δw	beta	0.45	0.05
$\rho_{\text{Y foreing output}}$	beta	0.50	0.10
$\rho_{\text{P foreing inflation}}$	beta	0.50	0.10
$\rho_{\text{R foreing interest ra}}$	beta	0.50	0.10
$\rho_{\text{A productivity}}$	beta	0.50	0.10
$\rho_{\text{PC price commodit}}$	beta	0.50	0.10
$\rho_{\text{Z2 preference}}$	beta	0.50	0.10
$\rho_{\text{Z3 mark-up prices}}$	beta	0.50	0.10
$\rho_{\text{Z4 risk premium}}$	beta	0.50	0.10
$\rho_{\text{Z5 mark-up wages}}$	beta	0.50	0.10
ρ_{MA1}	beta	0.50	0.10
ρ_{MA2}	beta	0.50	0.10
ρ_{MA3}	beta	0.50	0.10
ρ_{MA4}	beta	0.50	0.10
TREND_M	normal	0.80	0.10
CONST_I	gamm	0.93	0.50
CONST_R	gamm	1.45	0.70
CTREND	normal	0.40	0.10
CONSTEPINF	gamm	0.63	0.10
CONSTER	gamm	1.45	1.00
λ_{DSGE}	unif	3.00	2.00
$\sigma_{\text{M interest rate}}$	invg	0.50	0.60
$\sigma_{\text{Y foreing output}}$	invg	2.00	2.00
$\sigma_{\text{P foreing inflation}}$	invg	2.00	2.00
$\sigma_{\text{R foreing interest ra}}$	invg	2.00	2.00
$\sigma_{\text{A productivity}}$	invg	2.00	2.00
$\sigma_{\text{PC price commodit}}$	invg	8.00	4.00
$\sigma_{\text{X import}}$	invg	2.00	2.00
$\sigma_{\text{X export}}$	invg	2.00	2.00
$\sigma_{\text{Z2 preference}}$	invg	2.00	2.00
$\sigma_{\text{Z3 mark-up prices}}$	invg	2.00	2.00
$\sigma_{\text{Z4 risk premium}}$	invg	2.00	2.00
$\sigma_{\text{Z5 mark-up wages}}$	invg	2.00	2.00

Table 2. Posterior Odds for Alternative Models

		Australia	New Zealand	Chile	Colombia	Peru
DSGE	$\zeta 1e > 0$, $\zeta 2e > 0$	-1256.8	-1374.8	-1322.6	-1514.2	-1343.1
	$\zeta 1e = 0$, $\zeta 2e > 0$	-1023.9	-1262.3	-1409.3	-1578.5	**-1296.4**
	$\zeta 1e > 0$, $\zeta 2e = 0$	**-1018.3**	-1216.4	-1421.2	**-1503.5**	-1310.7
	$\zeta 1e = \zeta 2e = 0$	-1332.1	**-1123.3**	**-1277.5**	-1607.0	-1373.6
DSGE-VAR	$\zeta 1e > 0$, $\zeta 2e > 0$	-864.0	-969.1	-942.3	-1218.3	-1125.9
	$\zeta 1e = 0$, $\zeta 2e > 0$	-847.7	-961.2	-943.0	-1213.7	**-1121.2**
	$\zeta 1e > 0$, $\zeta 2e = 0$	-862.4	-983.7	-938.3	**-1211.6**	-1123.0
	$\zeta 1e = \zeta 2e = 0$	**-844.9**	**-956.2**	-937.7	-1211.7	-1162.5
BVAR	$\tau = 1$	-860.5	-992.0	-926.5	-1267.5	-1143.0
	$\tau = 2$	-894.0	-1016.2	-1003.9	-1289.5	-1209.5
	$\tau = 3$	-874.8	-1004.5	-971.7	-1244.0	-1175.5
	$\tau = 4$	-862.5	-987.6	-969.3	-1220.8	-1180.2

Table 3. Posterior Distribution for Small Open Economies

Parameters	Australia											
	DSGE											
	ζ1e > 0 , ζ2e > 0			ζ1e = 0 , ζ2e > 0			ζ1e > 0 , ζ2e = 0			ζ1e =ζ2e = 0		
	mean	5%	95%	mean	5%	95%	mean	5%	95%	mean	5%	95%
η_I	1.331	1.190	1.480	1.162	0.714	1.547	0.709	0.404	1.027	0.349	0.303	0.396
Ω_N	0.315	0.282	0.342	0.534	0.470	0.592	0.299	0.256	0.349	0.197	0.168	0.222
σ	2.345	2.303	2.379	1.793	1.716	1.852	1.885	1.827	1.944	2.299	2.268	2.321
Ω_M	0.291	0.270	0.312	0.217	0.175	0.261	0.230	0.196	0.275	0.305	0.277	0.326
τ_D	2.835	2.713	2.952	2.669	2.459	2.901	2.696	2.468	2.942	3.536	3.331	3.756
Ω	0.745	0.724	0.763	0.844	0.804	0.882	0.857	0.830	0.888	0.915	0.895	0.937
γ	0.327	0.299	0.353	0.377	0.335	0.420	0.510	0.444	0.570	0.111	0.096	0.126
λ	0.242	0.227	0.258	0.192	0.149	0.234	0.153	0.110	0.192	0.315	0.303	0.329
Ω_R	0.656	0.641	0.670	0.897	0.876	0.920	0.890	0.871	0.907	0.783	0.769	0.799
φ_Π	1.953	1.927	1.989	1.878	1.812	1.942	1.921	1.861	2.007	2.210	2.190	2.226
φ_Y	0.634	0.590	0.671	0.636	0.577	0.691	0.620	0.514	0.726	0.485	0.469	0.499
ζ^1_e	0.360	0.336	0.386	0.000	0.000	0.000	0.054	0.027	0.082	0.000	0.000	0.000
ζ^2_e	0.005	0.000	0.012	0.014	0.000	0.029	0.000	0.000	0.000	0.000	0.000	0.000
μ(*)	0.002	0.002	0.003	0.013	0.006	0.020	0.012	0.005	0.018	-0.001	-0.001	-0.001
Ω_Q	0.644	0.617	0.689	0.519	0.472	0.562	0.539	0.499	0.581	0.651	0.626	0.667
θ_D	0.696	0.678	0.726	0.728	0.695	0.757	0.750	0.702	0.794	0.699	0.689	0.707
δ_D	0.452	0.442	0.460	0.447	0.405	0.491	0.289	0.248	0.338	0.259	0.251	0.269
θ_W	0.543	0.527	0.560	0.669	0.612	0.725	0.644	0.619	0.669	0.627	0.607	0.645
δw	0.442	0.435	0.449	0.365	0.330	0.409	0.446	0.394	0.498	0.407	0.398	0.417
$\rho_{Y\ foreing\ output}$	0.822	0.798	0.842	0.853	0.810	0.899	0.842	0.791	0.895	0.601	0.558	0.658
$\rho_{P\ foreing\ inflation}$	0.799	0.781	0.819	0.673	0.605	0.736	0.650	0.568	0.738	0.345	0.301	0.383
$\rho_{R\ foreing\ interest\ rate}$	0.782	0.763	0.803	0.822	0.784	0.866	0.800	0.748	0.843	0.351	0.328	0.372
$\rho_{A\ productivity}$	0.546	0.521	0.570	0.523	0.459	0.587	0.553	0.491	0.618	0.302	0.269	0.329
$\rho_{PC\ price\ commodity}$	0.527	0.506	0.555	0.844	0.803	0.889	0.875	0.825	0.924	0.632	0.605	0.656
$\rho_{Z2\ preference}$	0.442	0.421	0.465	0.565	0.508	0.615	0.465	0.430	0.502	0.548	0.539	0.556
$\rho_{Z3\ mark\text{-}up\ prices}$	0.890	0.867	0.923	0.696	0.650	0.740	0.689	0.635	0.761	0.764	0.731	0.789
$\rho_{Z4\ risk\ premium}$	0.317	0.310	0.326	0.570	0.514	0.626	0.555	0.485	0.618	0.525	0.474	0.575
$\rho_{Z5\ mark\text{-}up\ wages}$	0.272	0.249	0.297	0.412	0.327	0.493	0.463	0.409	0.520	0.404	0.361	0.435
$\rho_{K\ invesment}$	0.674	0.640	0.709	0.762	0.674	0.828	0.794	0.752	0.839	0.466	0.415	0.502
ρ_{MA1}	0.367	0.329	0.400	0.431	0.370	0.482	0.348	0.296	0.405	0.407	0.377	0.438
ρ_{MA2}	0.606	0.559	0.644	0.671	0.579	0.760	0.651	0.601	0.705	0.429	0.414	0.444
ρ_{MA3}	0.253	0.217	0.293	0.341	0.279	0.417	0.395	0.242	0.562	0.656	0.631	0.673
ρ_{MA4}	0.679	0.628	0.731	0.458	0.374	0.554	0.491	0.397	0.561	0.417	0.367	0.464
TREND_M	0.747	0.696	0.794	0.483	0.420	0.535	0.495	0.451	0.538	0.863	0.842	0.887
CONST_I	0.653	0.629	0.676	0.712	0.691	0.733	0.723	0.706	0.744	0.627	0.610	0.649
CONST_R	1.424	1.055	1.785	1.323	0.938	1.751	1.330	0.892	1.815	2.256	2.088	2.365
CTREND	0.135	0.114	0.157	0.248	0.203	0.294	0.234	0.178	0.277	0.493	0.455	0.530
CONSTEPINF	0.534	0.518	0.554	0.536	0.517	0.555	0.536	0.516	0.555	0.542	0.530	0.554
CONSTER	0.696	0.522	0.905	0.666	0.377	0.940	0.719	0.419	1.023	0.802	0.688	0.930
λ_{DSGE}	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\sigma_{M\ interest\ rate}$	0.883	0.745	1.031	0.139	0.113	0.167	0.148	0.121	0.177	0.377	0.303	0.443
$\sigma_{Y\ foreing\ output}$	0.909	0.760	1.051	0.847	0.700	0.979	0.860	0.718	1.029	2.303	1.695	2.778
$\sigma_{P\ foreing\ inflation}$	0.462	0.392	0.532	0.509	0.426	0.588	0.518	0.437	0.596	0.719	0.589	0.849
$\sigma_{R\ foreing\ interest\ rate}$	0.274	0.235	0.306	0.273	0.235	0.309	0.274	0.235	0.305	0.429	0.355	0.505
$\sigma_{A\ productivity}$	2.632	2.103	3.125	1.552	1.270	1.821	1.906	1.564	2.203	2.391	2.040	2.726
$\sigma_{PC\ price\ commodity}$	7.861	7.059	8.588	5.240	4.374	6.184	4.905	4.137	5.638	7.312	6.906	7.727
$\sigma_{Z2\ preference}$	0.693	0.555	0.840	0.402	0.326	0.477	0.408	0.322	0.489	0.746	0.628	0.875
$\sigma_{Z3\ mark\text{-}up\ prices}$	0.554	0.430	0.667	0.416	0.320	0.509	0.409	0.313	0.500	0.711	0.561	0.865
$\sigma_{Z4\ risk\ premium}$	3.023	2.656	3.416	2.284	1.759	2.782	2.117	1.695	2.530	2.534	2.077	3.144
$\sigma_{Z5\ mark\text{-}up\ wages}$	0.789	0.658	0.918	0.503	0.422	0.589	0.492	0.412	0.576	0.589	0.493	0.690
$\sigma_{K\ investment}$	1.091	0.886	1.270	0.972	0.706	1.234	1.408	0.815	2.070	6.949	6.054	7.860

Table 3. Posterior Distribution for Small Open Economies (Continued)

Parameters	Australia											
	DSGE-VAR											
	ζ1e > 0 , ζ2e > 0			ζ1e = 0 , ζ2e > 0			ζ1e > 0 , ζ2e = 0			ζ1e =ζ2e = 0		
	mean	5%	95%	mean	5%	95%	mean	5%	95%	mean	5%	95%
η_I	1.250	0.904	1.599	1.508	1.077	1.970	1.412	1.082	1.785	1.502	1.012	1.991
Ω_N	0.567	0.457	0.646	0.561	0.490	0.629	0.571	0.490	0.652	0.512	0.416	0.593
σ	1.886	1.747	2.017	1.967	1.869	2.090	2.125	2.060	2.210	2.016	1.936	2.098
Ω_M	0.253	0.200	0.299	0.216	0.181	0.251	0.276	0.236	0.303	0.235	0.203	0.264
τ_D	4.846	3.824	5.856	4.260	3.666	4.792	3.868	3.169	4.586	4.207	3.433	4.842
Ω	0.689	0.615	0.760	0.666	0.599	0.726	0.602	0.500	0.697	0.691	0.633	0.753
γ	0.061	0.006	0.105	0.059	0.002	0.106	0.122	0.020	0.251	0.079	0.001	0.150
λ	0.216	0.142	0.291	0.201	0.129	0.270	0.176	0.118	0.238	0.176	0.112	0.238
Ω_R	0.875	0.843	0.908	0.861	0.826	0.898	0.884	0.852	0.915	0.883	0.855	0.914
φ_Π	1.926	1.867	2.000	1.836	1.679	2.026	1.895	1.792	2.000	1.942	1.839	2.033
φ_Y	0.561	0.485	0.631	0.574	0.484	0.686	0.558	0.485	0.638	0.549	0.453	0.661
ζ^1_e	0.091	0.036	0.140	0.000	0.000	0.000	0.089	0.039	0.139	0.000	0.000	0.000
ζ^2_e	0.021	0.000	0.048	0.048	0.000	0.096	0.000	0.000	0.000	0.000	0.000	0.000
μ(*)	0.065	0.034	0.087	0.081	0.074	0.087	0.077	0.064	0.087	0.080	0.072	0.087
Ω_Q	0.424	0.334	0.521	0.599	0.493	0.699	0.498	0.364	0.622	0.586	0.472	0.690
θ_D	0.697	0.638	0.758	0.679	0.638	0.721	0.668	0.629	0.701	0.726	0.671	0.774
δ_D	0.296	0.265	0.333	0.354	0.312	0.401	0.383	0.341	0.430	0.358	0.277	0.424
θ_W	0.633	0.579	0.685	0.564	0.517	0.612	0.640	0.613	0.667	0.635	0.605	0.662
δw	0.397	0.358	0.440	0.423	0.365	0.470	0.426	0.393	0.464	0.409	0.352	0.462
$\rho_{Y\text{ foreing output}}$	0.474	0.331	0.631	0.484	0.335	0.610	0.418	0.287	0.553	0.572	0.495	0.642
$\rho_{P\text{ foreing inflation}}$	0.561	0.435	0.699	0.590	0.509	0.693	0.641	0.547	0.748	0.567	0.479	0.671
$\rho_{R\text{ foreing interest rate}}$	0.687	0.510	0.834	0.660	0.567	0.763	0.658	0.552	0.770	0.686	0.597	0.780
$\rho_{A\text{ productivity}}$	0.337	0.249	0.426	0.343	0.267	0.419	0.310	0.201	0.415	0.376	0.288	0.448
$\rho_{PC\text{ price commodity}}$	0.514	0.429	0.590	0.497	0.397	0.578	0.568	0.453	0.657	0.497	0.406	0.611
$\rho_{Z2\text{ preference}}$	0.367	0.300	0.438	0.397	0.320	0.468	0.358	0.264	0.447	0.403	0.340	0.474
$\rho_{Z3\text{ mark-up prices}}$	0.354	0.269	0.430	0.372	0.297	0.445	0.466	0.402	0.539	0.305	0.230	0.392
$\rho_{Z4\text{ risk premium}}$	0.538	0.458	0.629	0.555	0.457	0.652	0.460	0.332	0.587	0.508	0.418	0.611
$\rho_{Z5\text{ mark-up wages}}$	0.372	0.298	0.469	0.511	0.406	0.599	0.590	0.511	0.659	0.493	0.374	0.629
$\rho_{K\text{ invesment}}$	0.462	0.383	0.546	0.506	0.412	0.612	0.545	0.456	0.633	0.442	0.367	0.510
ρ_{MA1}	0.477	0.374	0.582	0.328	0.223	0.416	0.435	0.332	0.525	0.348	0.242	0.453
ρ_{MA2}	0.459	0.360	0.572	0.522	0.374	0.661	0.500	0.390	0.602	0.469	0.385	0.553
ρ_{MA3}	0.424	0.281	0.560	0.235	0.155	0.316	0.334	0.191	0.506	0.258	0.155	0.382
ρ_{MA4}	0.490	0.418	0.565	0.594	0.515	0.671	0.587	0.463	0.704	0.526	0.406	0.637
TREND_M	0.830	0.745	0.925	0.599	0.509	0.688	0.668	0.584	0.767	0.637	0.528	0.733
CONST_I	0.635	0.445	0.828	0.631	0.456	0.812	0.616	0.433	0.809	0.605	0.444	0.771
CONST_R	1.277	1.023	1.588	1.316	1.117	1.510	1.295	1.022	1.558	1.407	1.182	1.614
CTREND	0.426	0.334	0.508	0.377	0.287	0.500	0.439	0.344	0.539	0.367	0.276	0.455
CONSTEPINF	0.593	0.481	0.702	0.552	0.492	0.614	0.567	0.513	0.627	0.607	0.524	0.678
CONSTER	1.304	0.866	1.759	1.148	0.769	1.527	1.158	0.778	1.551	1.186	0.827	1.581
λ_{DSGE}	0.856	0.700	1.035	0.931	0.714	1.126	0.887	0.694	1.064	0.989	0.748	1.247
$\sigma_{M\text{ interest rate}}$	0.095	0.075	0.115	0.095	0.077	0.114	0.096	0.078	0.116	0.092	0.072	0.110
$\sigma_{Y\text{ foreing output}}$	0.498	0.393	0.603	0.504	0.400	0.605	0.496	0.386	0.592	0.511	0.411	0.606
$\sigma_{P\text{ foreing inflation}}$	0.352	0.279	0.418	0.361	0.292	0.430	0.354	0.294	0.413	0.362	0.293	0.427
$\sigma_{R\text{ foreing interest rate}}$	0.265	0.235	0.291	0.266	0.235	0.297	0.264	0.235	0.291	0.266	0.235	0.296
$\sigma_{A\text{ productivity}}$	0.865	0.634	1.100	0.915	0.675	1.145	0.880	0.639	1.097	1.060	0.718	1.343
$\sigma_{PC\text{ price commodity}}$	2.923	2.243	3.501	2.782	2.190	3.370	2.824	2.249	3.387	2.923	2.297	3.623
$\sigma_{Z2\text{ preference}}$	0.408	0.328	0.491	0.387	0.308	0.457	0.387	0.307	0.469	0.379	0.308	0.449
$\sigma_{Z3\text{ mark-up prices}}$	0.372	0.286	0.453	0.381	0.300	0.458	0.380	0.302	0.455	0.360	0.285	0.431
$\sigma_{Z4\text{ risk premium}}$	1.746	1.152	2.373	1.727	1.094	2.343	1.727	1.139	2.296	1.812	1.196	2.399
$\sigma_{Z5\text{ mark-up wages}}$	0.419	0.335	0.499	0.424	0.349	0.505	0.417	0.336	0.506	0.405	0.332	0.473
$\sigma_{K\text{ investment}}$	1.015	0.670	1.336	0.822	0.539	1.088	0.803	0.565	1.051	0.932	0.604	1.265

Table 3. Posterior Distribution for Small Open Economies (Continued)

Parameters	New Zealand											
	DSGE											
	ζ1e > 0 , ζ2e > 0			ζ1e = 0 , ζ2e > 0			ζ1e > 0 , ζ2e = 0			ζ1e =ζ2e = 0		
	mean	5%	95%	mean	5%	95%	mean	5%	95%	mean	5%	95%
η_I	1.420	1.128	1.579	1.103	0.914	1.288	1.068	0.953	1.166	0.457	0.238	0.652
Ω_N	0.450	0.417	0.484	0.188	0.155	0.226	0.436	0.391	0.474	0.453	0.400	0.521
σ	2.039	2.017	2.060	2.148	2.126	2.169	2.115	2.095	2.139	2.127	2.067	2.187
Ω_M	0.259	0.241	0.276	0.227	0.211	0.240	0.236	0.222	0.251	0.225	0.198	0.251
τ_D	4.976	4.833	5.185	2.235	2.082	2.384	1.778	1.605	1.939	1.803	1.621	1.980
Ω	0.971	0.966	0.975	0.696	0.664	0.723	0.774	0.749	0.807	0.809	0.781	0.841
γ	0.117	0.103	0.126	0.443	0.421	0.463	0.488	0.440	0.538	0.069	0.014	0.108
λ	0.336	0.319	0.361	0.209	0.170	0.240	0.291	0.262	0.319	0.221	0.169	0.273
Ω_R	0.689	0.680	0.698	0.745	0.736	0.757	0.846	0.819	0.876	0.822	0.799	0.844
φ_Π	2.183	2.152	2.216	1.859	1.830	1.896	1.936	1.906	1.970	1.813	1.750	1.895
φ_Y	0.579	0.562	0.597	0.455	0.419	0.483	0.394	0.354	0.423	0.539	0.452	0.629
ζ^1_e	0.233	0.215	0.251	0.000	0.000	0.000	0.144	0.117	0.164	0.000	0.000	0.000
ζ^2_e	0.007	0.000	0.014	0.018	0.000	0.039	0.000	0.000	0.000	0.000	0.000	0.000
μ(*)	-0.001	-0.001	-0.001	0.011	0.005	0.018	-0.001	-0.001	0.000	0.001	-0.001	0.003
Ω_Q	0.546	0.530	0.560	0.584	0.556	0.629	0.423	0.376	0.479	0.454	0.389	0.519
θ_D	0.810	0.795	0.821	0.725	0.707	0.749	0.734	0.713	0.758	0.804	0.783	0.824
δ_D	0.332	0.320	0.342	0.316	0.287	0.339	0.338	0.321	0.360	0.388	0.342	0.438
θ_W	0.509	0.503	0.517	0.680	0.646	0.711	0.612	0.586	0.645	0.711	0.665	0.753
δw	0.444	0.442	0.448	0.325	0.306	0.351	0.489	0.470	0.515	0.453	0.429	0.474
$\rho_{\text{Y foreing output}}$	0.772	0.755	0.787	0.549	0.513	0.612	0.617	0.581	0.666	0.838	0.785	0.894
$\rho_{\text{P foreing inflation}}$	0.890	0.875	0.899	0.734	0.688	0.783	0.707	0.653	0.749	0.764	0.704	0.813
$\rho_{\text{R foreing interest rate}}$	0.409	0.377	0.436	0.618	0.596	0.644	0.855	0.815	0.883	0.797	0.753	0.861
$\rho_{\text{A productivity}}$	0.570	0.558	0.584	0.410	0.358	0.461	0.602	0.566	0.640	0.460	0.383	0.539
$\rho_{\text{PC price commodity}}$	0.681	0.651	0.705	0.497	0.454	0.544	0.419	0.402	0.433	0.561	0.496	0.631
$\rho_{\text{Z2 preference}}$	0.590	0.567	0.612	0.622	0.601	0.641	0.585	0.562	0.613	0.703	0.667	0.735
$\rho_{\text{Z3 mark-up prices}}$	0.498	0.470	0.517	0.772	0.756	0.791	0.576	0.534	0.619	0.445	0.384	0.498
$\rho_{\text{Z4 risk premium}}$	0.620	0.611	0.631	0.548	0.509	0.586	0.475	0.425	0.514	0.670	0.619	0.715
$\rho_{\text{Z5 mark-up wages}}$	0.380	0.371	0.392	0.515	0.463	0.566	0.593	0.560	0.628	0.219	0.156	0.265
$\rho_{\text{K invesment}}$	0.477	0.442	0.509	0.463	0.431	0.485	0.653	0.625	0.680	0.789	0.729	0.852
ρ_{MA1}	0.532	0.517	0.544	0.594	0.490	0.714	0.471	0.427	0.515	0.293	0.245	0.339
ρ_{MA2}	0.612	0.595	0.630	0.398	0.368	0.426	0.697	0.664	0.720	0.498	0.437	0.555
ρ_{MA3}	0.676	0.646	0.711	0.561	0.538	0.593	0.670	0.632	0.702	0.310	0.268	0.362
ρ_{MA4}	0.297	0.284	0.309	0.248	0.210	0.278	0.456	0.428	0.476	0.365	0.297	0.411
TREND_M	0.644	0.619	0.671	0.478	0.446	0.507	0.281	0.239	0.331	0.247	0.213	0.283
CONST_I	0.548	0.531	0.568	0.578	0.557	0.601	0.625	0.605	0.646	0.632	0.614	0.649
CONST_R	0.542	0.398	0.663	1.136	0.712	1.388	0.709	0.519	0.990	1.270	0.944	1.597
CTREND	0.271	0.258	0.286	0.226	0.193	0.249	0.230	0.189	0.263	0.227	0.186	0.269
CONSTEPINF	0.601	0.578	0.624	0.530	0.509	0.549	0.533	0.517	0.548	0.525	0.503	0.545
CONSTER	0.719	0.572	0.855	0.773	0.600	0.950	0.554	0.364	0.752	0.750	0.477	1.064
λ_{DSGE}	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\sigma_{\text{M interest rate}}$	0.590	0.490	0.700	0.345	0.287	0.401	0.289	0.239	0.334	0.227	0.187	0.265
$\sigma_{\text{Y foreing output}}$	0.952	0.802	1.092	1.336	1.121	1.575	1.212	1.023	1.419	0.851	0.710	0.982
$\sigma_{\text{P foreing inflation}}$	0.518	0.429	0.613	0.496	0.416	0.572	0.503	0.420	0.583	0.480	0.406	0.553
$\sigma_{\text{R foreing interest rate}}$	0.390	0.332	0.449	0.318	0.265	0.367	0.268	0.235	0.298	0.276	0.238	0.310
$\sigma_{\text{A productivity}}$	6.015	5.224	6.798	3.349	2.797	3.778	2.508	2.131	2.920	2.511	2.095	2.923
$\sigma_{\text{PC price commodity}}$	6.313	5.803	6.752	5.888	5.243	6.472	6.525	5.928	7.139	5.698	4.996	6.375
$\sigma_{\text{Z2 preference}}$	0.729	0.589	0.863	0.492	0.418	0.574	0.584	0.469	0.691	0.570	0.459	0.680
$\sigma_{\text{Z3 mark-up prices}}$	0.385	0.307	0.459	0.498	0.380	0.617	0.457	0.379	0.533	0.386	0.308	0.454
$\sigma_{\text{Z4 risk premium}}$	2.666	2.348	2.901	2.065	1.730	2.390	1.742	1.406	2.025	1.247	0.976	1.539
$\sigma_{\text{Z5 mark-up wages}}$	0.791	0.648	0.937	0.781	0.626	0.980	0.719	0.602	0.837	0.596	0.497	0.702
$\sigma_{\text{K investment}}$	5.276	4.823	5.714	3.326	2.704	3.831	2.025	1.624	2.433	2.507	1.527	3.432

Table 3. Posterior Distribution for Small Open Economies (Continued)

Parameters	New Zealand											
	DSGE-VAR											
	$\zeta 1e > 0$, $\zeta 2e > 0$			$\zeta 1e = 0$, $\zeta 2e > 0$			$\zeta 1e > 0$, $\zeta 2e = 0$			$\zeta 1e = \zeta 2e = 0$		
	mean	5%	95%	mean	5%	95%	mean	5%	95%	mean	5%	95%
η_I	1.250	0.904	1.599	1.508	1.077	1.970	1.412	1.082	1.785	1.502	1.012	1.991
Ω_N	0.567	0.457	0.646	0.561	0.490	0.629	0.571	0.490	0.652	0.512	0.416	0.593
σ	1.886	1.747	2.017	1.967	1.869	2.090	2.125	2.060	2.210	2.016	1.936	2.098
Ω_M	0.253	0.200	0.299	0.216	0.181	0.251	0.276	0.236	0.303	0.235	0.203	0.264
τ_D	4.846	3.824	5.856	4.260	3.666	4.792	3.868	3.169	4.586	4.207	3.433	4.842
Ω	0.689	0.615	0.760	0.666	0.599	0.726	0.602	0.500	0.697	0.691	0.633	0.753
γ	0.061	0.006	0.105	0.059	0.002	0.106	0.122	0.020	0.251	0.079	0.001	0.150
λ	0.216	0.142	0.291	0.201	0.129	0.270	0.176	0.118	0.238	0.176	0.112	0.238
Ω_R	0.875	0.843	0.908	0.861	0.826	0.898	0.884	0.852	0.915	0.883	0.855	0.914
φ_Π	1.926	1.867	2.000	1.836	1.679	2.026	1.895	1.792	2.000	1.942	1.839	2.033
φ_Y	0.561	0.485	0.631	0.574	0.484	0.686	0.558	0.485	0.638	0.549	0.453	0.661
ζ^1_e	0.091	0.036	0.140	0.000	0.000	0.000	0.089	0.039	0.139	0.000	0.000	0.000
ζ^2_e	0.021	0.000	0.048	0.048	0.000	0.096	0.000	0.000	0.000	0.000	0.000	0.000
$\mu(*)$	0.065	0.034	0.087	0.081	0.074	0.087	0.077	0.064	0.087	0.080	0.072	0.087
Ω_Q	0.424	0.334	0.521	0.599	0.493	0.699	0.498	0.364	0.622	0.586	0.472	0.690
θ_D	0.697	0.638	0.758	0.679	0.638	0.721	0.668	0.629	0.701	0.726	0.671	0.774
δ_D	0.296	0.265	0.333	0.354	0.312	0.401	0.383	0.341	0.430	0.358	0.277	0.424
θ_W	0.633	0.579	0.685	0.564	0.517	0.612	0.640	0.613	0.667	0.635	0.605	0.662
δw	0.397	0.358	0.440	0.423	0.365	0.470	0.426	0.393	0.464	0.409	0.352	0.462
$\rho_{\text{Y foreing output}}$	0.474	0.331	0.631	0.484	0.335	0.610	0.418	0.287	0.553	0.572	0.495	0.642
$\rho_{\text{P foreing inflation}}$	0.561	0.435	0.699	0.590	0.509	0.693	0.641	0.547	0.748	0.567	0.479	0.671
$\rho_{\text{R foreing interest rate}}$	0.687	0.510	0.834	0.660	0.567	0.763	0.658	0.552	0.770	0.686	0.597	0.780
$\rho_{\text{A productivity}}$	0.337	0.249	0.426	0.343	0.267	0.419	0.310	0.201	0.415	0.376	0.288	0.448
$\rho_{\text{PC price commodity}}$	0.514	0.429	0.590	0.497	0.397	0.578	0.568	0.453	0.657	0.497	0.406	0.611
$\rho_{\text{Z2 preference}}$	0.367	0.300	0.438	0.397	0.320	0.468	0.358	0.264	0.447	0.403	0.340	0.474
$\rho_{\text{Z3 mark-up prices}}$	0.354	0.269	0.430	0.372	0.297	0.445	0.466	0.402	0.539	0.305	0.230	0.392
$\rho_{\text{Z4 risk premium}}$	0.538	0.458	0.629	0.555	0.457	0.652	0.460	0.332	0.587	0.508	0.418	0.611
$\rho_{\text{Z5 mark-up wages}}$	0.372	0.298	0.469	0.511	0.406	0.599	0.590	0.511	0.659	0.493	0.374	0.629
$\rho_{\text{K invesment}}$	0.462	0.383	0.546	0.506	0.412	0.612	0.545	0.456	0.633	0.442	0.367	0.510
ρ_{MA1}	0.477	0.374	0.582	0.328	0.223	0.416	0.435	0.332	0.525	0.348	0.242	0.453
ρ_{MA2}	0.459	0.360	0.572	0.522	0.374	0.661	0.500	0.390	0.602	0.469	0.385	0.553
ρ_{MA3}	0.424	0.281	0.560	0.235	0.155	0.316	0.334	0.191	0.506	0.258	0.155	0.382
ρ_{MA4}	0.490	0.418	0.565	0.594	0.515	0.671	0.587	0.463	0.704	0.526	0.406	0.637
TREND_M	0.830	0.745	0.925	0.599	0.509	0.688	0.668	0.584	0.767	0.637	0.528	0.733
CONST_I	0.635	0.445	0.828	0.631	0.456	0.812	0.616	0.433	0.809	0.605	0.444	0.771
CONST_R	1.277	1.023	1.588	1.316	1.117	1.510	1.295	1.022	1.558	1.407	1.182	1.614
CTREND	0.426	0.334	0.508	0.377	0.287	0.500	0.439	0.344	0.539	0.367	0.276	0.455
CONSTEPINF	0.593	0.481	0.702	0.552	0.492	0.614	0.567	0.513	0.627	0.607	0.524	0.678
CONSTER	1.304	0.866	1.759	1.148	0.769	1.527	1.158	0.778	1.551	1.186	0.827	1.581
λ_{DSGE}	0.856	0.700	1.035	0.931	0.714	1.126	0.887	0.694	1.064	0.989	0.748	1.247
$\sigma_{\text{M interest rate}}$	0.095	0.075	0.115	0.095	0.077	0.114	0.096	0.078	0.116	0.092	0.072	0.110
$\sigma_{\text{Y foreing output}}$	0.498	0.393	0.603	0.504	0.400	0.605	0.496	0.386	0.592	0.511	0.411	0.606
$\sigma_{\text{P foreing inflation}}$	0.352	0.279	0.418	0.361	0.292	0.430	0.354	0.294	0.413	0.362	0.293	0.427
$\sigma_{\text{R foreing interest rate}}$	0.265	0.235	0.291	0.266	0.235	0.297	0.264	0.235	0.291	0.266	0.235	0.296
$\sigma_{\text{A productivity}}$	0.865	0.634	1.100	0.915	0.675	1.145	0.880	0.639	1.097	1.060	0.718	1.343
$\sigma_{\text{PC price commodity}}$	2.923	2.243	3.501	2.782	2.190	3.370	2.824	2.249	3.387	2.923	2.297	3.623
$\sigma_{\text{Z2 preference}}$	0.408	0.328	0.491	0.387	0.308	0.457	0.387	0.307	0.469	0.379	0.308	0.449
$\sigma_{\text{Z3 mark-up prices}}$	0.372	0.286	0.453	0.381	0.300	0.458	0.380	0.302	0.455	0.360	0.285	0.431
$\sigma_{\text{Z4 risk premium}}$	1.746	1.152	2.373	1.727	1.094	2.343	1.727	1.139	2.296	1.812	1.196	2.399
$\sigma_{\text{Z5 mark-up wages}}$	0.419	0.335	0.499	0.424	0.349	0.505	0.417	0.336	0.506	0.405	0.332	0.473
$\sigma_{\text{K investment}}$	1.015	0.670	1.336	0.822	0.539	1.088	0.803	0.565	1.051	0.932	0.604	1.265

Table 3. Posterior Distribution for Small Open Economies (Continued)

Parameters	Chile											
	DSGE											
	ζ1e > 0 , ζ2e > 0			ζ1e = 0 , ζ2e > 0			ζ1e > 0 , ζ2e = 0			ζ1e =ζ2e = 0		
	mean	5%	95%	mean	5%	95%	mean	5%	95%	mean	5%	95%
η_I	0.452	0.300	0.617	1.173	1.064	1.275	0.542	0.443	0.643	0.627	0.461	0.776
Ω_N	0.399	0.375	0.422	0.459	0.428	0.483	0.657	0.632	0.683	0.285	0.245	0.323
σ	2.139	2.119	2.160	1.892	1.867	1.932	1.668	1.636	1.698	1.944	1.924	1.965
Ω_M	0.216	0.204	0.229	0.270	0.260	0.280	0.344	0.334	0.353	0.223	0.210	0.235
τ_D	3.604	3.441	3.786	3.585	3.392	3.825	3.314	3.113	3.536	4.689	4.522	4.897
Ω	0.884	0.854	0.913	0.621	0.602	0.640	0.634	0.593	0.668	0.964	0.954	0.975
γ	0.185	0.167	0.204	0.161	0.136	0.183	0.195	0.170	0.211	0.185	0.154	0.220
λ	0.231	0.202	0.254	0.136	0.105	0.166	0.146	0.118	0.173	0.281	0.263	0.296
Ω_R	0.762	0.753	0.772	0.655	0.637	0.673	0.764	0.756	0.772	0.746	0.734	0.758
φ_Π	1.894	1.866	1.931	1.915	1.896	1.937	1.888	1.854	1.917	2.015	1.984	2.050
φ_Y	0.514	0.477	0.556	0.399	0.372	0.420	0.431	0.392	0.468	0.547	0.534	0.561
ζ^1_e	0.307	0.269	0.338	0.000	0.000	0.000	0.130	0.102	0.149	0.000	0.000	0.000
ζ^2_e	0.005	0.000	0.013	0.004	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000
μ(*)	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
Ω_Q	0.746	0.729	0.763	0.647	0.614	0.678	0.717	0.706	0.729	0.734	0.713	0.757
θ_D	0.690	0.679	0.701	0.692	0.679	0.705	0.694	0.683	0.704	0.700	0.689	0.712
δ_D	0.385	0.366	0.401	0.346	0.337	0.354	0.370	0.354	0.387	0.293	0.270	0.311
θ_W	0.608	0.591	0.624	0.625	0.614	0.635	0.634	0.623	0.644	0.666	0.653	0.684
δw	0.388	0.374	0.402	0.377	0.369	0.383	0.361	0.356	0.367	0.532	0.514	0.553
$\rho_{\text{Y foreing output}}$	0.448	0.417	0.481	0.480	0.456	0.509	0.546	0.523	0.565	0.731	0.680	0.807
$\rho_{\text{P foreing inflation}}$	0.582	0.564	0.602	0.589	0.545	0.630	0.494	0.472	0.520	0.692	0.670	0.718
$\rho_{\text{R foreing interest rate}}$	0.655	0.640	0.673	0.501	0.484	0.517	0.546	0.530	0.565	0.445	0.426	0.470
$\rho_{\text{A productivity}}$	0.527	0.506	0.548	0.496	0.453	0.527	0.515	0.495	0.537	0.626	0.602	0.643
$\rho_{\text{PC price commodity}}$	0.638	0.614	0.666	0.574	0.537	0.615	0.553	0.525	0.580	0.801	0.752	0.849
$\rho_{\text{Z2 preference}}$	0.487	0.466	0.505	0.527	0.491	0.562	0.537	0.521	0.551	0.617	0.604	0.631
$\rho_{\text{Z3 mark-up prices}}$	0.377	0.361	0.396	0.514	0.482	0.544	0.731	0.706	0.750	0.297	0.236	0.341
$\rho_{\text{Z4 risk premium}}$	0.612	0.592	0.636	0.542	0.504	0.577	0.375	0.348	0.395	0.558	0.531	0.584
$\rho_{\text{Z5 mark-up wages}}$	0.606	0.587	0.633	0.363	0.331	0.395	0.153	0.126	0.182	0.550	0.509	0.590
$\rho_{\text{K invesment}}$	0.663	0.643	0.685	0.530	0.512	0.559	0.507	0.491	0.525	0.652	0.609	0.702
ρ_{MA1}	0.637	0.610	0.663	0.501	0.473	0.524	0.647	0.619	0.674	0.570	0.534	0.598
ρ_{MA2}	0.517	0.501	0.531	0.635	0.611	0.658	0.657	0.624	0.706	0.442	0.403	0.479
ρ_{MA3}	0.502	0.481	0.525	0.428	0.405	0.467	0.468	0.456	0.482	0.631	0.603	0.663
ρ_{MA4}	0.581	0.559	0.602	0.635	0.612	0.651	0.492	0.477	0.508	0.469	0.437	0.505
TREND_M	0.552	0.523	0.579	0.722	0.707	0.735	0.633	0.612	0.655	0.728	0.708	0.747
CONST_I	0.766	0.740	0.794	0.777	0.748	0.805	0.799	0.780	0.819	0.732	0.704	0.763
CONST_R	1.384	1.266	1.490	2.376	2.239	2.555	2.882	2.651	3.084	1.195	0.849	1.427
CTREND	0.209	0.190	0.228	0.429	0.400	0.461	0.442	0.399	0.481	0.303	0.275	0.325
CONSTEPINF	0.555	0.542	0.569	0.538	0.525	0.552	0.540	0.529	0.550	0.532	0.499	0.562
CONSTER	0.876	0.631	1.069	0.597	0.454	0.743	0.764	0.595	0.914	0.761	0.616	0.926
λ_{DSGE}	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\sigma_{\text{M interest rate}}$	0.537	0.439	0.620	0.813	0.669	0.976	0.792	0.647	0.943	0.499	0.411	0.590
$\sigma_{\text{Y foreing output}}$	1.462	1.274	1.627	2.697	2.243	3.215	2.608	1.825	3.486	1.064	0.866	1.272
$\sigma_{\text{P foreing inflation}}$	0.552	0.471	0.644	0.550	0.463	0.626	0.593	0.515	0.676	0.530	0.435	0.627
$\sigma_{\text{R foreing interest rate}}$	0.312	0.261	0.359	0.368	0.309	0.432	0.340	0.288	0.392	0.382	0.328	0.442
$\sigma_{\text{A productivity}}$	2.640	2.371	2.898	4.703	3.777	6.125	2.393	2.085	2.744	3.189	2.747	3.617
$\sigma_{\text{PC price commodity}}$	11.538	11.054	12.080	11.589	11.048	12.283	9.798	9.203	10.658	11.898	11.276	12.427
$\sigma_{\text{Z2 preference}}$	1.507	1.319	1.704	1.183	0.932	1.393	1.029	0.830	1.196	0.823	0.675	0.968
$\sigma_{\text{Z3 mark-up prices}}$	0.926	0.718	1.156	1.009	0.816	1.200	0.566	0.461	0.685	0.905	0.725	1.075
$\sigma_{\text{Z4 risk premium}}$	1.402	1.166	1.616	1.393	1.170	1.605	1.718	1.435	1.940	1.575	1.331	1.818
$\sigma_{\text{Z5 mark-up wages}}$	1.016	0.850	1.207	0.969	0.785	1.114	0.938	0.781	1.084	0.845	0.652	1.021
$\sigma_{\text{K investment}}$	5.820	4.352	7.204	2.922	2.307	3.445	7.174	6.431	8.445	3.810	2.729	4.692

Table 3. Posterior Distribution for Small Open Economies (Continued)

Parameters	Chile											
	DSGE-VAR											
	ζ1e > 0 , ζ2e > 0			ζ1e = 0 , ζ2e > 0			ζ1e > 0 , ζ2e = 0			ζ1e =ζ2e = 0		
	mean	5%	95%	mean	5%	95%	mean	5%	95%	mean	5%	95%
η_I	1.146	0.708	1.535	1.813	1.390	2.262	1.041	0.620	1.439	1.123	0.503	1.789
Ω_N	0.460	0.331	0.581	0.408	0.354	0.467	0.395	0.311	0.492	0.460	0.360	0.567
σ	2.028	1.910	2.157	2.037	1.933	2.135	2.002	1.871	2.145	2.011	1.894	2.141
Ω_M	0.271	0.208	0.328	0.248	0.207	0.299	0.190	0.147	0.238	0.215	0.158	0.279
τ_D	4.891	3.685	6.218	4.332	3.694	5.015	4.976	4.219	5.669	4.519	3.716	5.368
Ω	0.488	0.350	0.619	0.549	0.404	0.673	0.586	0.488	0.714	0.566	0.406	0.730
γ	0.047	0.001	0.086	0.073	0.004	0.133	0.031	0.000	0.057	0.144	0.047	0.249
λ	0.264	0.144	0.387	0.242	0.146	0.338	0.180	0.116	0.243	0.234	0.147	0.313
Ω_R	0.800	0.768	0.844	0.804	0.759	0.850	0.810	0.758	0.856	0.797	0.757	0.835
φ_Π	1.976	1.887	2.052	1.896	1.776	2.041	1.944	1.844	2.038	1.931	1.830	2.022
φ_Y	0.518	0.415	0.625	0.430	0.350	0.490	0.454	0.371	0.548	0.414	0.318	0.491
ζ^1_e	0.177	0.065	0.298	0.000	0.000	0.000	0.152	0.084	0.222	0.000	0.000	0.000
ζ^2_e	0.067	0.000	0.135	0.090	0.000	0.172	0.000	0.000	0.000	0.000	0.000	0.000
μ(*)	0.075	0.008	0.137	0.096	0.004	0.196	0.076	0.006	0.146	0.065	0.003	0.124
Ω_Q	0.426	0.332	0.525	0.342	0.263	0.420	0.332	0.232	0.453	0.312	0.223	0.387
θ_D	0.698	0.651	0.745	0.677	0.647	0.715	0.699	0.661	0.741	0.679	0.621	0.723
δ_D	0.342	0.299	0.385	0.358	0.285	0.433	0.334	0.277	0.387	0.370	0.305	0.422
θ_W	0.630	0.585	0.675	0.587	0.527	0.646	0.580	0.543	0.619	0.625	0.578	0.666
δw	0.449	0.395	0.499	0.459	0.411	0.503	0.379	0.333	0.422	0.439	0.396	0.481
$\rho_{Y\ \text{foreing output}}$	0.468	0.379	0.542	0.514	0.410	0.622	0.535	0.465	0.615	0.520	0.404	0.632
$\rho_{P\ \text{foreing inflation}}$	0.563	0.457	0.657	0.449	0.348	0.551	0.487	0.358	0.601	0.530	0.400	0.648
$\rho_{R\ \text{foreing interest rate}}$	0.637	0.527	0.745	0.693	0.612	0.789	0.663	0.520	0.822	0.680	0.560	0.774
$\rho_{A\ \text{productivity}}$	0.449	0.366	0.536	0.308	0.215	0.403	0.350	0.225	0.456	0.354	0.203	0.497
$\rho_{PC\ \text{price commodity}}$	0.507	0.411	0.620	0.435	0.365	0.498	0.469	0.329	0.578	0.500	0.396	0.625
$\rho_{Z2\ \text{preference}}$	0.397	0.294	0.513	0.411	0.254	0.541	0.448	0.366	0.533	0.405	0.291	0.507
$\rho_{Z3\ \text{mark-up prices}}$	0.296	0.229	0.362	0.340	0.245	0.429	0.342	0.266	0.422	0.280	0.191	0.361
$\rho_{Z4\ \text{risk premium}}$	0.477	0.342	0.600	0.446	0.334	0.572	0.469	0.390	0.546	0.487	0.374	0.610
$\rho_{Z5\ \text{mark-up wages}}$	0.517	0.381	0.625	0.589	0.493	0.679	0.542	0.424	0.653	0.457	0.329	0.601
$\rho_{K\ \text{invesment}}$	0.562	0.445	0.672	0.420	0.327	0.492	0.517	0.429	0.595	0.517	0.369	0.713
ρ_{MA1}	0.469	0.333	0.604	0.482	0.385	0.570	0.463	0.361	0.579	0.411	0.272	0.567
ρ_{MA2}	0.409	0.257	0.550	0.504	0.419	0.595	0.530	0.386	0.655	0.580	0.459	0.692
ρ_{MA3}	0.384	0.268	0.491	0.388	0.266	0.513	0.303	0.240	0.360	0.320	0.210	0.422
ρ_{MA4}	0.526	0.426	0.630	0.496	0.385	0.610	0.429	0.254	0.566	0.502	0.383	0.618
TREND_M	0.698	0.608	0.789	0.779	0.676	0.903	0.598	0.509	0.710	0.639	0.548	0.703
CONST_I	0.809	0.581	1.000	0.871	0.633	1.125	1.015	0.751	1.270	0.906	0.644	1.125
CONST_R	1.480	1.020	1.929	1.705	1.224	2.234	1.884	1.357	2.409	1.776	1.443	2.229
CTREND	0.360	0.277	0.440	0.428	0.307	0.551	0.412	0.308	0.514	0.425	0.330	0.524
CONSTEPINF	0.523	0.456	0.587	0.556	0.471	0.649	0.585	0.514	0.664	0.564	0.475	0.650
CONSTER	0.808	0.352	1.268	1.126	0.571	1.600	1.133	0.648	1.581	1.013	0.637	1.376
λ_{DSGE}	0.773	0.631	0.914	0.774	0.628	0.900	0.827	0.666	0.983	0.814	0.671	0.944
$\sigma_{M\ \text{interest rate}}$	0.174	0.125	0.217	0.164	0.125	0.206	0.164	0.121	0.204	0.158	0.121	0.196
$\sigma_{Y\ \text{foreing output}}$	0.540	0.434	0.650	0.540	0.424	0.671	0.541	0.422	0.650	0.536	0.421	0.639
$\sigma_{P\ \text{foreing inflation}}$	0.347	0.287	0.408	0.351	0.288	0.420	0.349	0.289	0.409	0.347	0.291	0.400
$\sigma_{R\ \text{foreing interest rate}}$	0.275	0.235	0.311	0.270	0.235	0.303	0.275	0.236	0.311	0.271	0.235	0.303
$\sigma_{A\ \text{productivity}}$	1.013	0.739	1.317	1.028	0.741	1.292	1.121	0.832	1.391	0.981	0.721	1.260
$\sigma_{PC\ \text{price commodity}}$	5.997	4.601	7.370	5.371	3.896	6.560	5.710	4.362	6.926	6.021	4.461	7.721
$\sigma_{Z2\ \text{preference}}$	0.574	0.434	0.717	0.550	0.408	0.675	0.527	0.408	0.645	0.537	0.386	0.676
$\sigma_{Z3\ \text{mark-up prices}}$	0.386	0.297	0.472	0.373	0.292	0.458	0.371	0.302	0.448	0.387	0.305	0.467
$\sigma_{Z4\ \text{risk premium}}$	0.766	0.560	0.983	0.841	0.585	1.089	0.793	0.568	1.020	0.789	0.565	1.003
$\sigma_{Z5\ \text{mark-up wages}}$	0.405	0.324	0.484	0.413	0.334	0.491	0.418	0.324	0.496	0.405	0.320	0.475
$\sigma_{K\ \text{investment}}$	1.075	0.637	1.532	0.853	0.599	1.111	1.241	0.784	1.771	1.216	0.569	1.816

Table 3. Posterior Distribution for Small Open Economies (Continued)

Parameters	Colombia											
	DSGE											
	ζ1e > 0 , ζ2e > 0			ζ1e = 0 , ζ2e > 0			ζ1e > 0 , ζ2e = 0			ζ1e =ζ2e = 0		
	mean	5%	95%	mean	5%	95%	mean	5%	95%	mean	5%	95%
η_I	0.422	0.190	0.619	0.518	0.337	0.690	0.489	0.297	0.677	0.528	0.329	0.666
Ω_N	0.317	0.225	0.392	0.294	0.259	0.332	0.149	0.105	0.193	0.393	0.350	0.429
σ	2.006	1.910	2.093	1.733	1.695	1.774	2.069	2.006	2.126	1.695	1.645	1.753
Ω_M	0.282	0.251	0.317	0.216	0.193	0.241	0.138	0.116	0.160	0.377	0.351	0.394
τ_D	4.003	3.631	4.435	3.594	3.205	4.009	2.846	2.404	3.296	2.706	2.437	2.998
Ω	0.449	0.359	0.521	0.613	0.566	0.666	0.576	0.529	0.632	0.594	0.544	0.625
γ	0.560	0.453	0.667	0.780	0.746	0.817	0.480	0.392	0.562	0.669	0.623	0.710
λ	0.061	0.036	0.080	0.048	0.031	0.067	0.069	0.040	0.101	0.058	0.031	0.090
Ω_R	0.860	0.828	0.897	0.855	0.840	0.869	0.846	0.825	0.867	0.889	0.875	0.902
φ_Π	1.839	1.797	1.878	1.848	1.799	1.893	1.905	1.830	1.975	2.021	1.925	2.114
φ_Y	0.476	0.400	0.588	0.552	0.520	0.580	0.329	0.246	0.415	0.270	0.243	0.297
ζ^1_e	0.193	0.120	0.261	0.000	0.000	0.000	0.221	0.176	0.264	0.000	0.000	0.000
ζ^2_e	0.354	0.295	0.429	0.021	0.000	0.037	0.000	0.000	0.000	0.000	0.000	0.000
μ(*)	0.003	0.001	0.005	0.000	-0.001	0.002	0.003	0.000	0.006	0.001	-0.001	0.003
Ω_Q	0.328	0.255	0.391	0.891	0.856	0.917	0.818	0.760	0.891	0.923	0.895	0.950
θ_D	0.865	0.857	0.872	0.865	0.859	0.872	0.866	0.860	0.872	0.868	0.864	0.872
δ_D	0.394	0.357	0.424	0.424	0.382	0.457	0.451	0.408	0.495	0.522	0.510	0.534
θ_W	0.624	0.586	0.662	0.587	0.569	0.604	0.696	0.664	0.733	0.626	0.607	0.648
δw	0.407	0.360	0.455	0.587	0.571	0.604	0.426	0.393	0.468	0.510	0.485	0.538
$\rho_{Y\ foreing\ output}$	0.883	0.835	0.918	0.704	0.656	0.751	0.860	0.815	0.902	0.852	0.819	0.885
$\rho_{P\ foreing\ inflation}$	0.774	0.705	0.841	0.547	0.486	0.594	0.762	0.692	0.848	0.518	0.456	0.598
$\rho_{R\ foreing\ interest\ rate}$	0.782	0.729	0.843	0.604	0.584	0.628	0.674	0.595	0.752	0.587	0.535	0.629
$\rho_{A\ productivity}$	0.851	0.823	0.881	0.705	0.678	0.726	0.892	0.847	0.933	0.900	0.878	0.927
$\rho_{PC\ price\ commodity}$	0.576	0.507	0.632	0.656	0.633	0.677	0.576	0.529	0.635	0.486	0.440	0.531
$\rho_{Z2\ preference}$	0.546	0.477	0.607	0.580	0.546	0.613	0.563	0.424	0.686	0.706	0.684	0.723
$\rho_{Z3\ mark-up\ prices}$	0.800	0.734	0.861	0.749	0.705	0.793	0.789	0.742	0.835	0.756	0.734	0.776
$\rho_{Z4\ risk\ premium}$	0.598	0.476	0.690	0.368	0.341	0.404	0.526	0.489	0.567	0.340	0.297	0.384
$\rho_{Z5\ mark-up\ wages}$	0.577	0.526	0.638	0.618	0.554	0.677	0.403	0.359	0.444	0.480	0.424	0.535
$\rho_{K\ invesment}$	0.853	0.813	0.898	0.911	0.887	0.937	0.857	0.822	0.892	0.700	0.634	0.763
ρ_{MA1}	0.690	0.639	0.745	0.478	0.441	0.527	0.568	0.510	0.616	0.263	0.235	0.290
ρ_{MA2}	0.562	0.477	0.628	0.216	0.188	0.247	0.415	0.351	0.477	0.514	0.486	0.545
ρ_{MA3}	0.361	0.289	0.448	0.557	0.482	0.632	0.452	0.326	0.576	0.393	0.365	0.421
ρ_{MA4}	0.626	0.567	0.690	0.558	0.507	0.608	0.449	0.348	0.548	0.602	0.555	0.657
TREND_M	1.046	1.003	1.110	0.980	0.933	1.025	1.155	1.024	1.277	0.807	0.766	0.845
CONST_I	1.535	1.454	1.618	1.845	1.784	1.905	1.627	1.557	1.691	1.649	1.577	1.743
CONST_R	3.323	2.869	3.789	0.344	0.208	0.480	1.352	0.616	2.161	4.415	4.173	4.639
CTREND	0.203	0.153	0.245	0.253	0.225	0.278	0.234	0.179	0.280	0.202	0.158	0.252
CONSTEPINF	0.531	0.512	0.552	0.550	0.531	0.565	0.547	0.525	0.571	0.546	0.531	0.564
CONSTER	0.695	0.421	0.943	0.773	0.604	0.909	0.800	0.582	0.975	0.844	0.666	1.019
λ_{DSGE}	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\sigma_{M\ interest\ rate}$	1.528	1.094	1.950	1.059	0.854	1.268	1.360	1.079	1.623	1.078	0.900	1.293
$\sigma_{Y\ foreing\ output}$	0.831	0.679	0.954	1.050	0.848	1.238	0.845	0.704	0.995	0.835	0.691	0.952
$\sigma_{P\ foreing\ inflation}$	0.480	0.399	0.548	0.578	0.498	0.659	0.493	0.409	0.574	0.576	0.490	0.668
$\sigma_{R\ foreing\ interest\ rate}$	0.277	0.238	0.311	0.323	0.278	0.367	0.309	0.258	0.369	0.335	0.291	0.396
$\sigma_{A\ productivity}$	10.267	8.905	11.521	18.261	17.133	19.631	7.800	6.848	8.672	11.959	10.498	12.983
$\sigma_{PC\ price\ commodity}$	17.168	15.217	19.219	17.753	16.280	19.381	16.860	15.103	18.719	16.274	15.053	17.303
$\sigma_{Z2\ preference}$	0.574	0.451	0.683	0.513	0.412	0.618	0.582	0.419	0.748	0.417	0.337	0.493
$\sigma_{Z3\ mark-up\ prices}$	0.565	0.413	0.708	0.462	0.363	0.553	0.582	0.450	0.741	0.564	0.431	0.676
$\sigma_{Z4\ risk\ premium}$	3.900	2.916	5.092	6.189	5.330	6.976	5.534	4.558	6.410	8.346	6.917	9.658
$\sigma_{Z5\ mark-up\ wages}$	1.532	1.239	1.800	1.630	1.368	1.896	1.477	1.191	1.730	1.444	1.213	1.686
$\sigma_{K\ investment}$	3.801	2.333	5.989	1.950	1.231	2.572	3.194	1.821	4.574	7.339	6.745	7.917

Table 3. Posterior Distribution for Small Open Economies (Continued)

Parameters	Colombia											
	DSGE-VAR											
	ζ1e > 0 , ζ2e > 0			ζ1e = 0 , ζ2e > 0			ζ1e > 0 , ζ2e = 0			ζ1e =ζ2e = 0		
	mean	5%	95%	mean	5%	95%	mean	5%	95%	mean	5%	95%
η_I	1.318	0.615	1.950	1.482	1.040	1.896	1.395	0.933	1.922	1.273	0.865	1.655
Ω_N	0.453	0.347	0.559	0.497	0.401	0.581	0.392	0.294	0.498	0.467	0.343	0.576
σ	2.024	1.835	2.186	2.076	1.960	2.191	1.992	1.875	2.117	2.077	1.959	2.202
Ω_M	0.265	0.209	0.324	0.214	0.156	0.266	0.251	0.164	0.321	0.215	0.156	0.279
τ_D	4.830	3.966	5.616	4.238	3.283	5.229	4.266	3.491	4.928	4.060	3.305	4.819
Ω	0.633	0.516	0.755	0.532	0.413	0.644	0.639	0.537	0.733	0.544	0.432	0.646
γ	0.076	0.002	0.146	0.096	0.002	0.173	0.098	0.005	0.211	0.110	0.002	0.240
λ	0.230	0.163	0.306	0.220	0.156	0.304	0.189	0.130	0.251	0.222	0.151	0.301
Ω_R	0.735	0.684	0.795	0.744	0.696	0.809	0.727	0.670	0.781	0.698	0.653	0.746
φ_Π	1.885	1.781	1.987	1.899	1.808	2.003	1.910	1.827	1.986	1.945	1.832	2.064
φ_Y	0.558	0.411	0.689	0.593	0.397	0.783	0.442	0.312	0.559	0.396	0.273	0.523
ζ^1_e	0.181	0.081	0.272	0.000	0.000	0.000	0.166	0.089	0.238	0.000	0.000	0.000
ζ^2_e	0.047	0.000	0.099	0.073	0.000	0.132	0.000	0.000	0.000	0.000	0.000	0.000
$\mu(*)$	0.106	0.013	0.217	0.172	0.014	0.353	0.105	0.010	0.203	0.102	0.012	0.197
Ω_Q	0.440	0.344	0.549	0.435	0.348	0.535	0.411	0.312	0.516	0.416	0.319	0.518
θ_D	0.746	0.704	0.794	0.710	0.663	0.757	0.715	0.670	0.757	0.705	0.671	0.740
δ_D	0.350	0.307	0.396	0.352	0.292	0.411	0.323	0.275	0.366	0.363	0.310	0.412
θ_W	0.600	0.554	0.644	0.607	0.514	0.691	0.579	0.517	0.639	0.571	0.518	0.629
δw	0.425	0.376	0.474	0.432	0.373	0.490	0.408	0.342	0.462	0.425	0.370	0.476
$\rho_{Y \text{ foreing output}}$	0.660	0.538	0.778	0.605	0.450	0.738	0.556	0.417	0.707	0.548	0.376	0.698
$\rho_{P \text{ foreing inflation}}$	0.556	0.399	0.670	0.513	0.363	0.680	0.582	0.489	0.683	0.577	0.476	0.694
$\rho_{R \text{ foreing interest rate}}$	0.738	0.646	0.830	0.656	0.557	0.773	0.686	0.561	0.821	0.653	0.498	0.754
$\rho_{A \text{ productivity}}$	0.432	0.347	0.512	0.342	0.221	0.461	0.330	0.234	0.423	0.401	0.309	0.483
$\rho_{PC \text{ price commodity}}$	0.554	0.474	0.654	0.459	0.322	0.586	0.506	0.393	0.632	0.490	0.358	0.609
$\rho_{Z2 \text{ preference}}$	0.472	0.342	0.601	0.525	0.409	0.651	0.454	0.342	0.559	0.398	0.285	0.491
$\rho_{Z3 \text{ mark-up prices}}$	0.336	0.203	0.481	0.379	0.242	0.504	0.345	0.217	0.463	0.355	0.251	0.463
$\rho_{Z4 \text{ risk premium}}$	0.422	0.279	0.578	0.478	0.345	0.616	0.416	0.299	0.526	0.514	0.375	0.662
$\rho_{Z5 \text{ mark-up wages}}$	0.427	0.290	0.547	0.431	0.333	0.533	0.518	0.438	0.614	0.455	0.265	0.633
$\rho_{K \text{ invesment}}$	0.524	0.436	0.609	0.601	0.482	0.704	0.517	0.362	0.634	0.544	0.406	0.673
ρ_{MA1}	0.371	0.287	0.461	0.359	0.217	0.481	0.376	0.289	0.478	0.401	0.269	0.553
ρ_{MA2}	0.529	0.354	0.711	0.481	0.384	0.575	0.536	0.395	0.668	0.525	0.415	0.632
ρ_{MA3}	0.396	0.301	0.495	0.437	0.282	0.598	0.469	0.355	0.595	0.344	0.246	0.441
ρ_{MA4}	0.581	0.465	0.681	0.511	0.349	0.663	0.522	0.387	0.624	0.525	0.434	0.621
TREND_M	0.952	0.835	1.061	0.827	0.719	0.937	0.749	0.609	0.882	0.858	0.754	0.959
CONST_I	1.129	0.736	1.475	0.999	0.559	1.466	0.958	0.533	1.329	1.160	0.681	1.648
CONST_R	1.141	0.489	1.800	1.371	0.459	2.233	1.211	0.450	1.948	1.423	0.577	2.329
CTREND	0.385	0.221	0.568	0.368	0.264	0.466	0.334	0.189	0.499	0.359	0.247	0.466
CONSTEPINF	0.577	0.469	0.699	0.605	0.488	0.744	0.551	0.439	0.653	0.580	0.491	0.662
CONSTER	1.024	0.116	1.842	0.703	0.023	1.455	0.762	0.053	1.515	0.787	0.024	1.752
λ_{DSGE}	0.775	0.612	0.928	0.770	0.607	0.934	0.751	0.626	0.903	0.749	0.624	0.887
$\sigma_{M \text{ interest rate}}$	0.352	0.230	0.472	0.337	0.233	0.436	0.353	0.233	0.458	0.331	0.225	0.438
$\sigma_{Y \text{ foreing output}}$	0.546	0.429	0.671	0.539	0.422	0.641	0.530	0.419	0.641	0.533	0.411	0.645
$\sigma_{P \text{ foreing inflation}}$	0.363	0.297	0.432	0.366	0.292	0.433	0.367	0.304	0.439	0.363	0.295	0.428
$\sigma_{R \text{ foreing interest rate}}$	0.275	0.235	0.310	0.280	0.240	0.325	0.279	0.238	0.317	0.280	0.236	0.317
$\sigma_{A \text{ productivity}}$	1.733	1.176	2.330	1.556	1.077	2.020	1.777	1.217	2.365	1.560	1.065	2.117
$\sigma_{PC \text{ price commodity}}$	8.962	6.588	11.406	10.329	8.297	12.390	8.827	6.559	11.388	10.318	8.358	12.150
$\sigma_{Z2 \text{ preference}}$	0.631	0.457	0.798	0.594	0.435	0.751	0.618	0.480	0.796	0.646	0.474	0.791
$\sigma_{Z3 \text{ mark-up prices}}$	0.435	0.334	0.532	0.443	0.344	0.544	0.451	0.342	0.555	0.458	0.370	0.563
$\sigma_{Z4 \text{ risk premium}}$	2.074	1.368	2.758	2.243	1.343	3.118	2.022	1.312	2.651	1.870	1.200	2.557
$\sigma_{Z5 \text{ mark-up wages}}$	0.887	0.686	1.102	0.930	0.716	1.166	0.896	0.682	1.114	0.921	0.704	1.129
$\sigma_{K \text{ investment}}$	2.016	0.987	3.208	1.523	0.834	2.163	1.777	0.955	2.447	1.859	1.043	2.657

Table 3. Posterior Distribution for Small Open Economies (Continued)

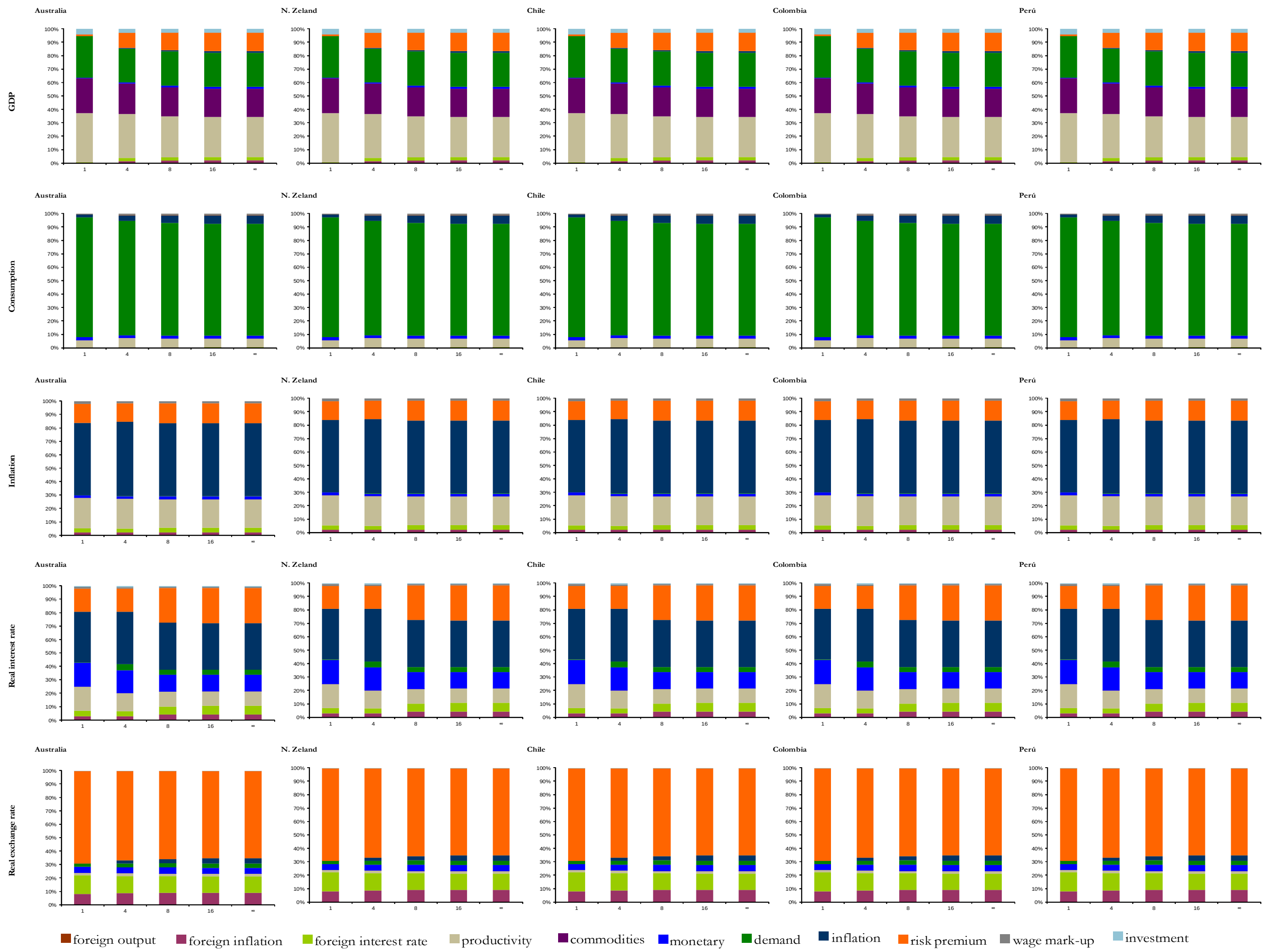
Parameters	Peru											
	DSGE											
	ζ1e > 0 , ζ2e > 0			ζ1e = 0 , ζ2e > 0			ζ1e > 0 , ζ2e = 0			ζ1e =ζ2e = 0		
	mean	5%	95%	mean	5%	95%	mean	5%	95%	mean	5%	95%
η_I	0.593	0.354	0.803	0.580	0.368	0.810	0.343	0.171	0.530	0.407	0.169	0.626
Ω_N	0.341	0.290	0.387	0.323	0.265	0.394	0.419	0.351	0.488	0.421	0.341	0.496
σ	2.207	2.141	2.264	1.998	1.918	2.087	2.048	1.952	2.142	2.112	2.034	2.185
Ω_M	0.364	0.337	0.399	0.205	0.157	0.257	0.266	0.227	0.310	0.214	0.177	0.245
τ_D	3.336	2.520	4.086	2.210	1.752	2.628	2.582	1.902	3.213	4.252	3.587	5.137
Ω	0.972	0.966	0.978	0.677	0.542	0.825	0.948	0.925	0.977	0.969	0.958	0.978
γ	0.159	0.116	0.199	0.584	0.504	0.682	0.753	0.694	0.819	0.335	0.248	0.482
λ	0.121	0.079	0.166	0.127	0.083	0.170	0.088	0.057	0.123	0.120	0.076	0.165
Ω_R	0.710	0.688	0.732	0.661	0.629	0.695	0.599	0.536	0.663	0.620	0.578	0.658
φ_Π	1.998	1.926	2.073	1.893	1.787	1.991	1.926	1.854	1.998	1.977	1.908	2.052
φ_Y	0.340	0.263	0.429	0.438	0.340	0.523	0.240	0.187	0.287	0.239	0.196	0.275
ζ^1_e	0.492	0.434	0.567	0.000	0.000	0.000	0.295	0.229	0.367	0.000	0.000	0.000
ζ^2_e	0.093	0.049	0.141	0.460	0.361	0.566	0.000	0.000	0.000	0.000	0.000	0.000
μ(*)	0.015	0.009	0.020	0.006	0.002	0.010	0.009	0.000	0.016	0.002	0.000	0.004
Ω_Q	0.879	0.828	0.931	0.846	0.788	0.906	0.860	0.818	0.914	0.305	0.247	0.361
θ_D	0.854	0.837	0.872	0.840	0.814	0.869	0.813	0.788	0.837	0.797	0.770	0.833
δ_D	0.412	0.367	0.471	0.408	0.332	0.490	0.459	0.403	0.510	0.412	0.382	0.441
θ_W	0.785	0.767	0.803	0.839	0.823	0.854	0.782	0.750	0.809	0.828	0.800	0.854
δw	0.516	0.454	0.570	0.375	0.316	0.432	0.441	0.411	0.483	0.380	0.345	0.417
$\rho_{\text{Y foreing output}}$	0.882	0.842	0.923	0.844	0.797	0.898	0.857	0.803	0.907	0.833	0.795	0.870
$\rho_{\text{P foreing inflation}}$	0.699	0.624	0.788	0.806	0.749	0.861	0.743	0.679	0.806	0.680	0.628	0.724
$\rho_{\text{R foreing interest rate}}$	0.700	0.651	0.754	0.762	0.696	0.821	0.780	0.698	0.847	0.836	0.796	0.877
$\rho_{\text{A productivity}}$	0.518	0.450	0.600	0.690	0.629	0.752	0.683	0.616	0.755	0.720	0.643	0.788
$\rho_{\text{PC price commodity}}$	0.711	0.651	0.773	0.780	0.731	0.835	0.793	0.749	0.843	0.779	0.733	0.823
$\rho_{\text{Z2 preference}}$	0.585	0.504	0.696	0.484	0.404	0.557	0.331	0.221	0.437	0.620	0.555	0.681
$\rho_{\text{Z3 mark-up prices}}$	0.652	0.607	0.698	0.676	0.591	0.758	0.680	0.612	0.747	0.473	0.390	0.551
$\rho_{\text{Z4 risk premium}}$	0.515	0.465	0.564	0.574	0.501	0.642	0.654	0.602	0.703	0.723	0.658	0.792
$\rho_{\text{Z5 mark-up wages}}$	0.399	0.323	0.474	0.488	0.369	0.619	0.474	0.387	0.562	0.476	0.400	0.548
$\rho_{\text{K invesment}}$	0.867	0.812	0.930	0.874	0.833	0.918	0.906	0.852	0.952	0.911	0.881	0.950
ρ_{MA1}	0.494	0.445	0.547	0.445	0.356	0.533	0.479	0.414	0.550	0.355	0.279	0.421
ρ_{MA2}	0.523	0.475	0.575	0.527	0.434	0.621	0.504	0.434	0.588	0.560	0.495	0.647
ρ_{MA3}	0.505	0.414	0.585	0.493	0.417	0.570	0.426	0.353	0.495	0.544	0.477	0.615
ρ_{MA4}	0.350	0.261	0.430	0.551	0.451	0.656	0.489	0.385	0.614	0.535	0.429	0.642
TREND_M	0.724	0.675	0.775	0.550	0.487	0.611	0.826	0.756	0.908	0.557	0.483	0.631
CONST_I	0.592	0.553	0.623	0.567	0.534	0.604	0.606	0.579	0.634	0.664	0.633	0.693
CONST_R	0.710	0.189	1.155	1.127	0.546	1.677	1.046	0.642	1.509	0.880	0.310	1.477
CTREND	0.224	0.165	0.283	0.236	0.190	0.290	0.217	0.162	0.270	0.238	0.196	0.270
CONSTEPINF	0.531	0.512	0.551	0.523	0.499	0.542	0.535	0.514	0.554	0.542	0.522	0.561
CONSTER	0.800	0.583	1.017	0.752	0.548	0.977	0.807	0.527	1.085	0.679	0.402	0.954
λ_{DSGE}	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\sigma_{\text{M interest rate}}$	1.137	0.962	1.321	1.169	0.978	1.370	1.204	0.975	1.422	1.046	0.871	1.236
$\sigma_{\text{Y foreing output}}$	0.799	0.675	0.924	0.851	0.711	0.994	0.831	0.697	0.952	0.853	0.718	0.986
$\sigma_{\text{P foreing inflation}}$	0.500	0.428	0.575	0.475	0.400	0.552	0.480	0.407	0.546	0.493	0.410	0.575
$\sigma_{\text{R foreing interest rate}}$	0.296	0.251	0.339	0.284	0.236	0.326	0.280	0.239	0.319	0.272	0.237	0.308
$\sigma_{\text{A productivity}}$	5.433	4.601	6.443	5.132	4.364	6.006	4.129	3.517	4.781	4.356	3.450	5.222
$\sigma_{\text{PC price commodity}}$	13.208	11.684	14.594	12.099	10.604	13.754	12.408	10.907	14.077	13.279	11.556	15.450
$\sigma_{\text{Z2 preference}}$	0.656	0.474	0.833	0.487	0.396	0.575	0.481	0.385	0.578	0.595	0.465	0.740
$\sigma_{\text{Z3 mark-up prices}}$	0.498	0.390	0.613	0.438	0.323	0.545	0.605	0.442	0.768	0.646	0.437	0.834
$\sigma_{\text{Z4 risk premium}}$	2.327	1.897	2.790	2.084	1.613	2.579	1.943	1.587	2.280	0.900	0.682	1.113
$\sigma_{\text{Z5 mark-up wages}}$	0.846	0.659	1.013	0.838	0.688	1.003	0.868	0.703	1.004	1.291	0.929	1.707
$\sigma_{\text{K investment}}$	1.499	1.034	1.962	1.466	0.905	2.066	1.835	1.076	2.719	1.766	0.808	2.828

Table 3. Posterior Distribution for Small Open Economies (Continued)

Parameters	Peru											
	DSGE-VAR											
	ζ1e > 0 , ζ2e > 0			ζ1e = 0 , ζ2e > 0			ζ1e > 0 , ζ2e = 0			ζ1e =ζ2e = 0		
	mean	5%	95%	mean	5%	95%	mean	5%	95%	mean	5%	95%
η_I	0.646	0.406	0.879	0.594	0.334	0.836	0.720	0.425	0.979	0.824	0.399	1.301
Ω_N	0.608	0.516	0.695	0.405	0.289	0.501	0.511	0.398	0.630	0.474	0.406	0.541
σ	2.169	2.045	2.310	2.043	1.926	2.188	2.058	1.974	2.153	1.988	1.903	2.054
Ω_M	0.219	0.158	0.286	0.172	0.121	0.219	0.205	0.159	0.258	0.194	0.165	0.218
τ_D	3.553	2.710	4.414	6.008	4.806	7.067	4.682	4.069	5.408	4.482	3.689	5.241
Ω	0.619	0.542	0.696	0.702	0.612	0.779	0.584	0.513	0.657	0.552	0.455	0.621
γ	0.170	0.044	0.298	0.230	0.089	0.342	0.084	0.018	0.160	0.080	0.008	0.132
λ	0.279	0.198	0.365	0.203	0.135	0.274	0.194	0.121	0.264	0.239	0.156	0.310
Ω_R	0.623	0.573	0.699	0.605	0.547	0.662	0.611	0.565	0.659	0.615	0.569	0.655
φ_Π	1.843	1.734	1.941	2.046	1.927	2.164	1.991	1.850	2.101	2.066	1.950	2.163
φ_Y	0.498	0.369	0.622	0.375	0.301	0.458	0.467	0.370	0.554	0.301	0.207	0.398
ζ^1_e	0.405	0.288	0.541	0.000	0.000	0.000	0.297	0.135	0.478	0.000	0.000	0.000
ζ^2_e	0.093	0.000	0.171	0.149	0.026	0.262	0.000	0.000	0.000	0.000	0.000	0.000
$\mu(*)$	0.009	-0.001	0.023	0.009	-0.001	0.023	0.008	-0.001	0.019	0.006	-0.001	0.015
Ω_Q	0.694	0.590	0.803	0.664	0.483	0.825	0.630	0.511	0.748	0.644	0.551	0.752
θ_D	0.691	0.639	0.739	0.710	0.668	0.751	0.706	0.636	0.767	0.747	0.718	0.778
δ_D	0.458	0.405	0.514	0.437	0.401	0.476	0.373	0.331	0.424	0.397	0.354	0.442
θ_W	0.561	0.515	0.604	0.589	0.509	0.678	0.623	0.554	0.698	0.649	0.611	0.687
δw	0.393	0.347	0.438	0.451	0.391	0.511	0.426	0.386	0.479	0.431	0.385	0.473
$\rho_{Y\ foreing\ output}$	0.586	0.506	0.660	0.605	0.512	0.696	0.405	0.333	0.468	0.589	0.535	0.657
$\rho_{P\ foreing\ inflation}$	0.527	0.434	0.619	0.469	0.368	0.575	0.598	0.522	0.696	0.624	0.578	0.669
$\rho_{R\ foreing\ interest\ rate}$	0.533	0.406	0.645	0.645	0.529	0.761	0.646	0.556	0.727	0.694	0.638	0.749
$\rho_{A\ productivity}$	0.482	0.383	0.582	0.377	0.279	0.479	0.386	0.296	0.472	0.471	0.381	0.566
$\rho_{PC\ price\ commodity}$	0.570	0.466	0.658	0.516	0.347	0.684	0.505	0.396	0.607	0.427	0.357	0.492
$\rho_{Z2\ preference}$	0.432	0.321	0.529	0.283	0.189	0.398	0.433	0.353	0.510	0.347	0.280	0.415
$\rho_{Z3\ mark\text{-}up\ prices}$	0.440	0.329	0.566	0.369	0.250	0.476	0.455	0.329	0.603	0.408	0.327	0.489
$\rho_{Z4\ risk\ premium}$	0.488	0.389	0.583	0.479	0.364	0.595	0.416	0.318	0.530	0.384	0.336	0.438
$\rho_{Z5\ mark\text{-}up\ wages}$	0.584	0.485	0.686	0.628	0.528	0.745	0.473	0.353	0.588	0.532	0.454	0.610
$\rho_{K\ invesment}$	0.554	0.446	0.655	0.566	0.453	0.698	0.615	0.541	0.686	0.579	0.502	0.673
ρ_{MA1}	0.451	0.366	0.529	0.405	0.300	0.497	0.348	0.228	0.453	0.390	0.309	0.471
ρ_{MA2}	0.615	0.532	0.696	0.401	0.307	0.504	0.642	0.580	0.715	0.465	0.409	0.567
ρ_{MA3}	0.492	0.409	0.579	0.414	0.264	0.579	0.636	0.538	0.715	0.303	0.229	0.392
ρ_{MA4}	0.374	0.323	0.425	0.533	0.381	0.660	0.587	0.457	0.729	0.497	0.412	0.572
TREND_M	0.754	0.647	0.862	0.796	0.693	0.927	0.788	0.698	0.882	0.686	0.601	0.765
CONST_I	0.581	0.277	0.897	0.461	0.207	0.686	0.488	0.225	0.741	0.535	0.236	0.856
CONST_R	1.129	0.439	1.745	0.800	0.315	1.275	1.021	0.495	1.592	1.157	0.710	1.668
CTREND	0.329	0.249	0.406	0.310	0.220	0.409	0.424	0.313	0.517	0.383	0.276	0.509
CONSTEPINF	0.608	0.538	0.678	0.508	0.420	0.594	0.525	0.451	0.609	0.522	0.429	0.607
CONSTER	0.258	0.029	0.477	0.323	0.025	0.604	0.388	0.057	0.750	0.281	0.053	0.524
λ_{DSGE}	0.780	0.601	0.943	0.793	0.643	0.985	0.790	0.622	0.959	0.824	0.629	1.072
$\sigma_{M\ interest\ rate}$	0.555	0.385	0.718	0.497	0.328	0.656	0.518	0.352	0.682	0.408	0.298	0.505
$\sigma_{Y\ foreing\ output}$	0.570	0.452	0.678	0.576	0.460	0.692	0.558	0.436	0.682	0.587	0.464	0.694
$\sigma_{P\ foreing\ inflation}$	0.389	0.313	0.458	0.373	0.310	0.433	0.381	0.315	0.447	0.359	0.319	0.402
$\sigma_{R\ foreing\ interest\ rate}$	0.276	0.237	0.310	0.274	0.235	0.310	0.272	0.235	0.302	0.271	0.236	0.300
$\sigma_{A\ productivity}$	1.363	1.001	1.761	1.799	1.240	2.414	1.563	1.093	2.023	2.008	1.572	2.844
$\sigma_{PC\ price\ commodity}$	6.993	5.222	8.570	7.455	5.571	9.717	7.051	5.371	8.515	6.808	5.388	8.208
$\sigma_{Z2\ preference}$	0.485	0.374	0.601	0.502	0.385	0.617	0.489	0.386	0.598	0.522	0.388	0.628
$\sigma_{Z3\ mark\text{-}up\ prices}$	0.401	0.309	0.503	0.410	0.313	0.506	0.399	0.302	0.496	0.392	0.325	0.467
$\sigma_{Z4\ risk\ premium}$	0.866	0.637	1.104	0.816	0.555	1.060	0.843	0.606	1.036	0.805	0.587	1.013
$\sigma_{Z5\ mark\text{-}up\ wages}$	0.605	0.474	0.733	0.610	0.479	0.754	0.600	0.455	0.733	0.613	0.482	0.743
$\sigma_{K\ investment}$	1.927	1.025	2.735	2.139	1.140	3.209	1.503	0.940	2.057	1.687	1.050	2.093

Figures

Figure 1. DSGE-VAR Variance Decomposition[a]



a. Computations conditional on the posterior mode values.

Figure 2. Transmission of a Monetary Shock in the DSGE-VAR (dotted lines) and DSGE (solid lines) Models

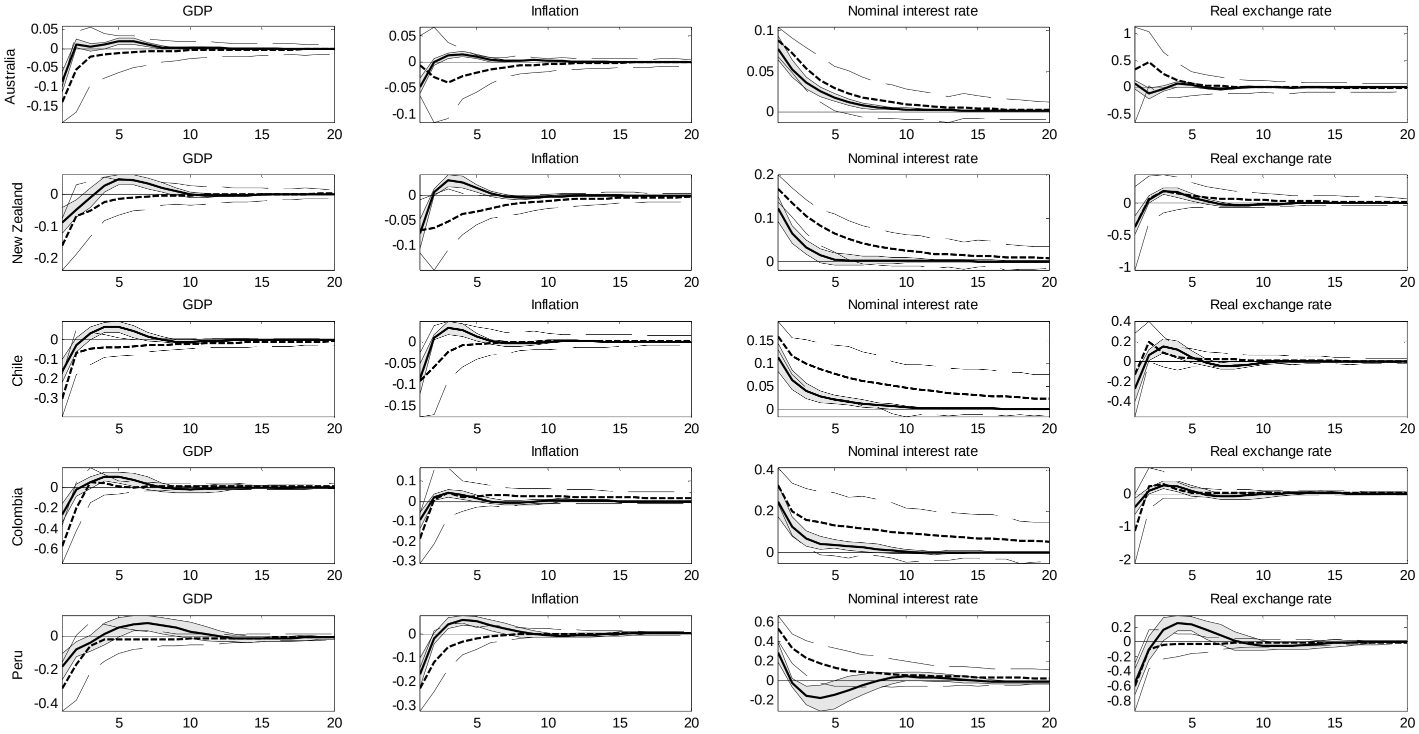


Figure 3. Transmission of a Productivity Shock in the DSGE-VAR (dotted lines) and DSGE (solid lines) Models

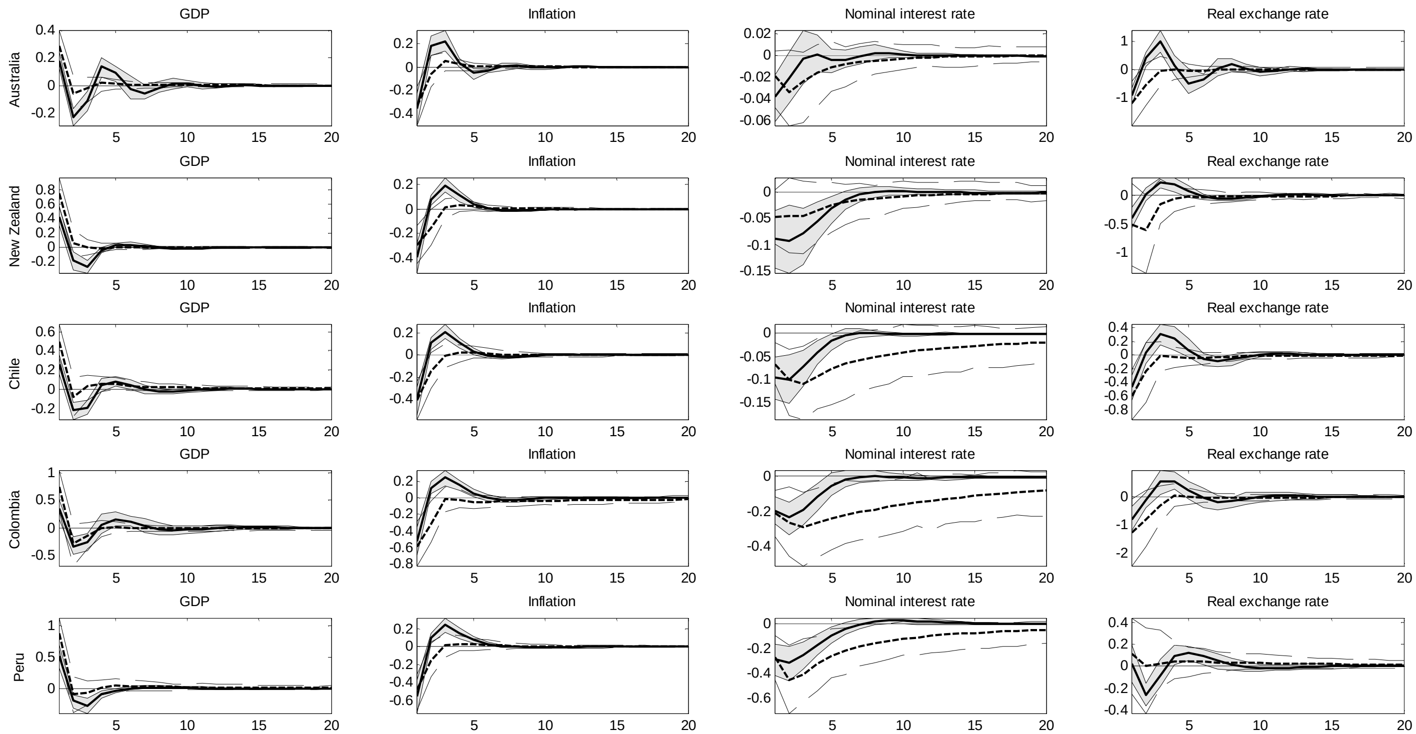


Figure 4. Transmission of a Preference Shock in the DSGE-VAR (dotted lines) and DSGE (solid lines) Models

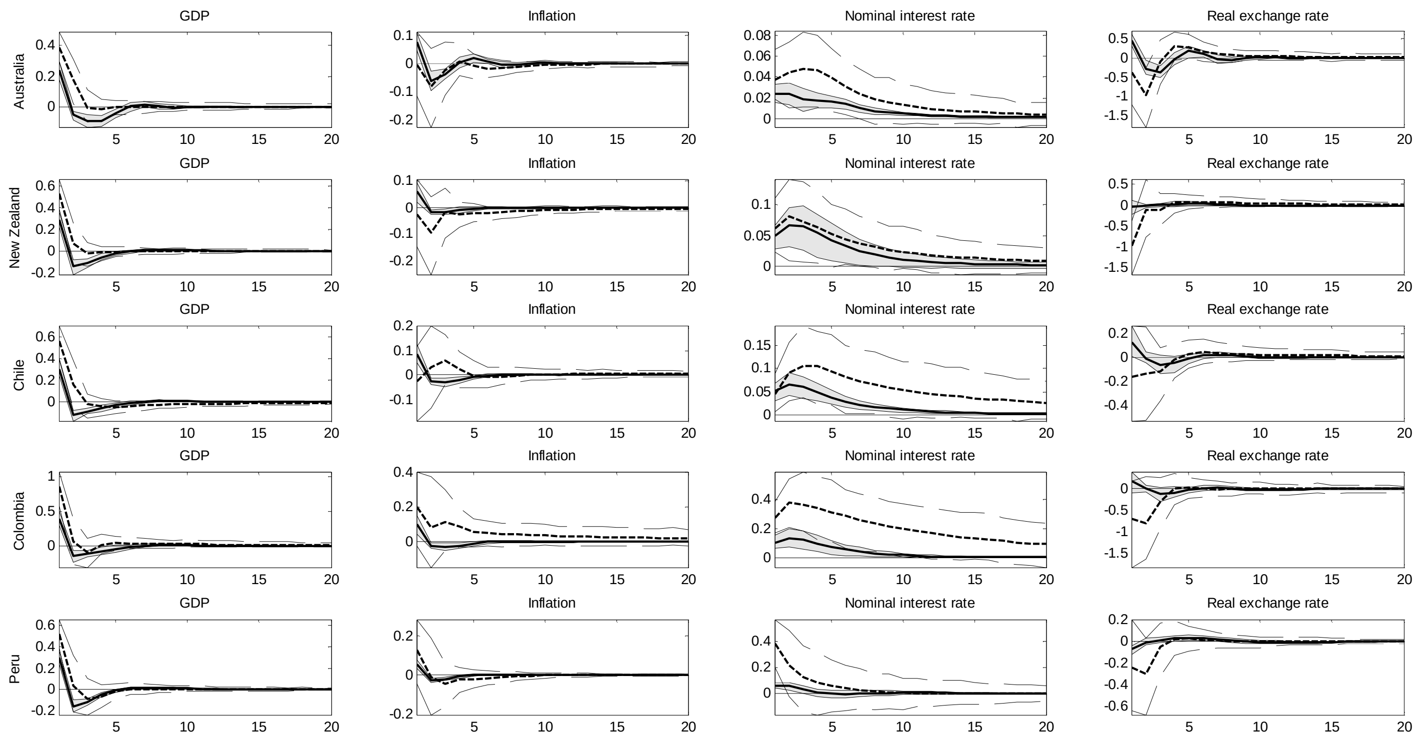


Figure 5. Transmission of a Price Mark-Up Shock in the DSGE-VAR (dotted lines) and DSGE (solid lines) Models

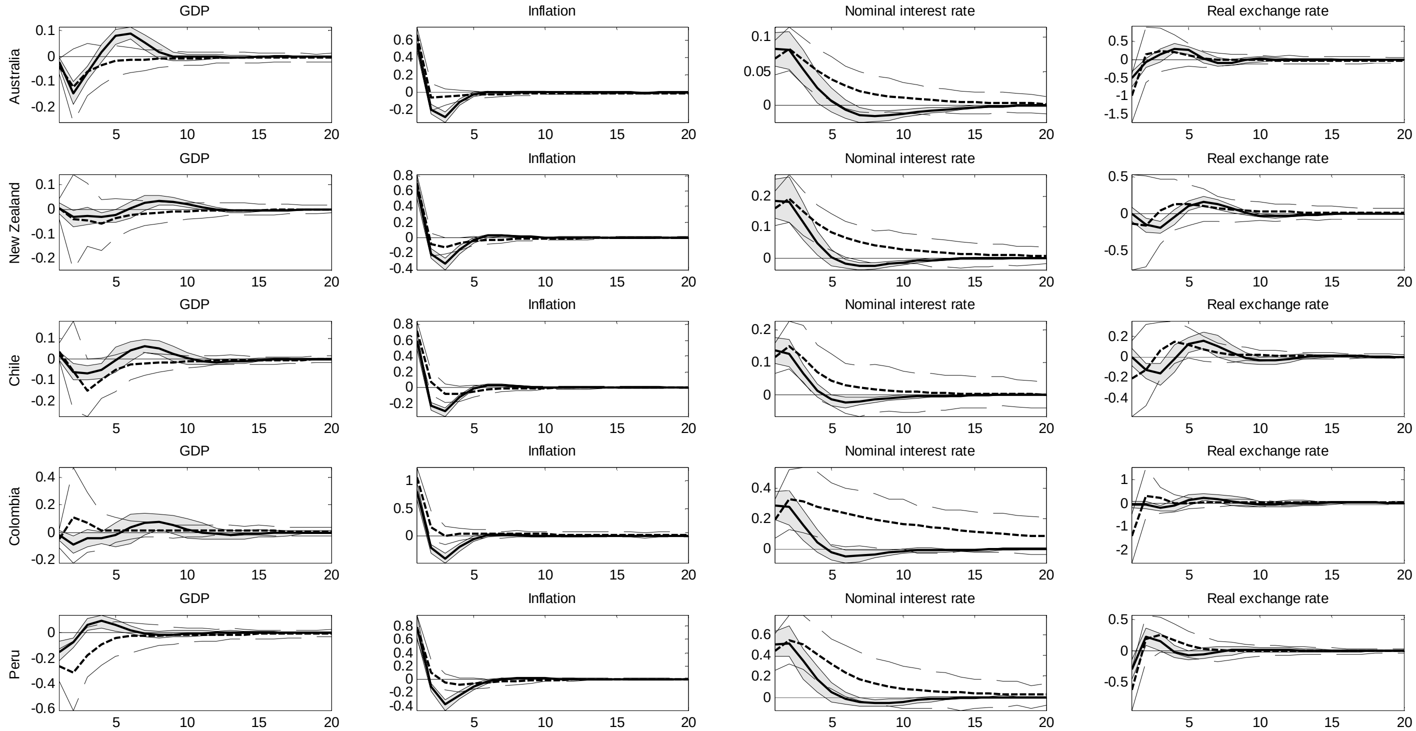


Figure 6. Transmission of a Wage Mark-Up Shock in the DSGE-VAR (dotted lines) and DSGE (solid lines) Models

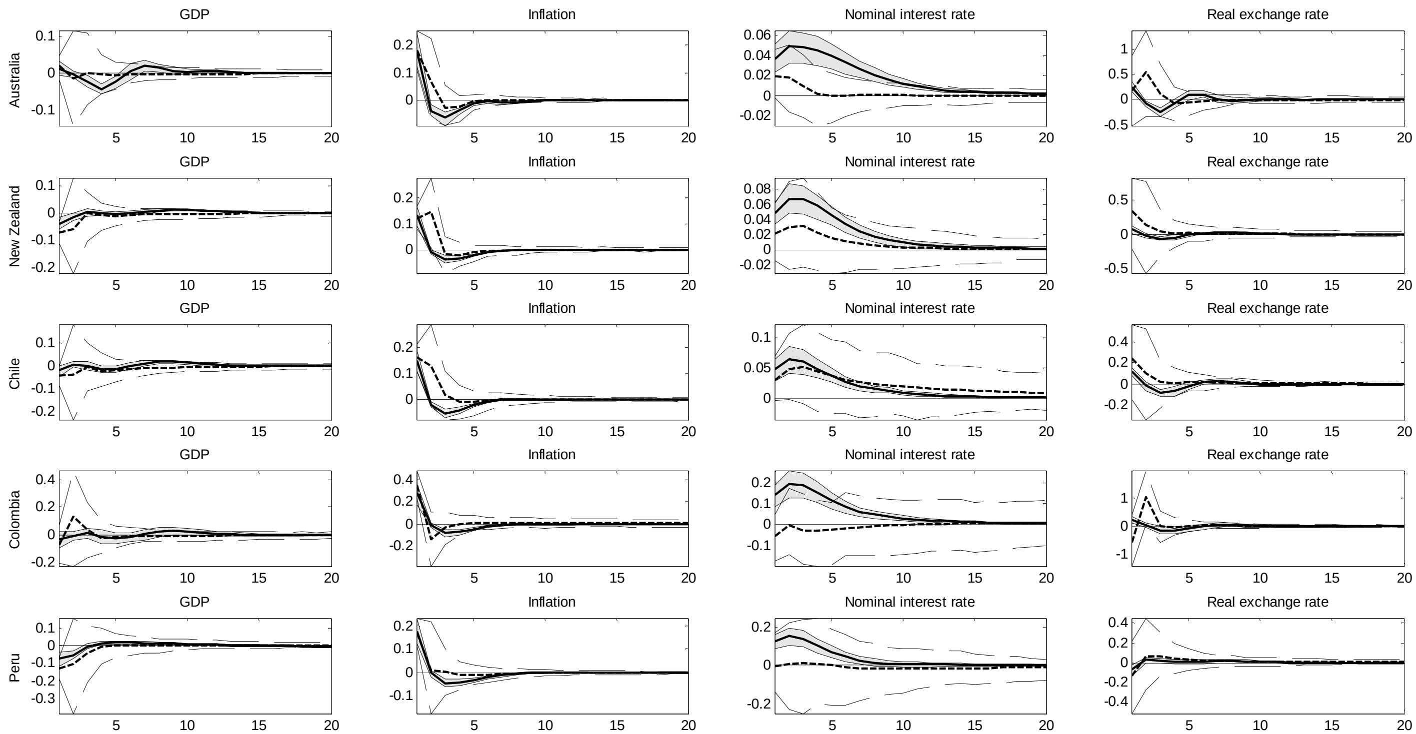


Figure 7. Transmission of a Commodity-Price Shock in the DSGE-VAR (dotted lines) and DSGE (solid lines) Models

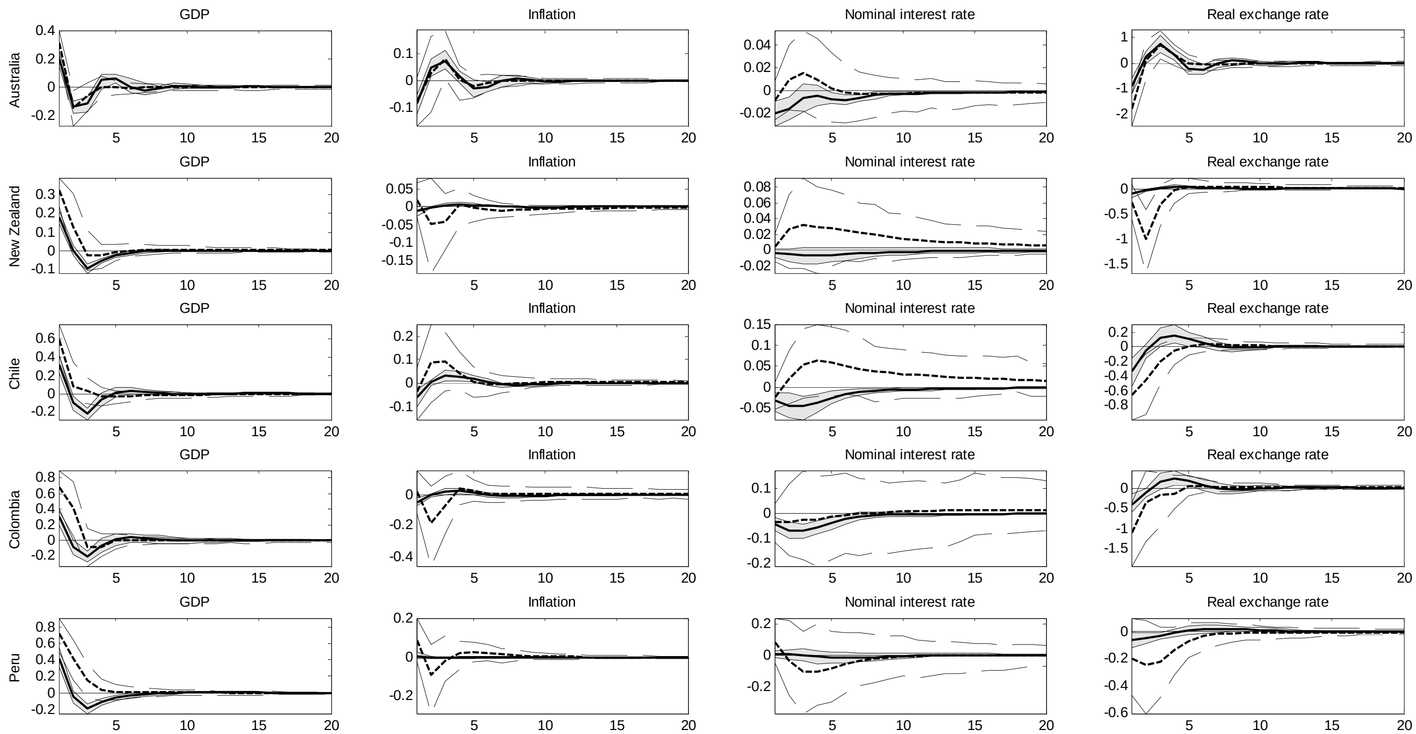


Figure 8. Transmission of a Risk-Premium Shock in the DSGE-VAR (dotted lines) and DSGE (solid lines) Models

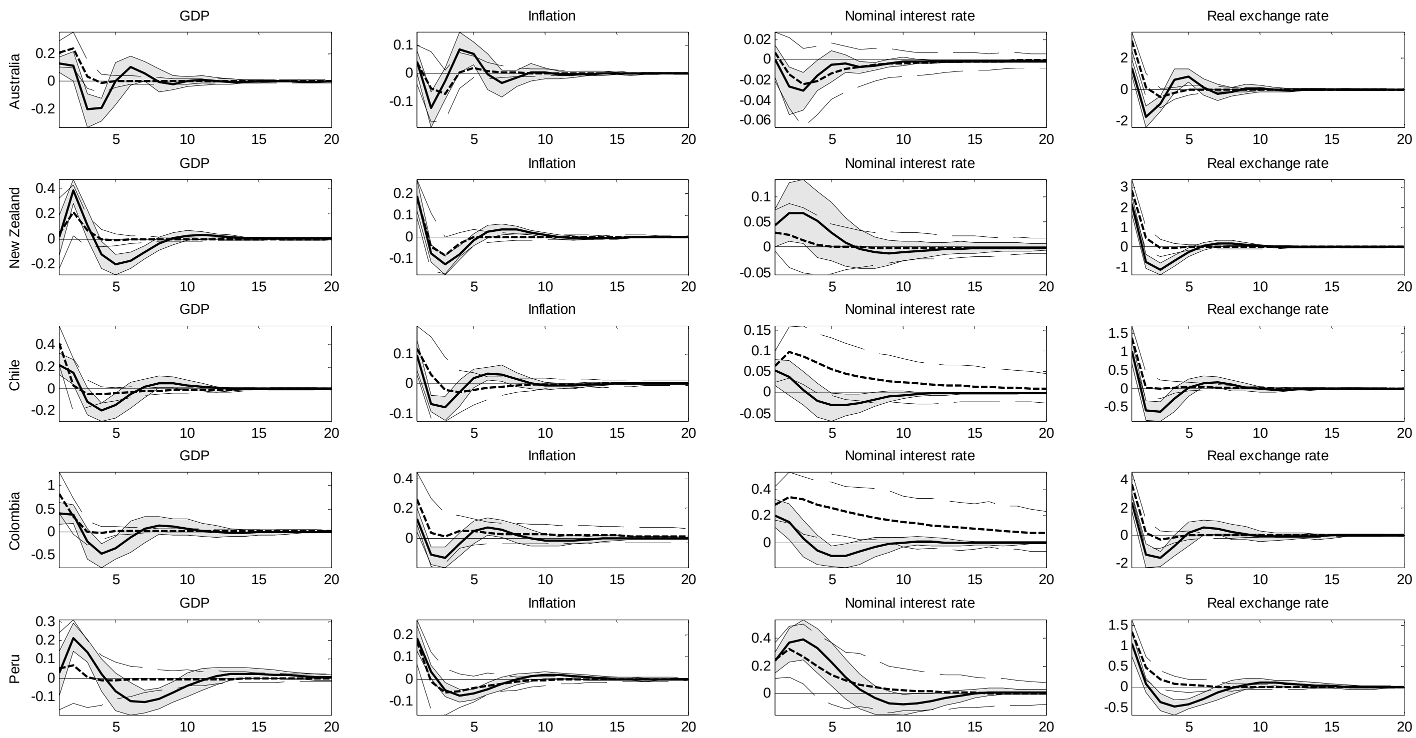


Figure 9. MCMC Chains
Australia

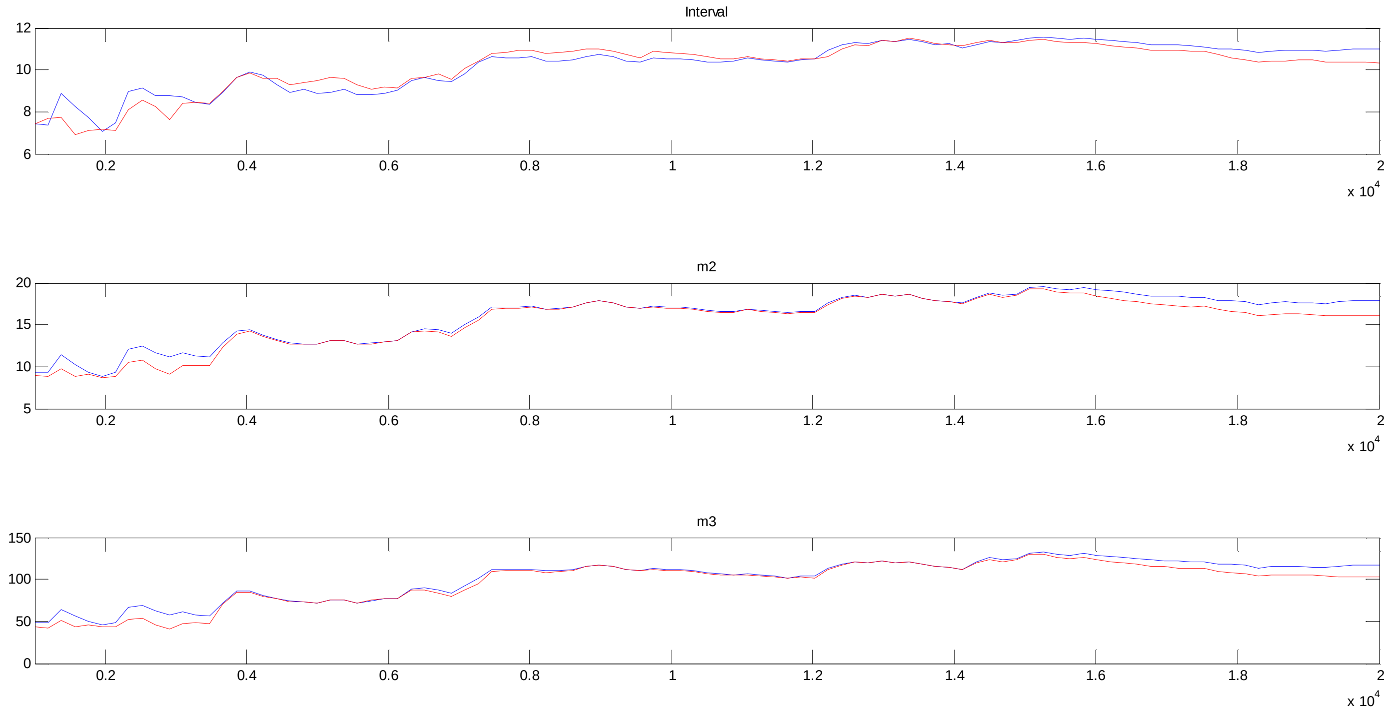


Figure 9. MCMC Chains (continued)
New Zealand

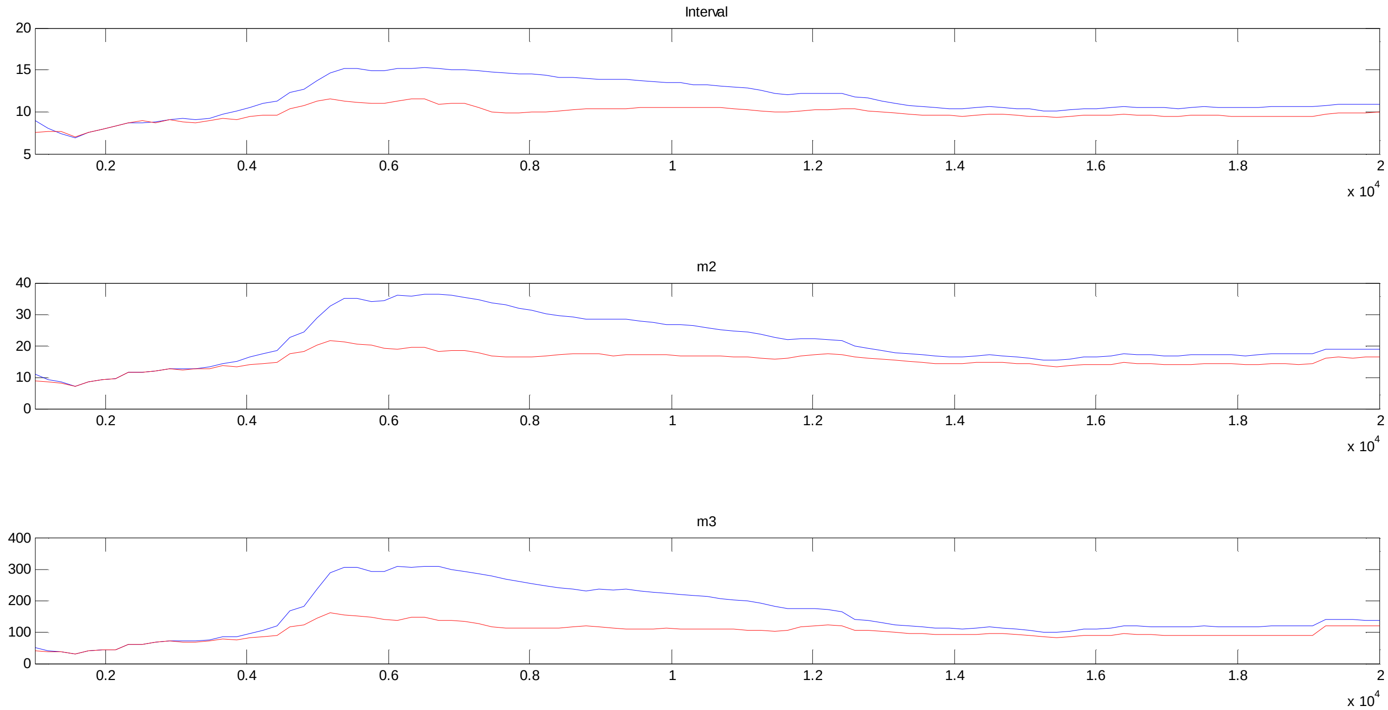


Figure 9. MCMC Chains (continued)

Chile

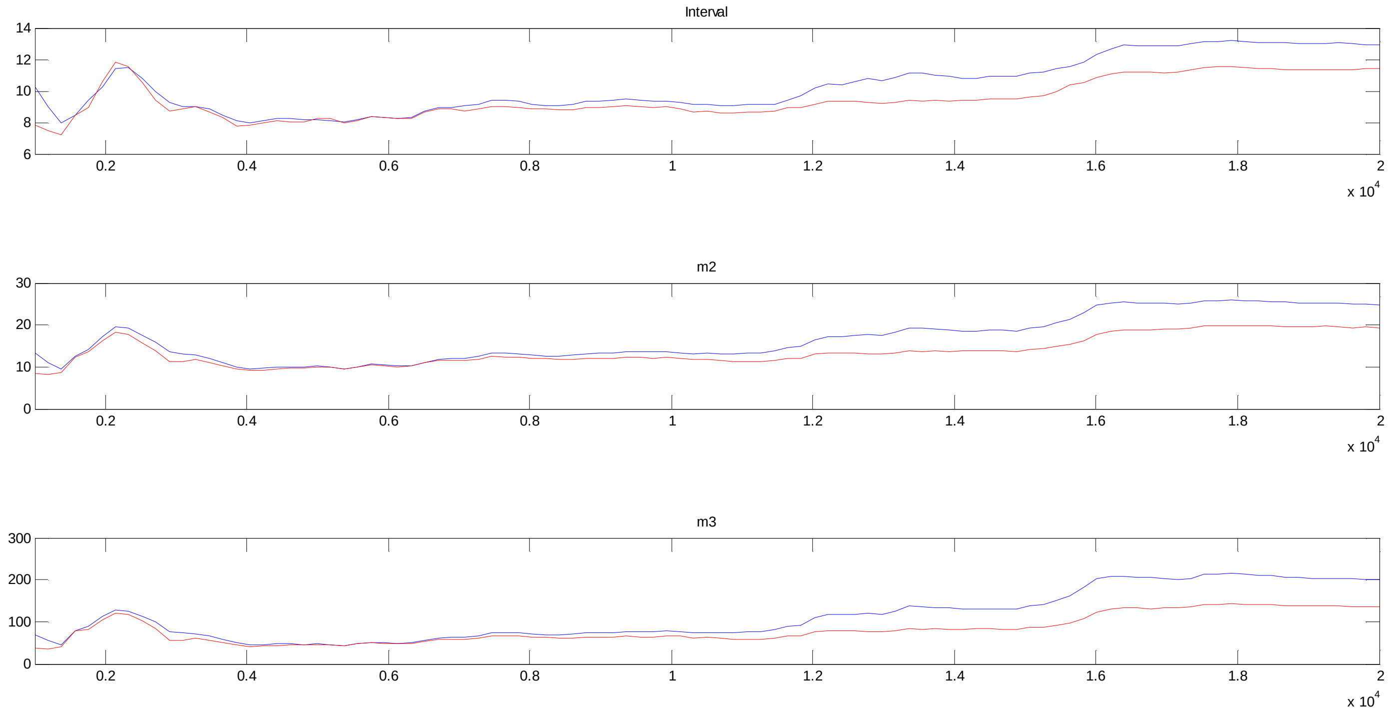


Figure 9. MCMC Chains (continued)
Colombia

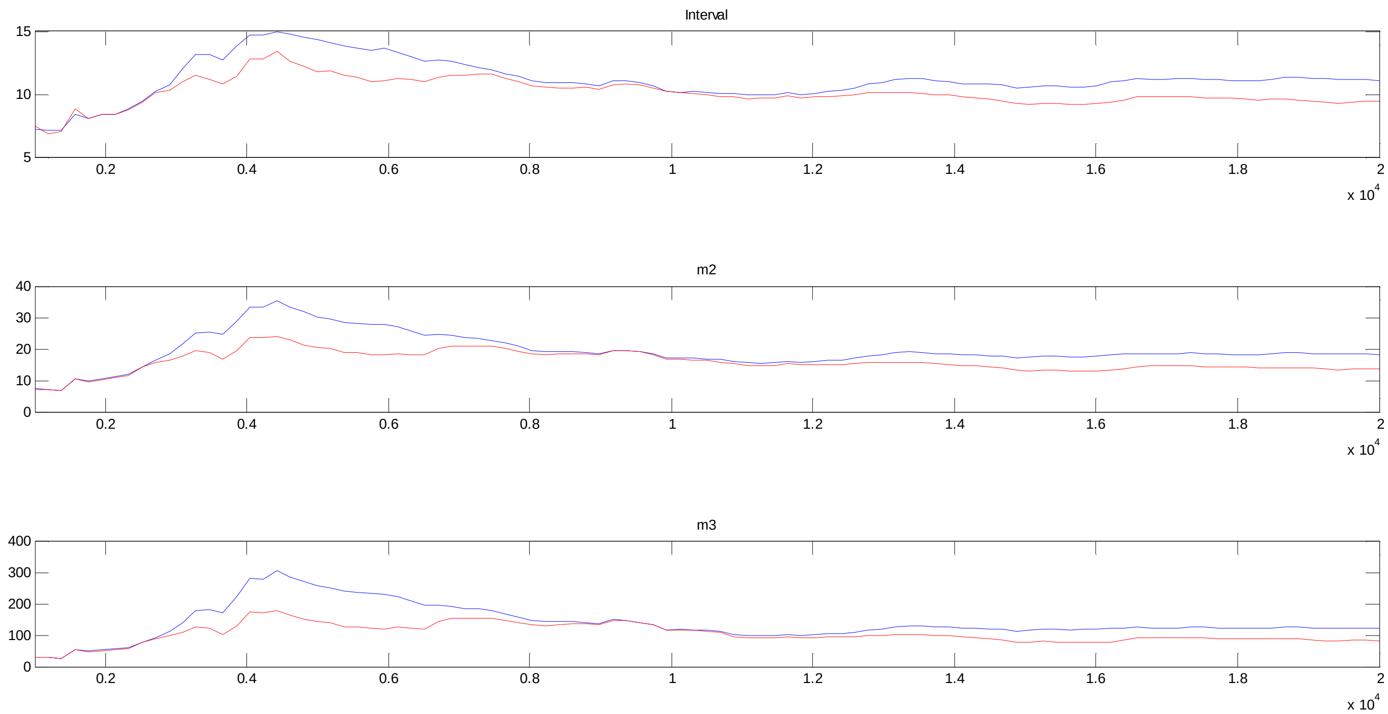


Figure 10. MCMC Chains (continued)
Peru