What Drives the Current Account in Commodity Exporting Countries? The Cases of Chile and New Zealand

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As capital markets have become increasingly integrated, savings and investment within countries have tended to become less correlated, in what is known as the Feldstein-Horioka (1980) correlation, with the corollary that savings-investment gaps (that is, current accounts) have tended to become more variable. Many countries have also registered a trend toward larger gross external asset and liability positions relative to gross domestic product (GDP), even when net positions have changed little (Lane and Milesi-Ferretti, 2003). The increase in both external stocks and external flows relative to income allows a more efficient matching of borrowers and savers, but it also creates risks for both macroeconomic stability and financial stability associated with swings in sentiment in financial markets. An assesment of the main domestic and external factors that drive variations in the external accounts helps in understanding the macroeconomic implications that might stem from adjustments. We observe the current account from three reduced-form

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perspectives: as current account transactions, such as imports, exports, and interest payments on debt; as financial transactions; and as the domestic savings-investment gap. When financial accounts were closed, developments in the terms of trade and competitiveness were thought to drive trade flows and the current account. As capital markets have opened, the role of savings-investment decisions and financial flows have come to be seen as increasingly important. None of these three reduced-form views, however, tells us about causality or about the endogenous interactions among factors such as interest rates, exchange rates, savings, and investment. To understand the underlying driving forces, we need a structural model.

This paper uses an estimated open economy dynamic stochastic general equilibrium (DSGE) model to ask what factors account for current account developments in Chile and New Zealand, two small open economies that share many common features. Using a DSGE model to describe the evolution of the current account offers several methodological advantages. This type of model provides a framework for understanding the joint determination of major macroeconomic variables based on a coherent description of micro-foundations and equilibrium conditions. In particular, our model provides a rich, detailed macroeconomic framework for assessing the economic implications and policy recommendations associated with current account behavior in Chile and New Zealand. Several types of nominal and real rigidities are in place, making the transmission mechanisms quantitatively appealing. We also include a commodity sector in the model structure to capture the relevance of commodity exports in both countries. Seven domestic shocks and three external shocks are considered to explain current account fluctuations. These include variations in foreign financial conditions, foreign demand, export commodity prices, productivity, an investment-specific shock, and macroeconomic policy.

Chile and New Zealand are both small open economies whose main exports are based on natural resources. Both economies have liberalized their trade and capital accounts. Chile implemented reforms in the 1970s, including trade and financial liberalization, and in the 1990s, it embraced new reforms and a policy of bilateral trade agreements.[1] New Zealand's external sector reforms were mainly concentrated in 1984–85. Another common feature is the

1. Some of the reforms were scaled back after the crisis in 1982. For instance, tariffs were increased between 1983 and 1985. In the 1990s, capital controls were introduced to slow down capital inflows, but many of those controls were removed in 1999.

macroeconomic policy framework. The central banks of both countries gained autonomy in 1989, and both operate monetary policy within an inflation-targeting framework. Both governments have a commitment to prudent fiscal policy. Despite these similarities, the countries display several significant differences. Per capita income in New Zealand is more than twice that in Chile, and income distribution is more equal. In Chile, profits from commodity exports accrue to the government and foreign investors, while in New Zealand, they accrue mainly to domestic private agents. New Zealand has faced large procyclical swings in immigration, which are not a relevant phenomenon in Chile. Lastly, the structure of external liabilities differs significantly in the two economies. New Zealand has a much larger net stock of external debt (77 percent of GDP at year-end 2006) than Chile. However, New Zealand has been able to finance this external debt largely with domestic currency borrowing, which somewhat offsets the risks of a large external position. Chile, like most emerging markets, still relies mainly on foreign-currency-denominated debt.

In our estimated model, the main factors that account for fluctuations in the current accounts of both countries are investment-specific shocks, changes in foreign financial conditions, and variations in foreign demand. In New Zealand, fluctuations in commodity export prices have also been important. In both countries, foreign shocks account for about half of the variation in the current account. Monetary and fiscal policy shocks (that is, deviations from policy rules) play a relatively small role in both countries, although our estimation for Chile indicates that monetary restraint can help to reduce a current account deficit. In contrast, the estimated role of monetary restraint in New Zealand in improving the trade account is offset by the negative effect of higher domestic interest rates on debt service.

Although the model offers a very comprehensive description of both countries, it still omits relevant features that may be important in understanding the propagation of shocks. In our accounting exercise with the estimated model, fluctuations in unobservable shocks might partially capture the propagation effects of these omitted features. This should be taken into account when interpreting the shocks from a structural perspective.[2]

2. For instance, the model abstracts from domestic financial frictions that might be important as a mechanism for amplifying and propagating fluctuations. Thus, if financial frictions are relevant at business cycle frequencies, their effects will be attributed to other shocks in the model. Chari, Kehoe, and McGrattan (2007) discuss how to connect inferred shocks with required frictions in general equilibrium models.

Counterfactual experiments show that if Chile's external debt was denominated in Chilean pesos, the impact of foreign shocks on the domestic variables would be reduced, but the current account response to domestic supply shocks would be amplified. It would also mean that monetary policy had less scope to influence current account dynamics, because the positive effect of higher interest rates on the trade balance would be largely offset by a negative effect on the investment income balance through higher debt service. Moreover, a smaller movement in the real exchange rate would be required to generate an adjustment in the current account. For the case of New Zealand, counterfactual experiments suggest that changes in the degree of smoothness of the monetary policy rule would have little effect on the exchange rate and current account paths.

The paper is organized as follows. The next section briefly outlines the main macroeconomic developments in New Zealand and Chile over the last twenty years. Section two then describes the small open economy model that characterizes the main features of the Chilean and New Zealand economies. Model estimation is presented in section three. In section four, we analyze the main transmission mechanism implied by the model for both Chile and New Zealand, by describing the impulse response functions to different shocks. In section five, we evaluate the relative importance of these shocks by presenting the variance decomposition and the historical decomposition of the current accounts. Section six reports counterfactual experiments regarding the elimination of the original-sin problem for Chile and the influence of monetary policy on the path of the exchange rate and current account in New Zealand. Section seven concludes.

1. Current Account and Macroeconomic Framework Developments

In the 1970s Chile began an extensive program of economic reforms that included profound trade and financial liberalizations. A fixed exchange rate system was introduced at the end of that decade to help stabilize the economy. However, the persistence of inflation led to a substantial appreciation of the real exchange rate, which was exacerbated by a surge in capital inflows. The current account deteriorated sharply between 1978 and 1981, reaching a deficit of almost 12 percent of GDP. In 1981, the Central Bank spent international reserves for an amount equivalent to more than 4 percent of GDP to defend the peg. In June 1982 the government was forced to abandon the peg. This currency crisis was accompanied by a financial crisis and a severe recession in which GDP felt by almost 16 percent in 1982–83.

After this crisis, private capital flows into the economy ceased. The current account deficit was mostly financed with official loans from international agencies, and it was steadily reduced by a sharp increase in domestic savings. This increase in domestic savings can be explained, in part, by the pension reform of 1981, which gradually introduced a fully funded pension system (Bennett, Loayza, and Schmidt-Hebbel, 2001; Morandé, 1998), and by the tax reform of 1984 (Agosín, 1998). During this period, exchange rate policy centered on a crawling peg, and some of the trade liberalization of the 1970s was reversed.

In 1989, the Central Bank of Chile, like the Reserve Bank of New Zealand, obtained autonomy in the implementation of monetary policy. The new constitutional charter that granted autonomy established two main objectives for the Central Bank: stabilizing the value of the national currency and ensuring the normal functioning of payments, including foreign payments. The Central Bank of Chile began to announce explicit annual targets for inflation in 1990. In addition to the inflation targets, the Central Bank maintained the crawling peg for the exchange rate put in place after the 1982 crisis.

In June 1991, the Central Bank introduced a set of capital controls to counteract the effects of large capital inflows. The rationale behind these capital controls was that some of the inflows were only transitory, but they had potentially long-lasting effects through their impact on the real exchange rate.[3] These capital inflows coincided with a general surge in capital inflows to emerging market economies (Calvo, Leiderman, and Reinhart, 1996; Fernández-Arias and Montiel, 1996), associated with both pull and push factors—that is, an increase in the appetite for investing in emerging markets economies by large foreign investors. They also coincided with a period of fast domestic growth and a large demand expansion. In addition to imposing capital controls, the Central Bank accumulated large international reserves to ameliorate the systematic appreciation of the real exchange rate. The Central Bank also set targets for the current account deficits as

3. The capital controls were aimed at alleviating pressures on the real exchange rate from the capital inflows and modifying their composition in favor of long-term foreign direct investment.

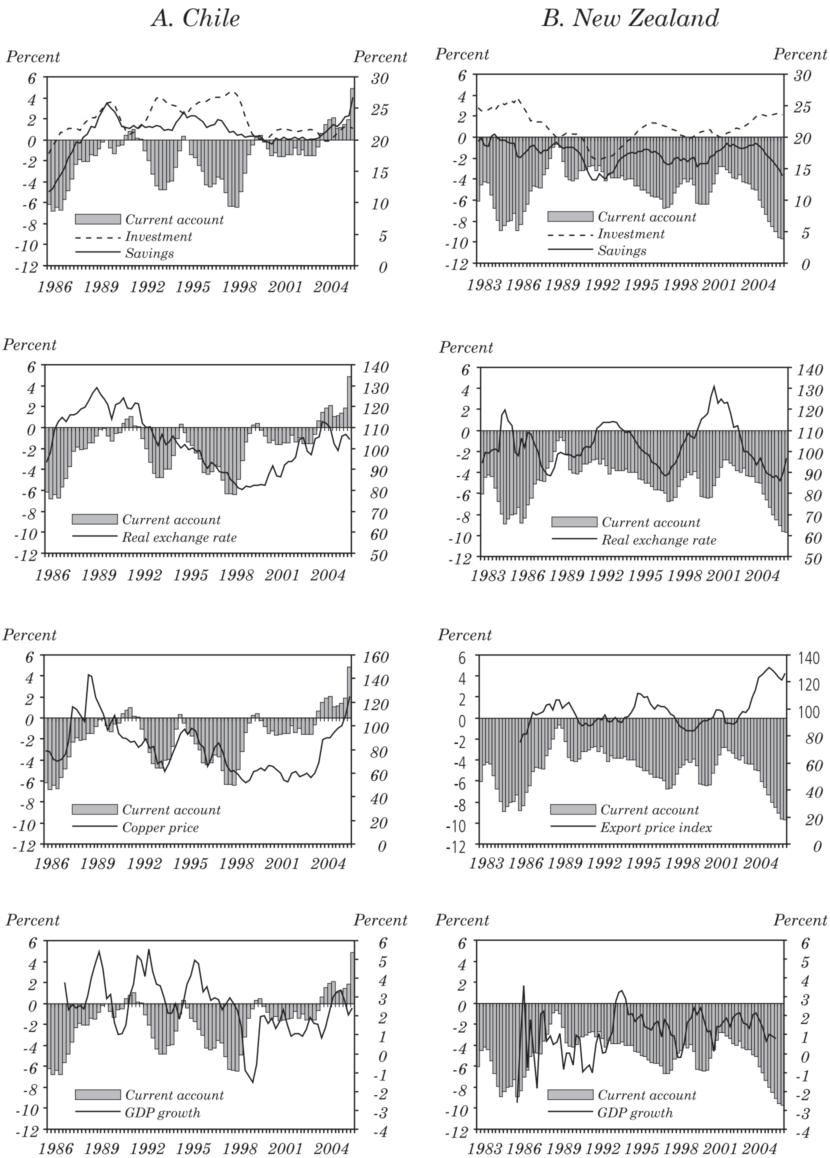
a precautionary policy against a sudden reversal of capital inflows, which might have undermined the normal functioning of the payments systems with undesirable consequences for GDP and inflation (see Zahler, 1998). The current account objective introduced an extra weight on the stabilization of the aggregate demand in the monetary policy, on top of that implied by the commitment to reduce inflation (see Medina and Valdés, 2002).

A short-lived current account reversal occurred after the 1994 Mexican crisis (see figure 1), but growth remained high. The Asian crisis of 1997 also led to a current account reversal. This time, however, it was accompanied by a sharp real depreciation of the currency, a significant reduction in GDP growth in 1998–99, and a drop in inflation from 4.6 percent in 1998 to 2.3 percent in 1999.

The events after the Asian crisis led the monetary authority to substantially revise its macroeconomic framework. The main new elements were the adoption of a full-fledged inflation targeting regime with a free-floating exchange rate, the deepening of the foreign exchange derivatives market, and the total opening of the capital account. Also, any explicit target for the current account deficit was eliminated (see Morandé, 2002; Massad, 2003). The Central Bank's transparency increased significantly with the publication of a regular inflation report and the public release of policy meeting minutes. A second key element was introduced into the macroeconomic policy framework in 2001. The Chilean government officially started implementing its fiscal policy through a structural balance rule. According to this rule, the government is committed to stabilizing public expenditures at a level consistent with potential output and with the long-run price of copper. This rule thus prevents excessive adjustments during a recession or unsustainable expenditure levels during booms. The commitment to debt sustainability and fiscal discipline has communicated a clear signal to the markets, which has helped lower the costs of external financing. Despite a period of low public savings after the Asian crisis, combined with growth rates below trend, Chilean sovereign bond spreads declined substantially, and their correlations with other emerging market spreads fell. More recently, the fiscal rule forced the government to save most of the windfall revenues from the high copper price.

New Zealand has received a net capital inflow every year since 1973. The decade prior to 1984 was characterized by large public sector deficits, and below-market interest rates drove a wedge between private savings and investment. On the trade side, competitiveness

Figure 1. Current Account and Economic Indicators: Chile and New Zealand



Source: Central Bank of Chile; Reserve Bank of New Zealand.

was eroded by the combination of a highly controlled economy, weak monetary control, declining terms of trade, an overvalued sliding-peg exchange rate, and the loss of favored trading status with Britain's entry into the European Economic Community. The current account deficit was financed by public borrowing abroad, which led to a buildup of public overseas debt. In 1984 external financing dried up as speculative pressures grew before the July election. Reserves were run down, resulting in a foreign exchange crisis.

After the election, New Zealand embarked on a major program of economic reform that included the liberalization of prices and financial markets, privatization, and the floating of the exchange rate in March 1985. This was followed by fiscal and labor market reforms in the early 1990s. The commitment to prudent macroeconomic policy was formalized in the 1989 Reserve Bank Act, which gave the central bank independence in implementing monetary policy and made explicit the inflation target objective. Fiscal debt continued to rise until the 1994 Fiscal Responsibility Act established a commitment to prudent fiscal policy. Public debt, including net external public debt, have since declined and are now close to zero.

The current account improved in the wake of the reforms, as the share of investment to GDP declined by almost 40 percent from 1986 to 1992 (see figure 1). The fall in investment was driven by a drop first in public investment after 1985 and then in nonresidential private investment, particularly nonresidential building, following the commercial property boom of the late 1980s and the stock market crash of 1987. From 1993 to 1997, New Zealand experienced strong GDP growth and a strong recovery in investment. The current account deficit deteriorated from about 3 percent of GDP to about 7 percent, reflecting the combination of a dip in national savings and the strong investment performance. The real exchange rate appreciated sharply, which discouraged exports and delivered cheap imported goods. The Reserve Bank changed the policy target agreement in 1999 to include a secondary objective of reducing output volatility. In 2004, the central bank was given broader authority to intervene in foreign exchange markets in periods of perceived exchange rate overshooting, as well as in cases of extreme market disorder (see Eckhold and Hunt, 2005).

Following the Asian crisis of 1997, slow domestic demand—particularly investment demand—and a large depreciation of the New Zealand dollar contributed to an improvement in the current account. The current account deficit deteriorated again between 2001 and 2006 (from about 3 percent of GDP to 9.7 percent) as a result of strong growth, expansion of investment, weak domestic saving, and an appreciating exchange rate. From a transactions perspective, the bulk of the current account deficit is accounted for by the investment income deficit, which averaged 5.9 percent of GDP from 1990 to 2006. This comprises interest payments on external debt and returns to nonresident ownership of New Zealand assets. The net stock of external liabilities was about 89 percent of GDP at the end of 2006, made up of net debt of about 77 percent of GDP and a net equity liability of about 12 percent of GDP.[4]

Domestically, liberalized domestic financial markets, international financial market integration, and a willingness among nonresidents to finance New Zealand dollar debt allowed New Zealand households to increase their borrowing. At the same time, the decline in inflation and nominal interest rates enabled households to service larger debts. Household indebtedness tripled as a share of disposable income, from 50 percent in 1990 to 150 percent in 2006. The rise in household indebtedness was associated with housing booms in the mid-1990s and in 2004; these booms have increased household collateral values and underpinned strong household demand. Given weak domestic savings, this borrowing has been largely funded externally, and the fall in public sector external debt has been replaced by private sector external debt.

2. The Model

The section briefly sketches the model economy.[5] We develop a small open economy model in the spirit of Christiano, Eichenbaum, and Evans (2005), Altig and others (2004), and Smets and Wouters (2003a, 2003b). The economy includes two types of households; Ricardian (optimizing, forward-looking) households make choices about consumption and borrowing, and they set wages; non-Ricardian households consume all their labor income and neither save nor borrow. Production technology uses labor and capital, and is subject to two stochastic shocks: a transitory shock and a permanent shock to

4. New Zealand's recent external imbalance has generated concern because it could constitute vulnerability to a sharp and abrupt current account reversal. See Edwards (2006a) for a quantitative analysis of the macroeconomic implications of current account reversals in New Zealand. The model in this paper might be used to explore these macroeconomic implications, but we leave this task for future work.

5. For a full version of the model, see the working paper version of this article (Medina, Munro, and Soto, 2007). The model is a modified version of the model in Medina and Soto (2006b).

labor productivity, which introduces a stochastic trend in the major aggregates. The economy grows at a constant rate, g_y, in steady state. Both prices and wages are sticky (subject to nominal rigidities à la Calvo), with partial indexation to past inflation. There are adjustment costs to investment, and the pass-through from the exchange rate to the price of imports is imperfect in the short run. To be consistent with the features of both Chile and New Zealand, we include a commodity sector whose production is based on a natural resource endowment and is assumed to be completely exported. Monetary policy is conducted through a policy rule for the interest rate, while fiscal policy is conducted through a structural rule in the case of Chile and a balanced budget rule in the case of New Zealand.

2.1 Households

The domestic economy is inhabited by a continuum of households. A share, $1 - \lambda$, of the households correspond to Ricardian households with access to the capital market, and the remaining fraction, λ, are non-Ricardian households without access to this market. We assume that households exhibit habit formation in their preferences, captured by a parameter h. Each household consumes a basket composed of two types of final goods: home goods and foreign goods. The composition of this basket is determined optimally by minimizing its cost.

2.1.1 Consumption and savings decisions

Ricardian households have access to four types of assets: money, one-period foreign noncontingent bonds denominated in either domestic or foreign currency, and one-period domestic contingent bonds.[6] A Ricardian household chooses a consumption path by maximizing its utility subject to a budget constraint. The first-order conditions on different contingent claims over all possible states define the following Euler equation for consumption:

$$\beta E_t \left\{ (1+i_t) \frac{P_t}{P_{t+1}} \frac{\zeta_{C,t+1}}{\zeta_{C,t}} \left[\frac{C_t(j) - hC_{t-1}}{C_{t+1}(j) - hC_t} \right] \right\} = 1, \text{ for all } j \in (\lambda, 1], \tag{1}$$

6. The domestic contingent bond pays a unit of consumption in the next period in a particular state of nature. Assuming a full set of contingent bonds ensures that all Ricardian households consume the same amount, independent of their labor income.

where $C_t(j)$ and C_t are consumption by household j and aggregate consumption, respectively, P_t corresponds to the consumption-based price index, i_t is the domestic risk-free interest rate, and β is the discount factor. The variable $\zeta_{C,t}$ corresponds to a preference shock that shifts consumption. The behavior of Ricardian households provides a consumption-smoothing rationale for current account fluctuations: they can use the current account to save and borrow in response to shocks to net income. Non-Ricardian households have no access to assets and own no shares in domestic firms. Therefore, each period they consume all of their after-tax disposable income:

$$C_t(j) = \frac{W_t}{P_t} l_t(j) - \frac{\tau_{p,t}}{P_t}, \quad \text{for } j \in [0, \lambda], \tag{2}$$

where W_t is the wage rate, $l_t(j)$ is labor supply by household j, and $\tau_{p,t}$ are per capita lump-sum taxes.

By combining equation (1) with the first-order condition with respect to foreign bonds, we obtain the following expression for the uncovered interest parity (UIP) condition:

$$\frac{1+i_t}{(1+i_t^*)\Theta(B_t)} = E_t\left(\frac{e_{t+1}}{e_t}\right) + a_t \tag{3}$$

where e_t is the nominal exchange rate measured as units local currency per one unit of foreign currency. The variable a_t captures a covariance term and $\Theta(B_t)$ corresponds to the risk premium domestic agents have to pay when borrowing abroad, which is a function of the ratio of the net foreign asset position to GDP, B_t. The foreign interest rate, i_t^*, is assumed to follow a first-order autoregressive, or AR(1), process subject to independent and identically distributed (i.i.d.) shocks. These shocks, which we call shocks to foreign financial conditions or UIP shocks, capture all financial factors, including price, risk premiums, and any other factors associated with the exchange rate arbitrage not captured by Θ(.).

2.1.2 Labor supply and wage setting

Each household is a monopolistic supplier of a differentiated labor service. A set of perfectly competitive labor service assemblers hires labor from each household and combines it into an aggregate labor service unit, which is used as an input in the production of domestic intermediate goods. As in Erceg, Henderson, and Levin (2000), wage setting is subject to a nominal rigidity à la Calvo (1983). In each period, each Ricardian household faces a probability $1 - \phi_L$ of being able to reoptimize its nominal wage. In this set-up, the parameter ϕ_L is a measure of the degree of nominal rigidity. The larger this parameter, the less frequently wages are adjusted (that is, the stickier they are).

A household that is able to reoptimize its wage at t will maximize the expected discounted future stream of labor income net of the disutility from its work effort, subject to labor demand and an updating rule for its nominal wage in case the household cannot reoptimize in the future. This updating rule considers the trend in labor productivity, as well as a geometric weighted average of past consumer price index (CPI) inflation and the inflation target set by the monetary authority. The weights in this rule reflect the degree of indexation in wages. For simplicity non-Ricardian households are assumed to set wages equal to the average wage set by Ricardian households. Given the labor demand for each type of labor, this assumption implies that the labor effort of non-Ricardian households coincides with the average labor effort by Ricardian households.

2.2 Investment and Capital Goods

A representative firm rents capital goods to firms producing intermediate goods. It decides how much capital to accumulate each period, assembling new capital goods with a constant elasticity of substitution (CES) technology that combines home and foreign final goods. The firm may adjust investment each period, but changing the flow of investment is costly. The adjustment cost for investment is determined by a concave function $S(.)$. The assumption that adjusting the flow of investment is costly provides a tractable approach to modeling investment inertia (see Christiano, Eichenbaum, and Evans, 2005). The firm chooses the level of investment, I_t, and the rental price of capital, Z_t, to maximize expected future profits (rental returns on capital net of the cost of investment), subject to the law of motion of the capital stock, K_t, which accounts for depreciation and investment adjustment costs. The capital accumulation process is subject to a transitory investment-specific shock, $\zeta_{I,t}$, that alters the rate at which investment is transformed into productive capital.[7] The optimality conditions for the above problem are the following:

$$\frac{P_{I,t}}{P_t} = \frac{Q_t}{P_t}\left[S\left(\frac{I_t}{I_{t-1}}\right) + S'\left(\frac{I_t}{I_{t-1}}\right)\frac{I_t}{I_{t-1}}\right]\zeta_{I,t}$$
$$-E_t\left\{\Lambda_{t,t+1}\frac{Q_{t+1}}{P_{t+1}}\left[S'\left(\frac{I_{t+1}}{I_t}\right)\left(\frac{I_{t+1}}{I_t}\right)^2\right]\zeta_{I,t+1}\right\} \text{ and} \tag{4}$$

$$\frac{Q_t}{P_t} = E_t\left\{\Lambda_{t,t+1}\left[\frac{Z_{t+1}}{P_{t+1}} + \frac{Q_{t+1}}{P_{t+1}}(1-\delta)\right]\right\},$$

where δ is the depreciation rate; $P_{I,t}$ is the investment-based price index, which is a weighted average of home and foreign good prices; and $\Lambda_{t,t+1}$ is the relevant discount factor for firms. The previous two equations simultaneously determine the evolution of the shadow price of capital, Q_t, and real investment expenditure.

2.3 Domestic Production

Domestic final home goods are assembled from domestic intermediate goods using a CES technology and are sold both at home and abroad. The final home goods sector is assumed to be perfectly competitive, so the demand for a differentiated intermediate good will depend on its relative price and on the domestic and foreign demand for final home goods. The price of final home goods is a weighted average of the price of intermediate goods.

Intermediate goods are produced by firms that have monopoly power. These firms maximize profits by choosing the prices of their differentiated good subject to demand in the market (foreign or domestic) in which they are being sold, given the available technology. The technology to produce a particular intermediate good, z_H, is Cobb-Douglas:

$$Y_{H,t}(z_H) = A_{H,t}\left[T_t l_t(z_H)\right]^{\eta_H}\left[K_t(z_H)\right]^{1-\eta_H}, \tag{5}$$

7. Greenwood, Hercowitz, and Krusell (2000) argue that this type of investment-specific shock is relevant in explaining business cycle fluctuations in the United States.

where $Y_{H,t}(z_H)$ is the quantity of good z_H produced, $l_t(z_H)$ is the amount of labor used, and $K_t(z_H)$ is the amount of physical capital rented. The parameter η_H defines their corresponding shares in production, while $A_{H,t}$ represents a stationary productivity shock common to all firms. The variable T_t is a stochastic trend in labor productivity that introduces a unit root in the major aggregates.

With imperfect competition in the intermediate goods sector, price setting is assumed to follow a Calvo-type structure. In every period, the probability that a firm receives a signal for adjusting its price for the domestic market is $1 - \phi_{HD}$; the probability of adjusting its price for the foreign market is $1 - \phi_{HF}$. These probabilities are the same for all firms, independent of their history. If a firm does not receive a signal, it updates its price following a simple rule that weights past inflation and the inflation target set by the central bank. Given this pricing structure, the behavior of inflation is captured by a new-Keynesian Philips curve with indexation. In its log-linear form, inflation depends on last period's inflation, expected inflation in the next period, and marginal costs.

We also assume that a single firm produces a homogeneous commodity good that is completely exported abroad. Production evolves with the same stochastic trend as other aggregate variables, requires no labor or capital inputs, and is subject to a transitory stochastic production shock. Hence, production in this sector can be interpreted as the exogenous evolution of an endowment of natural resources. This sector is particularly relevant for the two economies, as it captures the copper sector in Chile and natural resources production in New Zealand.

2.4 Imports Retailers

We assume local-currency price stickiness to allow for incomplete exchange rate pass-through into import prices in the short run. Importing firms buy goods abroad and resell them domestically to assemblers of final foreign goods. Each importing firm has monopoly power in the domestic retailing of a particular good, and it adjusts the domestic price of its variety infrequently (à la Calvo, 1983), only when receiving a signal. The signal arrives with probability $1 - \phi_F$ each period. When a firm receives a signal, it chooses a new price to maximize the present value of expected profits subject to the domestic demand for its variety and the updating rule followed by nonoptimizing firms. As in the case of domestically produced goods, if a firm does not receive a signal, it updates its price following a passive rule that is a weighted average of past price changes and the inflation target set by the central bank.

In this setup, changes in the nominal exchange rate will not immediately be passed through to the prices of imported goods sold domestically. Exchange rate pass-through will therefore be incomplete in the short run. In the long run, firms freely adjust their prices, so the law of one price holds up to a constant (because of a steady-state markup). This feature of the model mitigates the expenditure-switching effect of exchange rate movements and matches the observed degree of substitution between foreign and home goods.

2.5 Fiscal Policy

When agents are Ricardian, defining a trajectory for the primary deficit is irrelevant for household decisions, as long as the budget constraint of the government is satisfied. When a fraction of the agents are non-Ricardian, however, the trajectory of the public debt and the primary deficit become relevant. The path of public expenditure may also be relevant on its own as long as its composition differs from the composition of private consumption. Here we assume the government consumes only home goods.

Fiscal policy is defined by the fiscal net asset position, net revenues (income tax revenues minus transfers to the private sector), and government expenditure. Given the budget constraint of the government, it is necessary to define a behavioral rule for two of these three variables.

In the case of Chile, we assume that about half of all households are non-Ricardian, so the timing of the fiscal variables is relevant for the private sector. The public asset position is denominated in foreign currency. Fiscal revenues come from two sources: tax income from the private sector, which is a function of the average tax rate and GDP, and the government's share (40 percent) of revenues from copper sales through the state company.

More importantly, we consider that the Chilean government follows a structural balance fiscal rule (see Medina and Soto, 2006a). The purpose of this fiscal rule is to avoid excessive fluctuations in government expenditure stemming from transitory movements in fiscal revenues. Government expenditure can increase if its net asset position improves, if interest payments on its debt fall, or if output is below potential (countercyclical policy). In the case of a transitory rise in fiscal revenues from copper price increases, the rule implies that the additional fiscal income should mainly be saved. The rule is subject to a transitory stochastic shock that captures temporary deviation of government expenditure from this fiscal rule.

In the case of New Zealand, we assume that all households are Ricardian ($\lambda = 0$).[8] Ricardian equivalence holds, and the particular mix of assets and liabilities and timing of taxes that finance government absorption is irrelevant. We therefore abstract from government debt, without lost of generality, and assume that lump-sum taxes are adjusted every period to keep the government budget balanced, subject to a stochastic shock to government expenditure.

An important difference between the policy rule assumed for Chile and the rule for New Zealand is that the former allows for accumulation or depletion of net assets by the government. However, the effects of a shock under either rule would be the same if all agents were Ricardian.

2.6 Monetary Policy Rule

Monetary policy in Chile is characterized as a simple feedback rule for the real interest rate, where the Central Bank responds to deviations of CPI inflation from the target and to deviations of output from its trend. We also allow the Central Bank to react to deviations of the real exchange from a long-run level. This is meant to capture the fact that the Central Bank of Chile had a target for the exchange rate over most of the sample period. We define the rule in terms of the real interest rate to be consistent with the Central Bank of Chile's practice during most of the sample period used to estimate the model.[9] Thus, we approximate the monetary policy rule as follows:

$$r_t = \psi_i r_{t-1} + (1 - \psi_i)\begin{bmatrix} \psi_y y_t + (\psi_\pi - 1)(\pi_t - \bar{\pi}_t) \\ + \psi_{\text{RER}} \text{RER}_t \end{bmatrix} + \nu_t, \tag{6}$$

8. This reflects New Zealand's smaller share of poor households that do not have access to the capital market. This parameter is calibrated since its joint estimation with the habit formation parameter presents some identification problems.

9. From 1985 to July 2001, the Central Bank of Chile used an indexed interest rate as its policy instrument. This indexed interest rate corresponds roughly to an ex ante real interest rate (Fuentes and others, 2003).

where $\pi_t = P_t/P_{t-1} - 1$ is consumer price inflation, $\overline{\pi}_t$ is the inflation target set for period t, and $r_t = (1 + i_t) / (P_t/P_{t-1}) - 1$ is the net (ex post) real interest rate. The variable y_t is the (log) deviation of GDP from its balanced growth path, and RER_t is the (log) deviation of the real exchange rate from its long-run level. The variable ν_t is a monetary policy shock that corresponds to a deviation from the policy rule, and it is assumed to be an i.i.d. innovation.

As mentioned, Chile adopted a fully-fledged inflation-targeting framework in late 1999 and abandoned the target zone for the exchange rate. To capture this policy shift, we allow for a discrete change in all the parameters of the monetary policy rule, imposing $\Psi_{\text{RER}} = 0$ for the second period, which starts in 2000.[10]

In the case of New Zealand, monetary policy is characterized as a simple feedback rule for the nominal interest rate where the Reserve Bank is assumed to respond to deviations of CPI inflation from target (assumed to be 2 percent for the period) and to deviations of output from its trend:[11]

$$i_t = \psi_i i_{t-1} + (1 - \psi_i)\left[\psi_y y_t + \psi_\pi (\pi_t - \overline{\pi}_t)\right] + \nu_t. \tag{7}$$

For New Zealand we assume that the parameters of this rule have remained constant over the whole sample period.

3. Model Estimation

We estimate the parameters of the model using a full-information Bayesian approach (see DeJong, Ingram, and Whiteman, 2000;

10. This change in parameter values is assumed to be permanent and unanticipated. This means that when agents make decisions, they expect that these parameters will remain constant forever.

11. The inflation target objective set out in the Policy Targets Agreement (PTA) between the Reserve Bank and the government is specified in terms of CPI inflation and a target band. In practice, the target changed over the period: it was initially set at 0 to 2 percent and later changed to 0 to 3 percent and then to 1 to 3 percent. The PTA also requires the Reserve Bank to avoid unnecessary instability in output, interest rates, and the exchange rate. The Reserve Bank did explicitly respond to exchange rate developments in 1986–88, when a monetary conditions index was used to guide policy between forecast rounds. Several papers suggest, however, that little is gained by including the exchange rate in the rule, even if the exchange rate is included in the loss function, because of unfavorable volatility tradeoffs; see West (2003). The gain in empirical fit from including the exchange rate in the rule is small (see Lubik and Schorfheide, 2007).

Fernández-Villaverde and Rubio-Ramárez, 2004; and Lubik and Schorfheide, 2006).[12] The estimation is based on the likelihood function obtained from the solution of the log-linear version of the model. Prior distributions for the parameters of interest are used to incorporate additional information into the estimation.[13]

The log-linear version of the model developed in the previous section forms a linear rational expectations system that can be written in canonical form as follows:

$$\mathbf{\Gamma}_0(\vartheta)\mathbf{z}_t = \mathbf{\Gamma}_1(\vartheta)\mathbf{z}_{t-1} + \mathbf{\Gamma}_2(\vartheta)\varepsilon_t + \mathbf{\Gamma}_3(\vartheta)\xi_t,$$

where $\mathbf{z}_t$ is a vector containing the model variables expressed as log-deviation from their steady-state values. It includes endogenous variables and ten exogenous variables, as follows: a preference shock ($\zeta_{C,t}$), a foreign interest rate shock (i_t^*), a stochastic productivity trend shock ($\zeta_{T,t}$), a stationary productivity shock ($A_{H,t}$), an investment adjustment cost shock ($\zeta_{I,t}$), a commodity production shock ($Y_{S,t}$), a commodity price shock ($P_{S,t}^*$), a government expenditure shock ($\zeta_{G,t}$ for Chile and G_t for New Zealand), a monetary shock (ν_t), and a foreign output shock (Y_t^*). In their log-linear form, each of these variables is assumed to follow a first-order autoregressive process. The vector ε_t contains white noise innovations to these variables, and ξ_t is a vector containing rational expectation forecast errors. The matrices $\mathbf{\Gamma}_i$ (i = 0,..., 3) are nonlinear functions of the structural parameters contained in vector ϑ. The solution to this system can be expressed as follows:

$$\mathbf{z}_t = \Omega_{\mathbf{z}}(\vartheta)\mathbf{z}_{t-1} + \Omega_{\varepsilon}(\vartheta)\varepsilon_t, \quad (8)$$

where $\Omega_{\mathbf{z}}$ and Ω_{ε} are functions of the structural parameters. A vector of observable variables, $\mathbf{y}_t$, is related to the variables in the model through a measurement equation:

$$\mathbf{y}_t = \mathbf{H}\mathbf{z}_t + \mathbf{v}_t, \quad (9)$$

12. Fernández-Villaverde and Rubio-Ramírez (2004) and Lubik and Schorfheide (2006) discuss the advantages of this approach to estimating DSGE models.

13. One of the advantages of the Bayesian approach is that it can cope with potential model misspecification and possible lack of identification of the parameters of interest (Lubik and Schorfheide, 2006).

where $\mathbf{H}$ is a matrix that relates elements from $\mathbf{z}_t$ with observable variables and $\mathbf{v}_t$ is a vector containing i.i.d. measurement errors. Equations (8) and (9) correspond to the state-space form representation of $\mathbf{y}_t$. We assume that the white noise innovations and measurement errors are normally distributed. Using the Kalman filter, we can compute the conditional likelihood function, $L(\vartheta \mid \mathbf{Y}^T)$, for the structural parameters of the model, ϑ, where $\mathbf{Y}^T = \{\mathbf{y}_1,\ldots, \mathbf{y}_T\}$. Let $p(\vartheta)$ denote the prior density on the structural parameters. The joint posterior density of the parameters is computed using Bayes' theorem:

$$p\left(\vartheta \middle| \mathbf{Y}^T\right) = \frac{L\left(\vartheta \middle| \mathbf{Y}^T\right) p(\vartheta)}{\int L\left(\vartheta \middle| \mathbf{Y}^T\right) p(\vartheta) d\vartheta}. \tag{10}$$

We computed an approximated solution for the posterior mode of parameters using numerical optimization algorithms since the likelihood function has no analytical expression.[14] Prior parameter density functions reflect our beliefs about parameters values. In general, we chose priors based on evidence from previous studies for Chile and New Zealand. When the evidence on a particular parameter is weak or nonexistent, we impose more diffuse priors by setting a relatively large standard deviation for the corresponding density function.

3.1 Data

For Chile, we use quarterly data for the period 1990:1 to 2005:4. We choose the following observable variables: real GDP, Y_t; real consumption, C_t; real investment, INV_t; the ratio of real government expenditure to GDP, G_t/Y_t; the short-run real interest rate, r_t; a measure of core inflation computed by the Central Bank (IPCX1) as a proxy for inflation, π_t; the real exchange rate, RER_t; the ratio of the current account to GDP, $CA_t/(P_{Y,t}Y_t)$; and real wages, W_t/P_t. We also include as an observable variable the international price of copper

14. The appendix describes the complete list of estimated parameters and presents the calibrated parameters chosen to match the steady state of the model with the long-run trends in the Chilean and New Zealand economies. The appendix also presents the prior distribution for each parameter contained in the parameter vector, ϑ, its mean, and an interval containing 90 percent of probability. See the working paper version of this article for a detailed analysis and description of calibrated parameters and prior distributions (Medina, Munro, and Soto, 2007).

(in dollars, deflated by a foreign price index) as a proxy for the real price of the commodity good, $pr^*_{S,t}$. In total, we have ten observable variables. The inflation rate is expressed as the deviation from its target, $\overline{\pi}_t$ In the case of real quantities, we use the first difference of the corresponding logarithm (except for the ratio of government expenditures to GDP):

$$\mathbf{y}_t^{CH} = \left\{ \begin{array}{l} \Delta \ln Y_t, \Delta \ln C_t, \Delta \ln \mathrm{INV}_t, r_t, \pi_t, \\ \mathrm{RER}_t, \dfrac{\mathrm{CA}_t}{P_{Y,t} Y_t}, \dfrac{G_t}{Y_t}, \Delta \ln \left(\dfrac{W_t}{P_t} \right), pr^*_{S,t} \end{array} \right\}.$$

The short-run real interest rate corresponds to the monetary policy rate. This was an indexed rate from the beginning of the sample until July 2001. After July 2001, the monetary policy was conducted using a nominal interest rate. For the later period, we thus construct a series for the real interest rate, computing the difference between the nominal monetary policy rate and the current inflation rate.

For New Zealand, we use quarterly data for the period 1989:2 to 2005:4. We chose the following observable variables: real GDP; real consumption; real investment; commodity production (primary production plus commodity-based processing), $Y_{S,t}$; the short-run nominal interest rate, i_t; CPI inflation; the real exchange rate; the ratio of the current account to GDP; and real wages. We also include as an observable variable a commodity price index (in U.S. dollars, deflated by a foreign price index) as a proxy for the real price of the commodity good. In total, we have ten observable variables.

As in the case of Chile, real variables are expressed in first log differences and inflation as the deviation from its target. The set of observable variables for New Zealand is the following:

$$\mathbf{y}_t^{NZ} = \left\{ \begin{array}{l} \Delta \ln Y_t, \Delta \ln C_t, \Delta \ln \mathrm{INV}_t, \Delta \ln Y_{S,t}, i_t, \\ \pi_t, \mathrm{RER}_t, \dfrac{CA_t}{P_{Y,t} Y_t}, \Delta \ln \left(\dfrac{W_t}{P_t} \right), pr^*_{S,t} \end{array} \right\}.$$

The short-run nominal interest rate is the overnight interest rate (the call rate prior to March 1999 and the official cash rate after March 1999). We subtract the inflation target from the nominal interest rate to make this variable stationary.

3.2 Posterior Distributions

The estimated modes of the parameter posterior distributions are broadly consistent with other studies for Chile and New Zealand (see table 1). The degree of habit in consumption is a little higher for New Zealand at 0.81 than for Chile at 0.57. The inverse of the labor supply elasticity is very low for New Zealand (0.001). For Chile, the estimated elasticity (0.16) is a little bit above other studies that only consider Ricardian households. The intratemporal elasticity of substitution for consumption is about 1.2 for both Chile and New Zealand, which is relatively low. The posterior estimate for the intratemporal elasticity of substitution for investment is very close to the prior estimate and may not be well identified in the data. The price elasticity of foreign demand, η^*, is two in New Zealand versus one in Chile. This means that exports respond more strongly to price signals (such as a currency depreciation) in New Zealand.

For Chile, nominal wages are reoptimized every five periods, with little indexation to past inflation. For New Zealand, wages are be reoptimized at eleven quarters, also with a low degree of indexation to past inflation. The less frequent wage adjustment in New Zealand may reflect a higher degree of credibility in monetary policy, which makes costly adjustment less necessary. Domestic prices are optimally adjusted frequently in both economies: every two quarters for Chile, on average, and every three quarters for New Zealand. The prices of home goods sold abroad and domestic imports are reoptimized much less frequently. This provides evidence of exchange rate disconnection in both countries in the short run, which reduces the expenditure-switching effects of the exchange rate.

Estimated monetary policy parameters are in line with other studies for both countries. In general, the degree of interest rate smoothing and the responses to both inflation and output growth are estimated to be higher for New Zealand. These parameters are not directly comparable because the policy rule specification is not the same in the two countries. However, the rule for the later period in Chile and the estimated rule for New Zealand are both characterized by pure inflation targeting and are quite similar: the interest rate smoothing parameters are 0.8 for Chile and 0.9 for New Zealand; the response to deviations of inflation from target are 1.6 and 1.5; and the response to the deviation of output growth from steady state are estimated at 0.31 and 0.39.

Table 1. Posterior Distributions (Mode)

	Mode posterior	
Parameter	*Chile*	*New Zealand*
σ_L	0.164	0.001
h	0.572	0.813
ϕ_L	0.806	0.911
χ_L	0.058	0.102
η_C	1.221	1.239
η_I	1.107	1.031
μ_S	2.288	1.694
ϕ_{HD}	0.486	0.631
χ_{HD}	0.127	0.086
ϕ_{HF}	0.966	0.915
χ_{HF}	0.227	0.181
ϕ_F	0.838	0.968
χ_F	0.806	0.178
$\psi_{I,1}$, ψ_i	0.670	0.897
$\psi_{p,1}$, ψ_p	1.244	1.455
$\psi_{y,1}$, ψ_y	0.184	0.389
$\psi_{rer,1}$	0.052	—
$\psi_{i,2}$	0.778	—
$\psi_{\pi,2}$	1.632	—
$\psi_{y,2}$	0.305	—
η^*	0.999	2.007
θ	0.016	0.001
ρ_{aH}	0.901	0.690
ρ_{yS}	0.642	0.907
ρ_{Y*}	0.736	0.653
$\rho_{\zeta C}$	0.227	0.332
$\rho_{\zeta I}$	0.862	0.412
$\rho_{\zeta G}$, ρ_G	0.315	0.393
ρ_{i*}	0.985	0.923
ρ_T	0.987	0.156
σ_{aH}	1.498	1.915
σ_{yS}	28.418	1.993
σ_{Y*}	10.275	8.847
σ_{i*}	0.332	0.360
σ_m	0.392	0.189
$\sigma_{\zeta C}$	5.032	6.291
$\sigma_{\zeta G}$, σ_G	12.180	9.739
$\sigma_{\zeta I}$	7.125	10.291
σ_T	0.190	0.498

Source: Authors' estimations.

The estimated volatility and persistence of the shocks are more similar than different. The only big difference in shock volatility is the much larger commodity production shocks in Chile. This likely reflects the fact that Chile has a single commodity, whereas New Zealand features a basket. Commodity production shocks are, however, less persistent in Chile, with an AR(1) coefficient of 0.64 versus 0.91 for New Zealand; this may be due to the agricultural nature of commodity production in New Zealand. In general, Chile is estimated to face more persistent domestic shocks. Investment-specific shocks are estimated to be more persistent in Chile, with an AR(1) coefficient of 0.86 versus 0.41 for New Zealand, as are labor productivity shocks, with an AR(1) coefficient of 0.99 versus 0.16 for New Zealand, and to a lesser degree transitory productivity shocks, with an AR(1) coefficient of 0.90 versus 0.69 for New Zealand.

4. Impulse Response Analysis

To analyze the main transmission mechanisms implied by the model, we explore the effects of the exogenous shocks on the current account and some other variables for Chile and New Zealand. Figures 2 and 3 present the impulse responses to all the shocks in the model. For Chile we show the responses under the policy rule prevailing after 2000. The differences under this rule and the one prevailing before 2000 are small (see Medina, Munro, and Soto, 2007).

4.1 Productivity and Endowment Shocks

We assess two types of productivity shocks—namely, a permanent labor productivity shock common to all firms and a transitory shock to domestic noncommodity production—and one shock to the commodity endowment. A permanent labor productivity shock increases output of all firms on impact, but not all the way to the new steady-state level.[15] As domestic households anticipate higher income in the future, they increase their consumption today. For the same reason, firms look to expand their production by increasing their demand for capital in anticipation of higher profits in the future. The increase in both consumption and investment leads to a lowering in the current account. Aguiar and Gopinath (in this volume) discuss the relevance

15. The variables are detrended by labor productivity.

Figure 2. Impulse-Responses: Chile

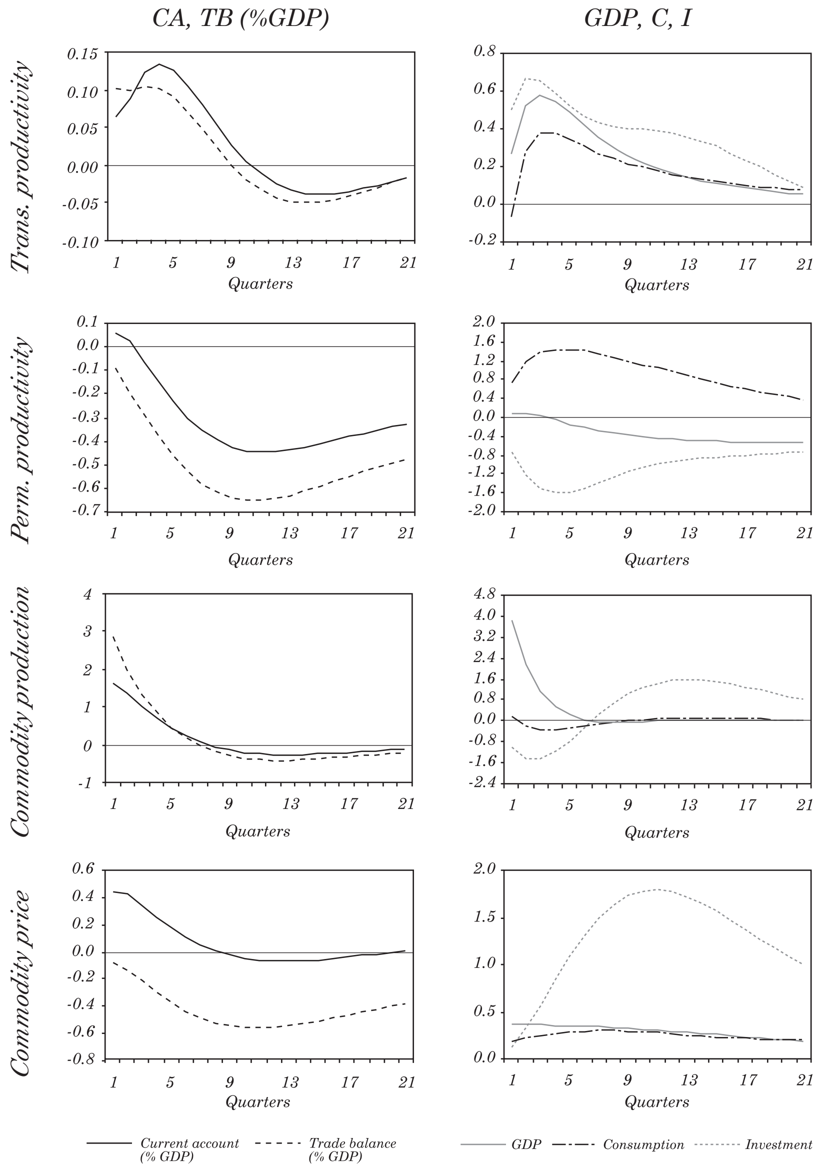


Figure 2. (continued)

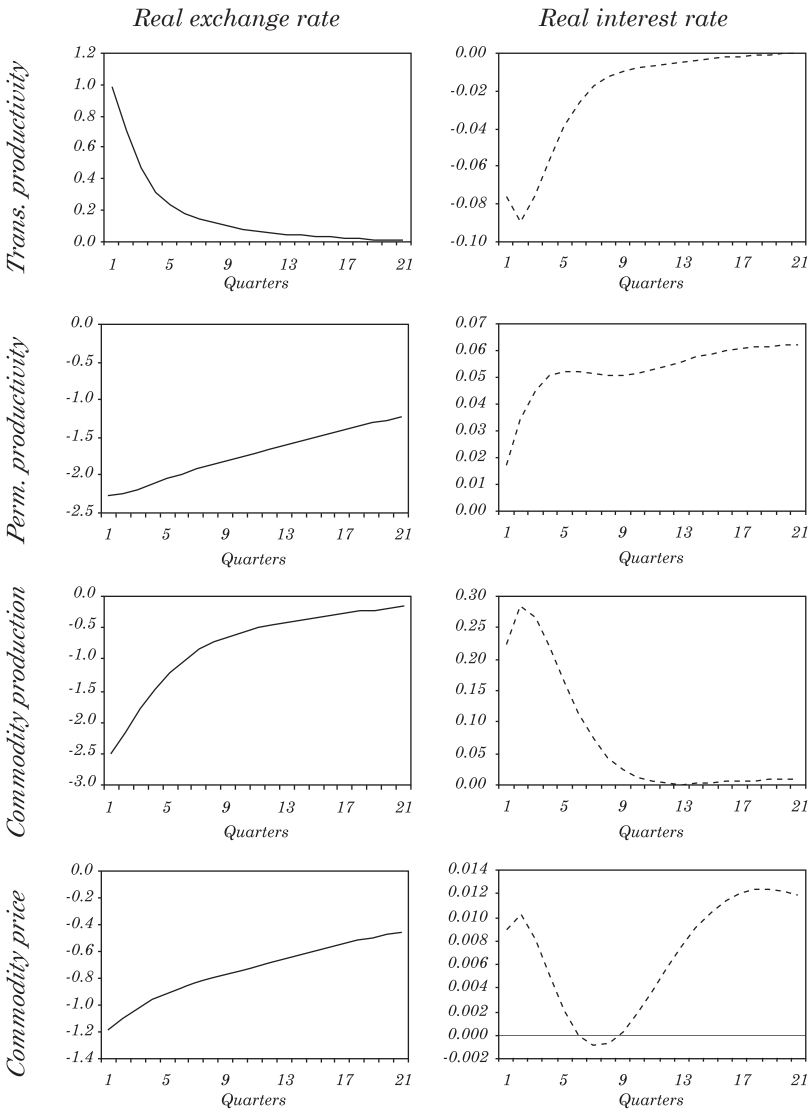


Figure 2. (continued)

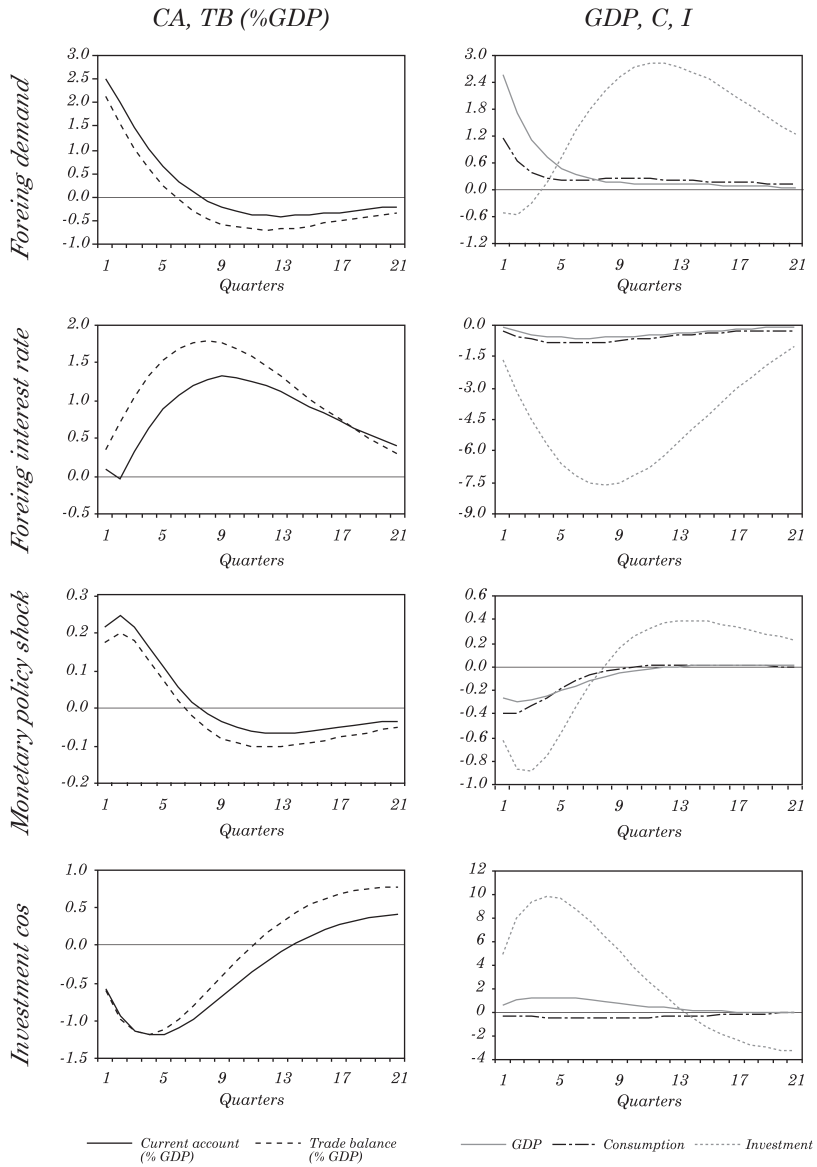
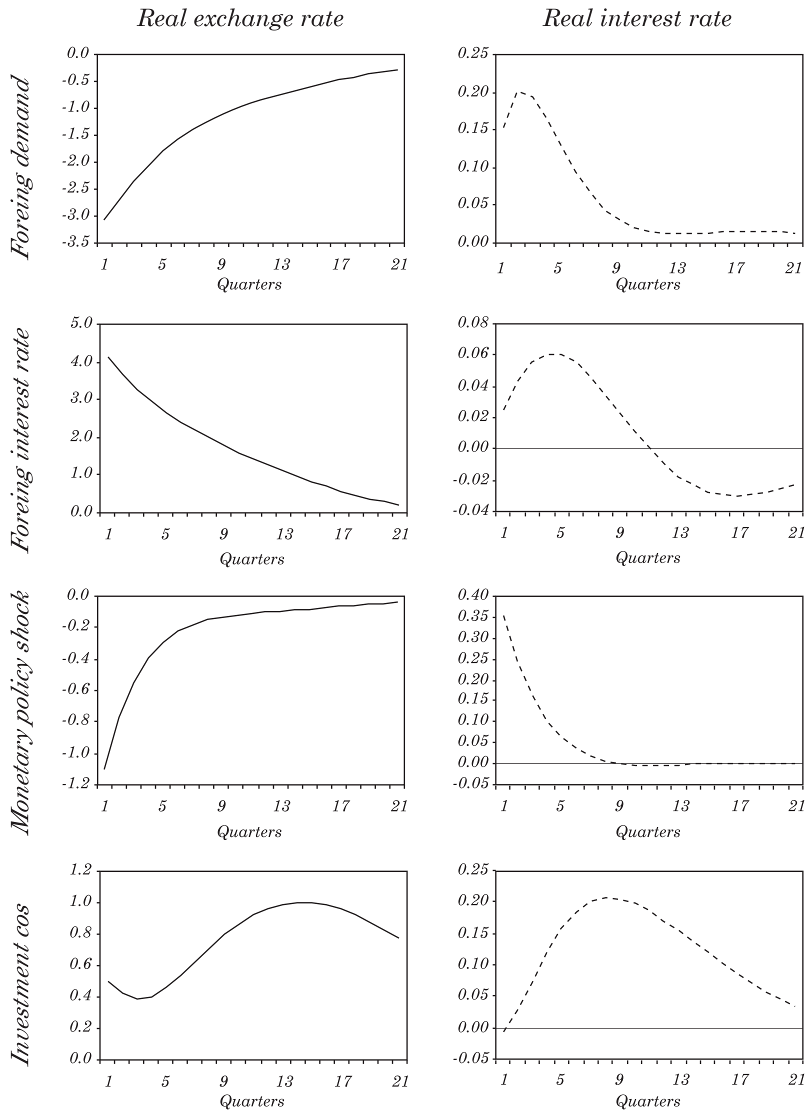


Figure 2. (continued)



Source: Authors' computations.

Figure 3. Impulse-Responses: New Zealand

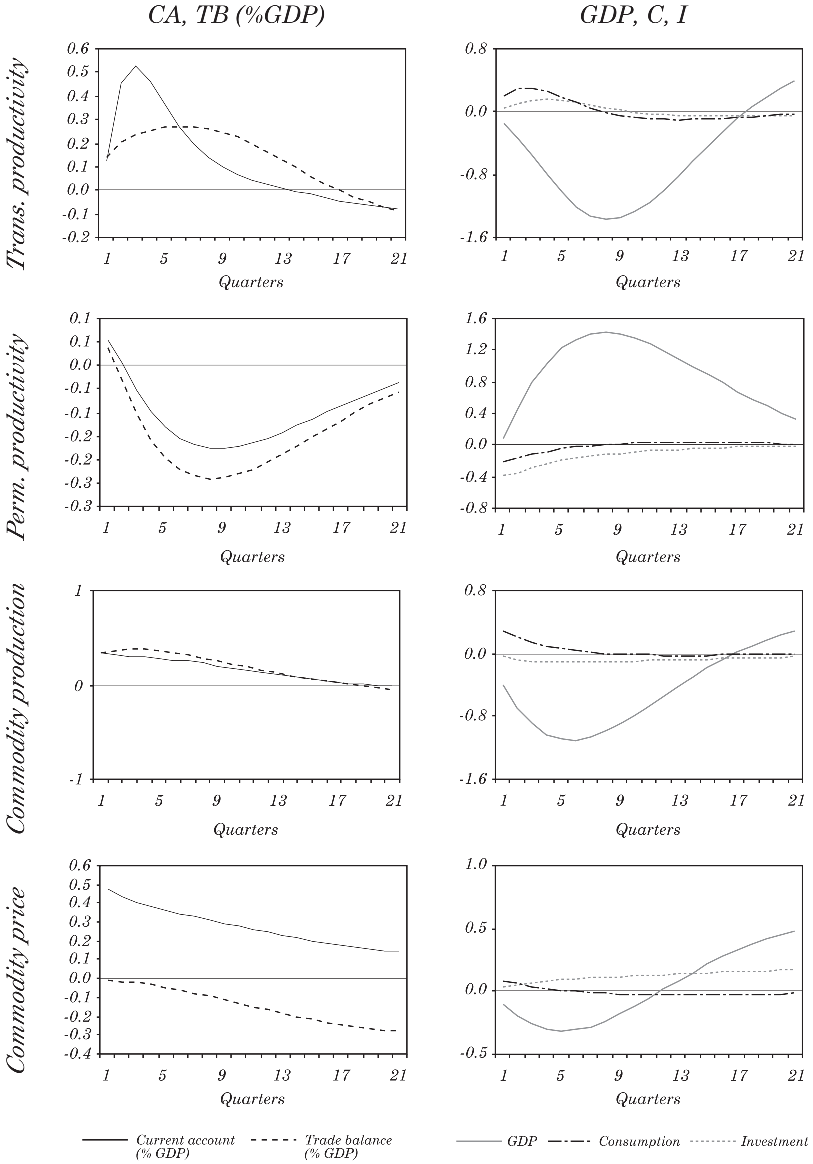


Figure 3. (continued)

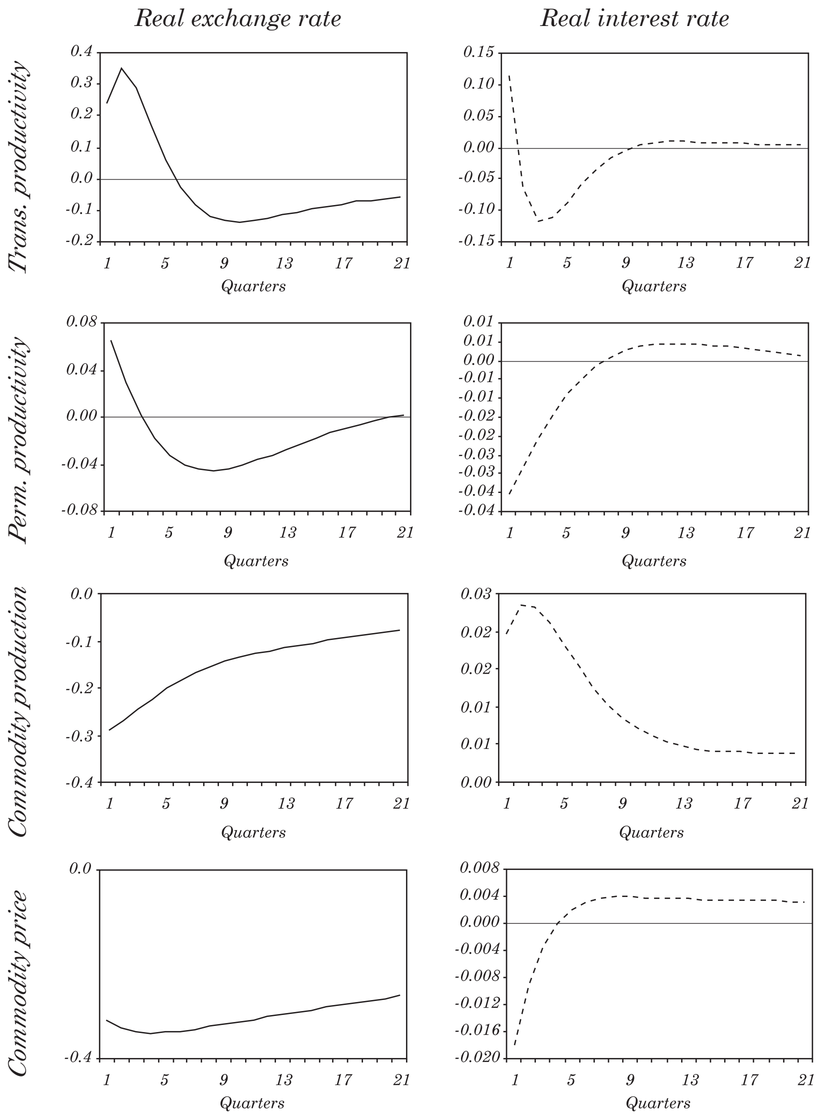


Figure 3. (continued)

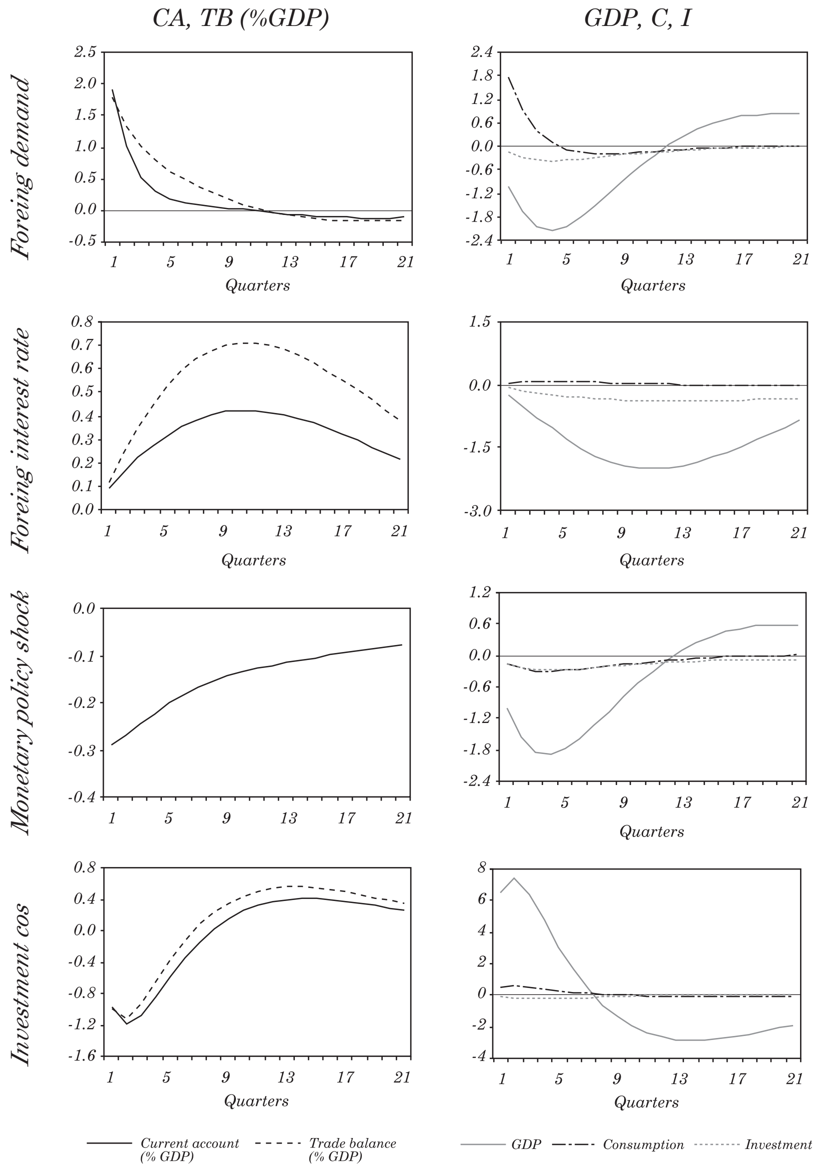
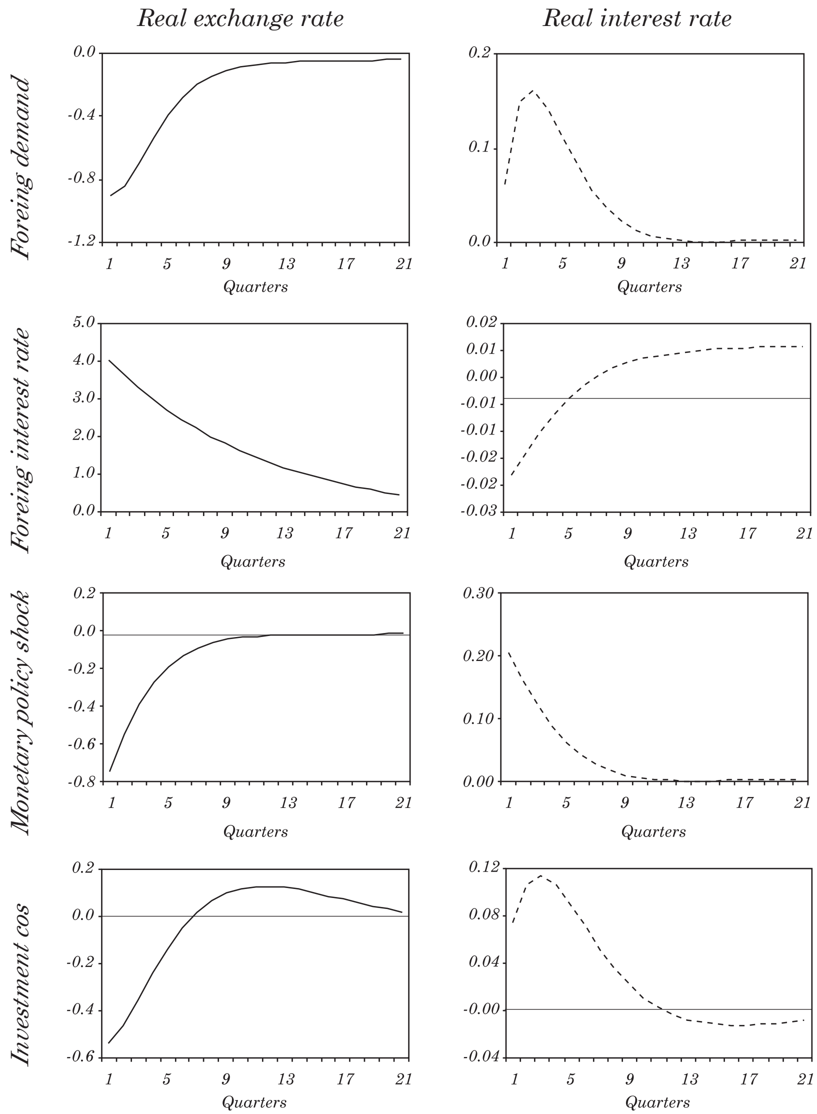


Figure 3. (continued)



Source: Authors' computations.

of this type of shock for explaining current account behavior in a small open economy. They show that a standard real business cycle model for a small open economy requires a permanent productivity shock to generate the countercyclical current account surplus observed in emerging market economies.

Transitory productivity shocks have larger standard deviations and are more persistent in Chile than in New Zealand. In both economies, this type of shocks raises output, reduces employment, and boosts real wages. It also initially depreciates the real exchange rate. The fall in labor is explained by the income effect on the labor supply and the slow expansion of aggregate demand, which is due to intertemporal smoothing in consumption, consumption habits, and investment adjustment costs. In both countries, consumption rises, although in Chile it initially decreases slightly owing to the presence of non-Ricardian households, whose labor income falls. Chilean investment increases as the marginal productivity of capital rises. After a few quarters, however, it falls below its trend level. For New Zealand, the productivity shock is not persistent enough to induce an expansion in investment, and this variable falls below trend immediately after the shock. The current account, measured as fraction of GDP, improves in both countries, as a result of the transitory output expansion, consumption smoothing, the fall in investment (in New Zealand), and the expenditure-switching effect induced by a temporary real depreciation of the exchange rate.

A rise in the commodity endowment (that is, an exogenous increase in commodity production) directly implies an increase in domestic GDP and exports in both Chile and New Zealand. In both economies, this shock appreciates the real exchange rate. Consumption and investment also rise, as do imports. Exports expand more than imports, however, and the current account improves in response to this shock in both economies. The shock is more volatile but less persistent in Chile than in New Zealand.

4.2 Foreign Shocks

We explore three types of foreign shocks: a commodity price shock, a foreign output shock, and a foreign interest rate shock. Commodity price shocks are larger in Chile than in New Zealand (for Chile, they corresponds to copper price shocks, while for New Zealand they are shocks to a broader commodity export price index). A shock like this implies windfall revenues for the Chilean government and for foreign investors. Despite the intertemporal government consumption smoothing implied by Chile's fiscal rule, the persistence of the shock leads the government to moderately increase its expenditure on home goods, as its debt service falls. This expansion in aggregate demand raises output. Private consumption increases because of the increase in the current income of non-Ricardian households and because the shock expands the overall wealth of the country. The growth in output increases the marginal product of capital, which leads to a boom in investment. In the case of New Zealand, the windfall is received by households that own 90 percent of commodity export firms. Thus, the shock raises permanent income, and consumption increases smoothly over time. The increase in consumption leads to a rise in output and in investment. In both economies, the current account improves. The positive export price effect of the shock on the current account is moderated to some degree by a decline in export volumes, an expansion of investment in response to higher demand (which draws in imports), and exchange rate appreciation.[16] In New Zealand, the higher debt repayments in response to the monetary tightening that follows the shock also dampens the shock's effect on the current account. In Chile, the investment income account deteriorates because of higher profits for foreign investors. For both countries, the trade-balance-to-GDP ratio measured at constant prices declines as a consequence of the fall in export volumes and the increase in imports.

A foreign demand shock increases demand for home goods, and domestic output rises in both economies. Consumption increases with income, putting upward pressure on domestic prices and an exchange rate appreciation in anticipation of the endogenous monetary policy tightening. In both countries, investment increases to boost production, but only slowly owing to adjustment costs. The stronger exchange rate reduces the cost of imports, which also contributes to the expansion in investment since investment is import intensive. The direct effect of foreign output on exports dominates the increase in imports, and the current account improves in response to this shock.

16. For New Zealand, the currency appreciation—the so-called commodity currency effect—is smaller than implied by reduced-form estimates (here a 10 percent rise in commodity export prices leads to an exchange rate appreciation of about 1 percent, versus 5–7 percent in reduced-form estimates). The difference may be the result of the covariance of world commodity prices with other factors such as world demand or the UIP shock, not captured by our model. A larger commodity currency effect would reduce the positive effect of this shock on the current account.

A foreign interest rate shock (a shock to the foreign cost of capital) shock in figures 2 and 3 leads to a 4 percent real depreciation of the domestic currency in both countries. The real exchange rate depreciation triggers an expenditure switching effect that boosts exports and lowers imports. In Chile, the improvement in the trade balance is mainly due to contraction of imports, while in New Zealand it is mainly due to the expansion of exports. This is the result of the different pricing structures for imports and the currency denomination of foreign liabilities. In Chile, import prices are reoptimized more often than in New Zealand, and there is a very high degree of indexation to last period's inflation. Higher import prices in domestic currency thus generate a much more persistent effect on inflation. The depreciation leads to a strong monetary policy response in Chile that depresses consumption and investment, reinforcing the effect of higher import prices on consumption and especially on import-intensive investment and thereby reducing imports. In Chile, the depreciation also leads to valuation effects: the domestic currency value of foreign currency liabilities increases, and the resulting higher debt repayment further depresses aggregate demand. In New Zealand, the real depreciation effect is muted by a high degree of local currency pricing (with very infrequent reoptimization and indexation mainly to the inflation target). Also, a larger export response and smaller fall in aggregate demand prevent a fall in output. In both countries, this shock leads to a current account improvement.

4.3 Expenditure Shocks

Identified investment shocks—namely, decreases in the cost of transforming one unit of investment into one unit of capital—are a little larger in New Zealand, but more persistent in Chile.[17] They lead to a boom in investment that increases output and employment. In the case of Chile, the increase in output raises current income, and non-Ricardian household consumption surges. Total consumption

17. The shocks are associated with a change in the supply of capital goods and may reflect other sources of fluctuations that are absent from the model. As noted above, in a model with financial frictions, a shock like this could be obtained if the severity of the financial constraints varies with the cyclical position of the economy. Alternatively, changes in the efficiency through which the financial sector transferred savings to productive capital investment might be attributed to this shock, as well. This shock captures financial sector developments or other factors that affect the capital accumulation process that are not modeled explicitly.

rises, despite the monetary contraction. In New Zealand, since all households are assumed to be Ricardian, the monetary contraction causes a fall in consumption. For both countries, the current account initially deteriorates, mainly as a result of the investment-driven rise in imports. However, the increase in the capital stock eventually leads to higher production and higher exports, so that the current account balance increases above trend after a couple of years.

Both the consumption preference shock and government expenditure shock play a minor role in explaining the current account in Chile and New Zealand. We therefore do not report the impulse responses for them in the present article. For further details see Medina, Munro, and Soto (2007).

A consumption preference shock leads to a consumption boom that raises output and increases demand for labor and capital inputs. The monetary authority increases the interest rate and the real exchange rate appreciates. Despite the increase in the demand for capital and a small fall in the cost of imports, the intertemporal substitution effect driven by the monetary policy response generates a contraction in investment. This shock deteriorates the current account. Initially, the rise in consumption draws in imports, while exports fall because of the real appreciation of the currency. In New Zealand, the drop-off in investment dominates the boom in consumption after a couple of quarters, so that imports fall below trend. This effect improves the trade account, but it is offset by the investment income deterioration and thus does not improve the current account. In Chile, the fall in imports stemming from the contraction in investment leads to a slight improvement in the current account after several quarters.

A government expenditure shock in Chile corresponds to a deviation from the structural balance rule described above. It increases aggregate demand and boosts output and employment. The monetary policy responds by increasing the interest rate, which depresses investment and Ricardian consumption. Despite the increase in consumption by non-Ricardian households, overall consumption falls. The shock also implies an appreciation of the exchange rate because of the rise in the interest rate and because of the composition of government spending, which is biased toward home goods. Although the fiscal balance worsens in response to this shock, the contraction in private expenditure causes a small and short-lived improvement in the current account. In the case of New Zealand, the government expenditure shock also boosts output and depresses consumption and investment. Since the government consumes only home goods, whereas households consume both home and foreign goods, and given that investment utilizes foreign goods, the crowding out effect of public spending in New Zealand implies a short-run improvement in the current account. As monetary policy tightens and the interest rate increases, debt service also increases and the current account deteriorates. In the medium term, when the interest rate has eased, the current account improves again as a consequence of the fall in imports.

4.4 Monetary Shock

A monetary shock induces a contraction in aggregate demand (consumption and investment), output, and employment. In both countries, exports fall because of the appreciation of the currency, and imports fall because of the contraction of consumption and investment. In the case of Chile, given the estimated elasticities of substitution and the calibrated shares of foreign goods in consumption and investment, the intertemporal positive effect on the current account dominates the negative intratemporal effect on this variable. Therefore, the current account initially improves. However, it deteriorates a little several quarters after the shock, as imports pick up in response to the recovery in investment while exports remain depressed. In New Zealand, the current account improves initially because of the contraction in imports. It deteriorates one quarter after the shock, because domestic currency debt service costs rise with the domestic interest rate. The current account therefore falls despite an improvement in the trade balance. After some quarters, the trade balance effect dominates and the current account improves, but it falls again as imports pick up while exports remain low. Our model and estimation thus indicate that monetary policy is more effective at reducing the current account deficit in Chile than New Zealand, and a key difference is related to the denomination of external debt.

5. What Drives the Current Account in Chile and New Zealand?

We use the estimated model to better understand the evolution of the current account in both countries. We first discuss the variance decomposition of the current account. We then use our identified shocks to show the contribution of each one to the historical evolution of the current account of both countries over the sample period. The variance and historical decompositions abstract from the steady-state current account position, which is –1.8 percent of GDP for Chile and about –5.0 percent for New Zealand. The latter is mainly associated with investment income payments on New Zealand's large stock of external liabilities.

5.1 Variance Decomposition

To analyze the variance decomposition of the current account for Chile and New Zealand, we group shocks into four categories, as before: foreign shocks, domestic supply shocks, domestic demand shocks, and monetary shocks. In both countries, foreign shocks explain about half or more than half of the variation in the current account at all horizons (see table 2).[18] The most important foreign shock in both cases is the shock to the foreigninterest rate. Given the uncovered interest rate parity condition, this shock captures not only fluctuations in the foreign interest rate, but also the unobserved currency risk premium, and any capital flow effects that influence the exchange rate. This shock is very persistent in both countries, with estimated AR(1) coefficients of 0.985 in Chile and 0.923 in New Zealand. Its main effect on the current account occurs about two years after the shock. It accounts for 58–71 percent of current account variance at the three- to four-year horizon in Chile, and 40–44 percent in New Zealand. The foreign demand shock has a strong but transitory short-term effect, accounting for about 40 percent of current account variation in the first year after the shock in both countries.

While the effects of these two shocks are similar, the effect of the third foreign shock, the commodity export price shock, is quite different in the two countries. In Chile, a change in the copper price has a brief short-term effect, accounting for about two percent of current account variation in the first year.[19] In New Zealand, a change in the price

18. This result is consistent with Munro and Sethi (2007), who use a smaller shock model to analyze New Zealand's current account.

19. The variance decomposition is computed using the mode estimate of the variance of each shock. The recent copper price shock was much larger than historical shocks, so the share of this shock in explaining the recent current account event is likely much higher. See the historical decomposition below.

Table 2. Current Account Variance Decomposition: Foreign Shocks
Percent

Country and horizon	*Foreign demand*	*Commodity export price*	*Foreign interest rate (UIP)*	*Total*
Chile 1990–99				
1 year	40.9	1.6	5.3	47.8
2 years	1.7	0.1	45.6	47.4
3 years	3.9	0.2	71.3	75.4
4 years	6.2	0.1	62.0	68.3
Chile 2000–04				
1 year	45.3	2.0	3.4	50.7
2 years	3.3	0.2	44.7	48.2
3 years	4.6	0.2	69.1	73.9
4 years	8.2	0.2	57.5	65.9
New Zealand				
1 year	39.6	7.5	2.3	49.4
2 years	11.1	19.9	27.4	58.4
3 years	1.0	15.6	44.1	60.7
4 years	1.5	9.3	39.6	50.4

Source: Authors' computations.

of agricultural exports has a larger and more medium-term effect, accounting for 15–20 percent of current account variation at the two- and three-year horizons. The difference likely reflects the different ownership structures, with the windfall gains going to private agents in New Zealand and to the government and foreign investors in Chile. The 60 percent share of the windfall that goes to foreign investors in Chile directly offsets the improved trade balance through an investment income deficit. It may also be explained by the fact that Chile's government has saved a large part of its share of the windfall revenues from copper.[20]

Domestic supply and demand shocks in Chile each account for about half of the remaining variation in the current account, with monetary policy shocks accounting for very little (see tables 3 and 4). In

20. De Gregorio (2006) argues that although the structural balance rule was not in place before 2000, the government behaved very much as if the rule was already in place in the 1990s. In fact, during most of our sample period, Chile maintained a stabilization fund linked to the copper price, which smoothed out the effects of shocks to this variable.

Table 3. Current Account Variance Decomposition: Domestic Supply Shocks

Country and horizon	*Productivity*		*Commodity output*	*Total*
	Transitory	*Permanent*		
Chile 1990–99				
1 year	1.4	3.1	17.2	21.7
2 years	0.7	12.1	0.7	13.5
3 years	0.1	16.5	1.7	18.3
4 years	0.6	19.7	2.7	23.0
Chile 2000–04				
1 year	0.5	0.8	20.5	21.8
2 years	0.4	9.2	1.7	11.3
3 years	0.0	17.6	2.3	19.9
4 years	0.2	23.0	4.1	27.3
New Zealand				
1 year	5.6	0.3	4.5	10.4
2 years	10.0	5.4	3.2	28.6
3 years	3.4	6.8	7.7	17.9
4 years	0.4	3.8	1.9	6.1

Source: Authors' calculations.

New Zealand, domestic demand shocks are relatively more important, and monetary policy shocks again explain very little.[21]

The contribution of domestic demand shocks to variation in the current account mainly comes from the inferred investment-specific shock. In Chile this accounts for 30–40 percent of current account variation in the first two years; in New Zealand it explains 40 percent in the first year, with persistent effects at longer horizons. The contribution of domestic supply shocks in Chile is mainly from commodity output fluctuations in the short term (17–20 percent of the variance in the first year) and from permanent labor productivity shocks in the longer term (16–20 percent of current account variance in the third and fourth years). In New Zealand, variations in commodity production affect the current account with a similar magnitude, but with the main effect in the second year; and both permanent and transitory productivity shocks are important.

21. These policy shocks are deviations from the policy rules. The endogenous component of monetary policy—that is, the reaction function—may be important to determine the relative contribution of other shocks. See subsection 6.2 below.

Table 4. Current Account Variance Decomposition: Domestic Demand and Monetary Policy Shocks

	Domestic demand shocks				
Country and horizon	*Investment-specific*	*Consumer preference*	*Government expenditures*	*Total*	*Monetary policy shock*
Chile 1990–99					
1 year	30.0	0.2	0.1	30.3	0.4
2 years	39.0	0.0	0.0	39.0	0.0
3 years	6.2	0.0	0.0	6.2	0.1
4 years	8.7	0.0	0.0	8.7	0.1
Chile 2000–04					
1 year	26.7	0.1	0.1	26.9	0.8
2 years	40.4	0.0	0.0	40.4	0.1
3 years	6.0	0.0	0.0	6.0	0.2
4 years	6.5	0.0	0.0	6.5	0.3
New Zealand					
1 year	39.0	0.5	0.3	39.8	0.6
2 years	11.6	0.2	0.2	12.0	1.0
3 years	21.1	0.2	0.1	21.4	0.2
4 years	41.0	1.3	0.5	42.7	0.9

Source: Authors' calculations.

Government spending shocks are estimated to account for a small part of current account variance in both countries. The effect is a little larger in New Zealand than in Chile, and it is probably understated a little given our assumption that the government consumes only home goods. In the case of Chile, these shocks correspond to the government deviating from the policy rule. Therefore, they do not capture in full the effects of fiscal policy—broadly defined—on the evolution of the current account.

The fact that investment-specific shocks play an important role in explaining the current account shows the positive shock absorber role performed by this variable in both countries. With an open capital account, households, in the aggregate, can smooth consumption in the face of shocks by using the current account to borrow and lend, much as an individual uses a bank account.

5.2 Historical Decomposition of the Current Account

This subsection highlights how some major developments can be interpreted in terms of the model shocks and the current account responses to those shocks. Figures 4 and 5 present the historical contribution of each shock to the evolution of the current account for Chile and New Zealand respectively.

Figure 4. Historical Decomposition of the Current Account: Chile, 1990–2005

Deviation from steady state (in percent)

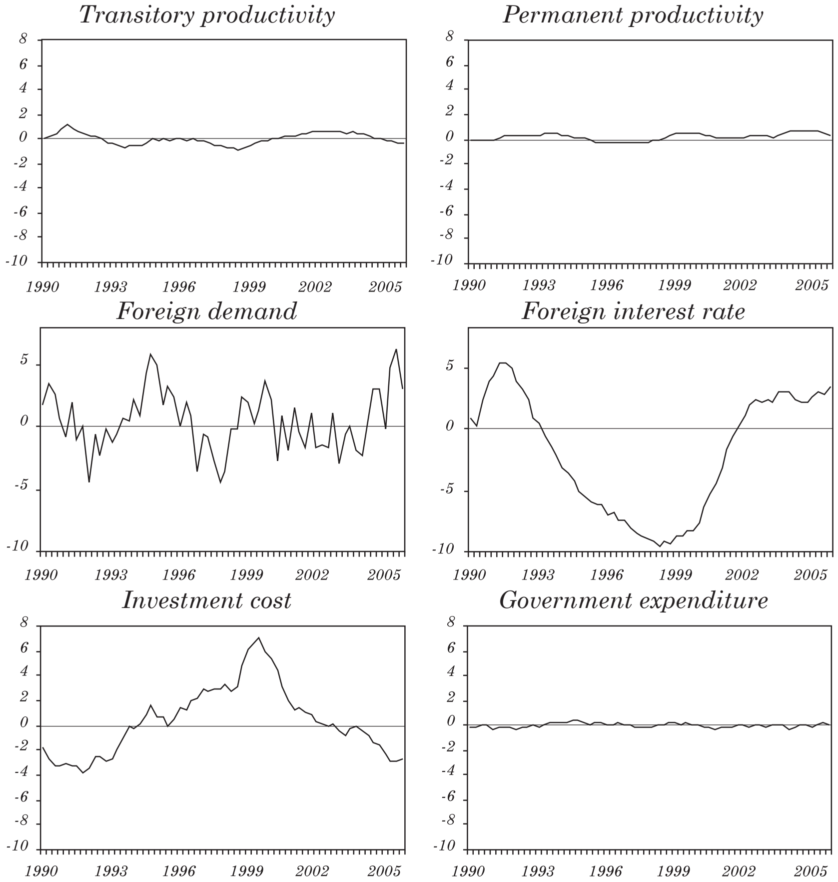
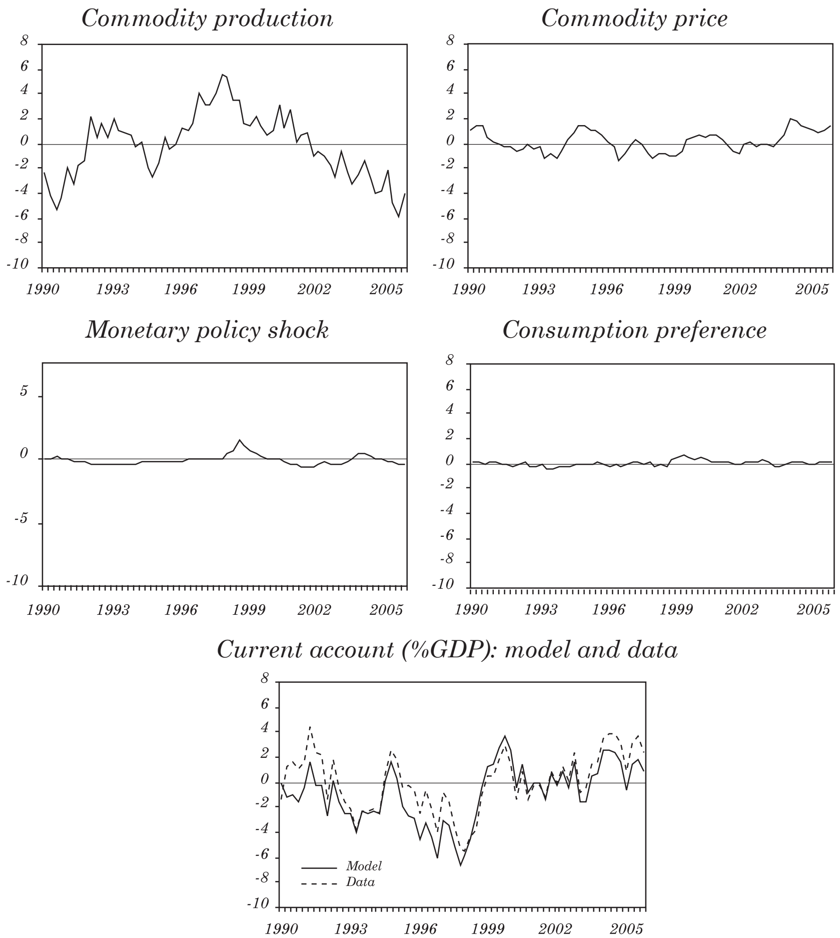


Figure 4. (continued)



Source: Authors' calculations.

Figure 5. Historical Decomposition of the Current Account: New Zealand, 1990–2005

Deviation from steady state (in percent)

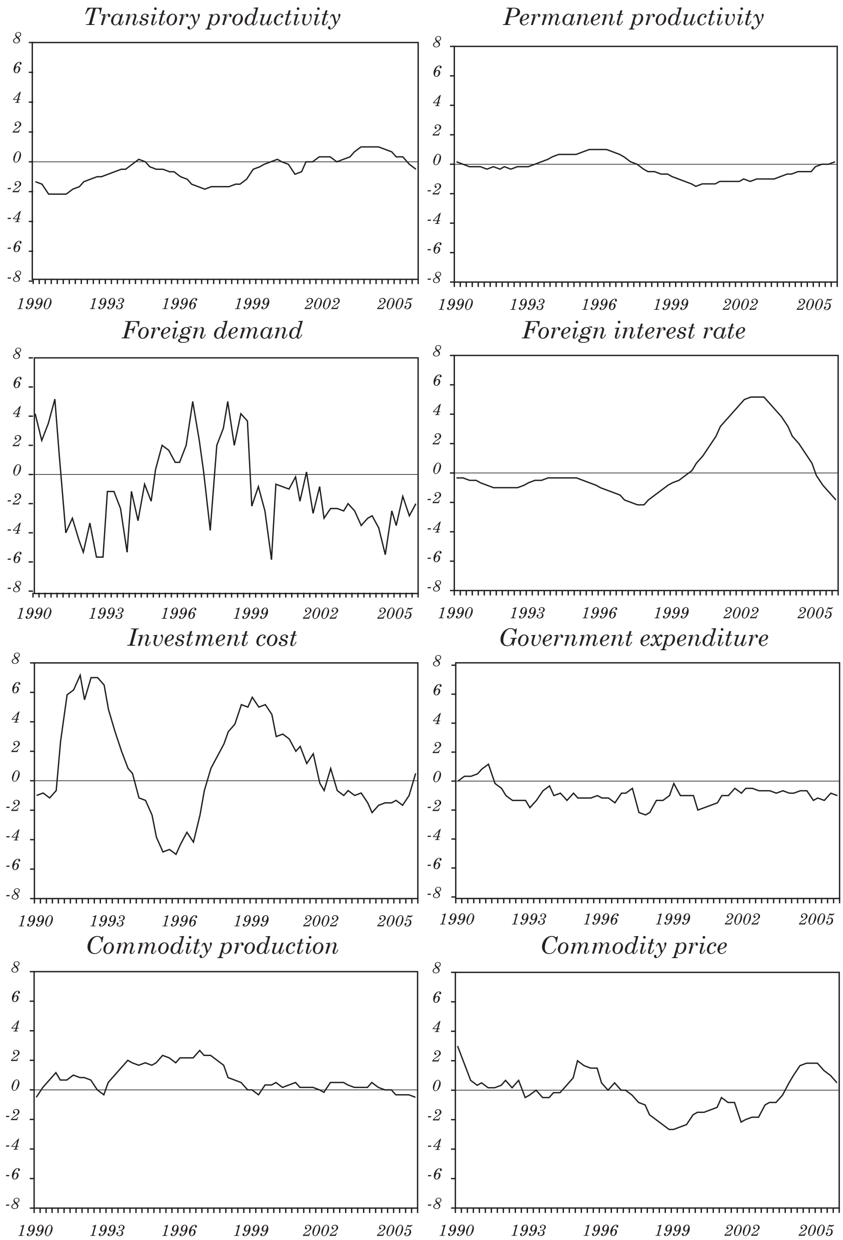
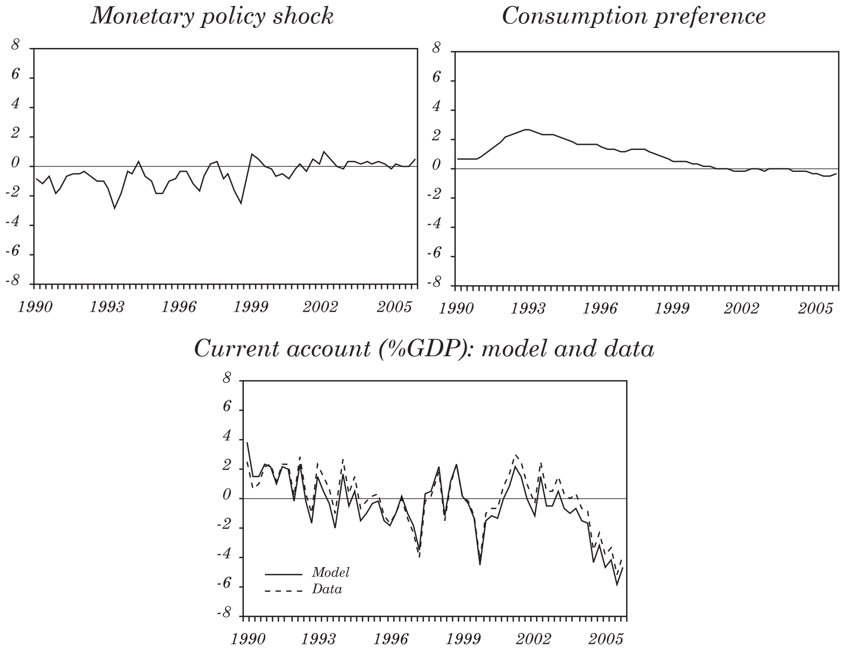


Figure 5. (continued)



Source: Authors' calculations.

5.2.1 Chile

The evolution of the current account in Chile over the period is characterized by a phase of moderate deficits from 1990 until 1999–2000 and then by a period in which the current account oscillated between small deficits and surpluses. The deficits observed at the beginning of the 1990s are explained mostly by a boom in investment, triggered by favorable domestic conditions, and by a weakness in foreign activity that depressed exports (figure 4). According to the model, the small reversal of the current account in 1995, which coincides with the Mexican crisis, is explained by favorable external conditions that boosted exports. In fact, an index of foreign output constructed by averaging the output of Chile's main trade partners grew more than 4.5 percent at the beginning of that year.

Foreign financial conditions also played an important role in explaining the evolution of the current account in the 1990s. From 1991 until 1999, easing foreign financial conditions (reflected in a stronger exchange rate) put downward pressure on the current account. The improvement in foreign financial conditions of that period seems to capture the observed large capital inflows and the associated real exchange rate appreciation. The current account reversed dramatically in 2000, after the Asian crisis and during the Argentine crisis. The reversal in the current account began before the reversal in foreign financial conditions, however. In 1999 a dramatic negative investment shock depressed investment and imports. This last shock could be capturing the stress experienced by the domestic financial sector after the Asian crisis. While there was an important contractionary monetary shock in late 1998, the model does not attribute a large share of responsibility for the fall in investment and the reversal of the current account to that shock.

Despite the fact that the country's spread has been falling since the 2001 Russian crisis, the model identifies tightening external financial conditions as one of the reasons why the current account improved after 2000. As mentioned before, these shocks to foreign financial conditions capture more than the observed movements in the foreign interest rate and the risk premium faced by the country. They also capture any change in market conditions that affects the exchange rate so that the UIP condition holds. In the case of Chile, for example, this shock could be capturing the significant capital outflows of the last few years of the sample, which were associated with foreign investment by Chilean companies in Latin America and the portfolio strategies of pension fund administrators (AFPs). The decline in natural resources GDP and a small investment boom after 2002 would have led to a current account deficit, had no other shock hit the economy. More recently, an export expansion triggered by more robust growth in trading partners, combined with the copper-price boom, explains the current account surpluses observed over recent quarters.

5.2.2 New Zealand

According to our estimation, the largest swings in the current account during the period have come from investment-specific shocks (see figure 5). In the model, a positive investment adjustment shock means that a given amount of investment is transformed more efficiently into productive capital, thereby reducing the cost of capital. This shock may also capture effects such as financial constraints that affect investment. Investment-specific shocks were negative during the labor market reforms of the early 1990s, positive in the mid-1990s (a period of rising investment), and negative in the late 1990s (possibly related to the end of the domestic housing boom or financial crises in other countries). This last shock had a relatively small effect on the recent current account deterioration, compared with the shock in the mid-1990s. While both periods were characterized by investment booms and current account deteriorations, the effects of foreign financial conditions on the exchange rate are estimated to have been more important in recent years.

The estimated foreign demand shock shows weak foreign demand in the early 1990s (following recession in some trading partners), strong foreign demand through the rest of the 1990s, and weak foreign demand after about 2001. The foreign demand shock has a strong, but transitory short-term effect, and the effect on the current account follows a similar pattern.[22] As shown in figure 5, the relatively low world price of commodity exports in 1998–2003 had a negative effect on the current account position, while the rise in commodity export prices in 2004–05 had a positive effect on the current account position, much as one would expect. Over all, from 1997 to 2002, the main factors that are estimated to have led to an improvement in the current account position were the investment-specific shock and the contribution of changes in foreign financial conditions to the depreciation of the New Zealand dollar.

The estimated historical shocks show periods of New Zealand dollar strength in 1996 and in 2004–05 and weakness in 2000–01. The foreign interest rate/UIP shock is not only persistent, but its main effect on the current account occurs through the volume of imports and exports with a lag of about two years. Thus, the weak New Zealand dollar of 2000–01 had a positive influence on the current account balance in 2002–03 (see figure 5). The lagged response implies that the strong New Zealand dollar seen in 2004–05 may continue to have a negative effect on the current account balance through 2007, all else being equal.

6. Conterfactual Experiments

This section explores conterfactual experiments for the evolution of the current account of Chile and New Zealand. First, we analyze

22. This shock appears to pick up the effect of government imports (in the model the government is assumed to consume only home goods). This is seen clearly in the two spikes in 1997 and 1999, which correspond to the import of two navy frigates. Government imports have expanded in the past year or two on a smaller scale, so the effect of foreign demand is likely to be overstated and government spending correspondingly understated.

the dynamics of the estimated model under a scenario that eliminates Chile's original-sin problem, assuming that external debt is denominated completely in Chilean pesos rather than in foreign currency. Second, we explore whether a more or less aggressive monetary policy response in New Zealand would change the current account responses to different shocks.

6.1 Chile without Original Sin

According to Eichengreen, Hausmann, and Panizza (2005), if a country is unable to borrow abroad in its own currency, it suffers from so-called original sin. Chile faces this problem. Most of the country's debt is denominated in U.S. dollars, creating an aggregate currency mismatch on its balance sheets. Consequently, external shocks could be amplified in the domestic economy. To shed light on the macroeconomic implication of issuing debt in domestic currency, we explore the dynamics of the model under a scenario in which Chile's entire external debt is denominated in Chilean pesos.

The responses of the main aggregate variables for the estimated model for Chile assuming an external debt denominated in pesos are shown in figure 6. For purpose of comparison, these are plotted together with the impulse response functions of the original estimated model, in which the external debt is denominated in U.S. dollars. GDP is less sensitive to external shocks (namely, commodity price, foreign demand, and interest rate shocks) when the external debt is in Chilean pesos, although the difference is moderate. This result may indicate that eliminating the valuation effects in the foreign income investment of the current account would help isolate aggregate domestic demand from fluctuations in external conditions.

The model predicts that the responses of the current account to some supply shocks would be larger if the external debt was denominated in Chilean pesos. In particular, the improvement in the current after a transitory productivity shock is around 1 percent in the short run when the debt is denominated in pesos, whereas this response is small in the baseline estimation. Permanent productivity shocks would generate a more significant worsening in the current account surplus with a peso denomination of external debt. We also observe that when the external debt is in pesos, the required movement in the exchange rate to generate an adjustment in the current account would be smaller.

In terms of monetary policy, interest rate innovations become less effective in influencing the current account if the external debt

Figure 6. Impulse-Responses: Changing the External Debt Denomination in Chile

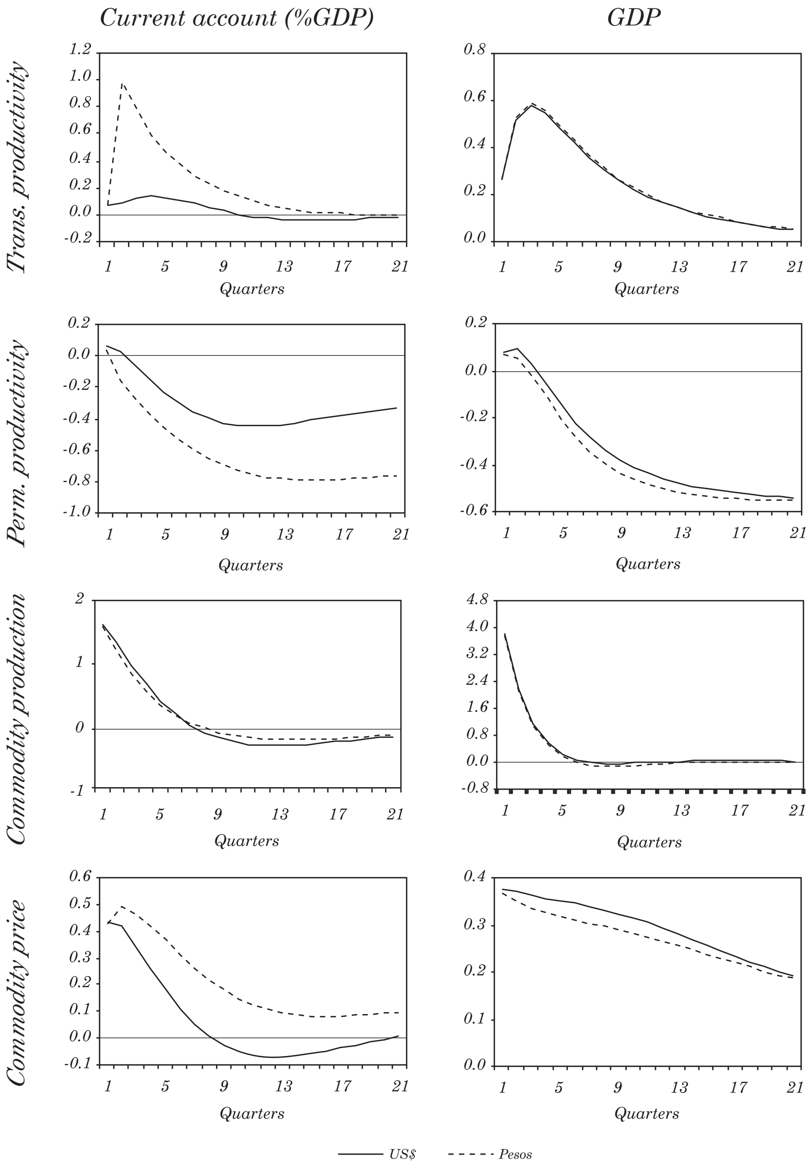


Figure 6. (continued)

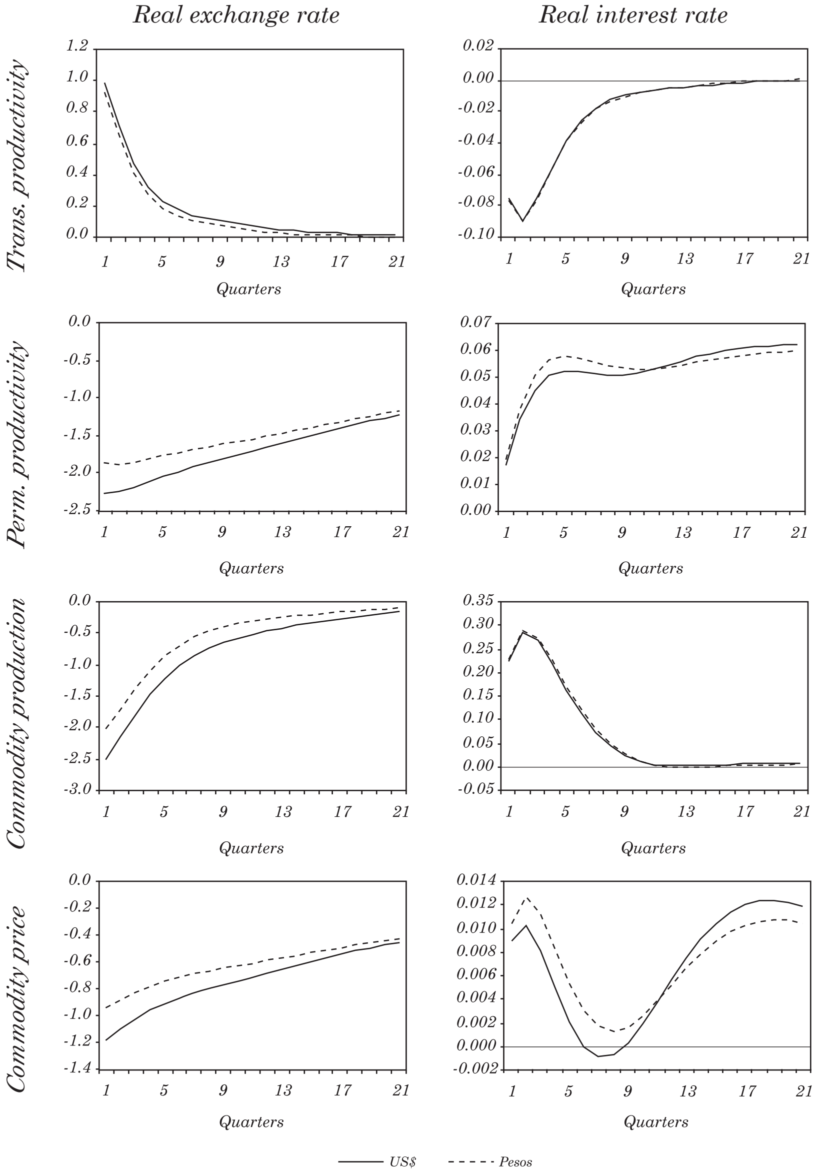


Figure 6. (continued)

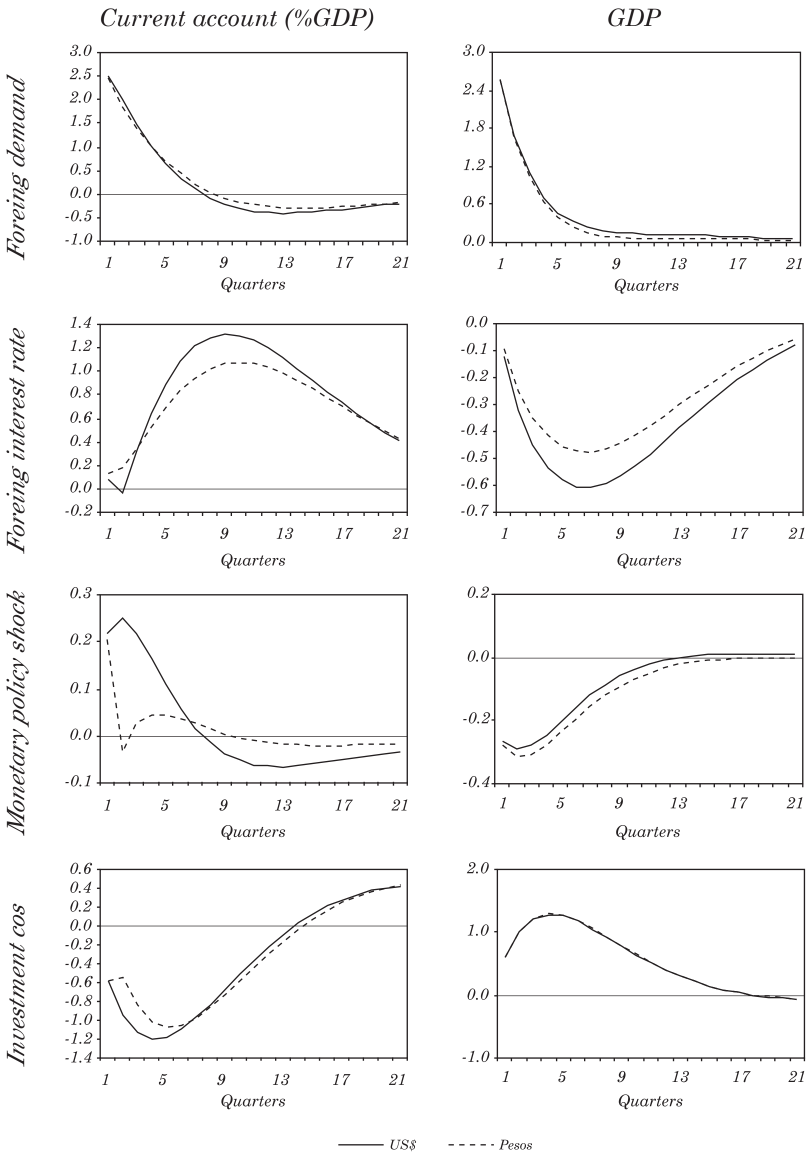
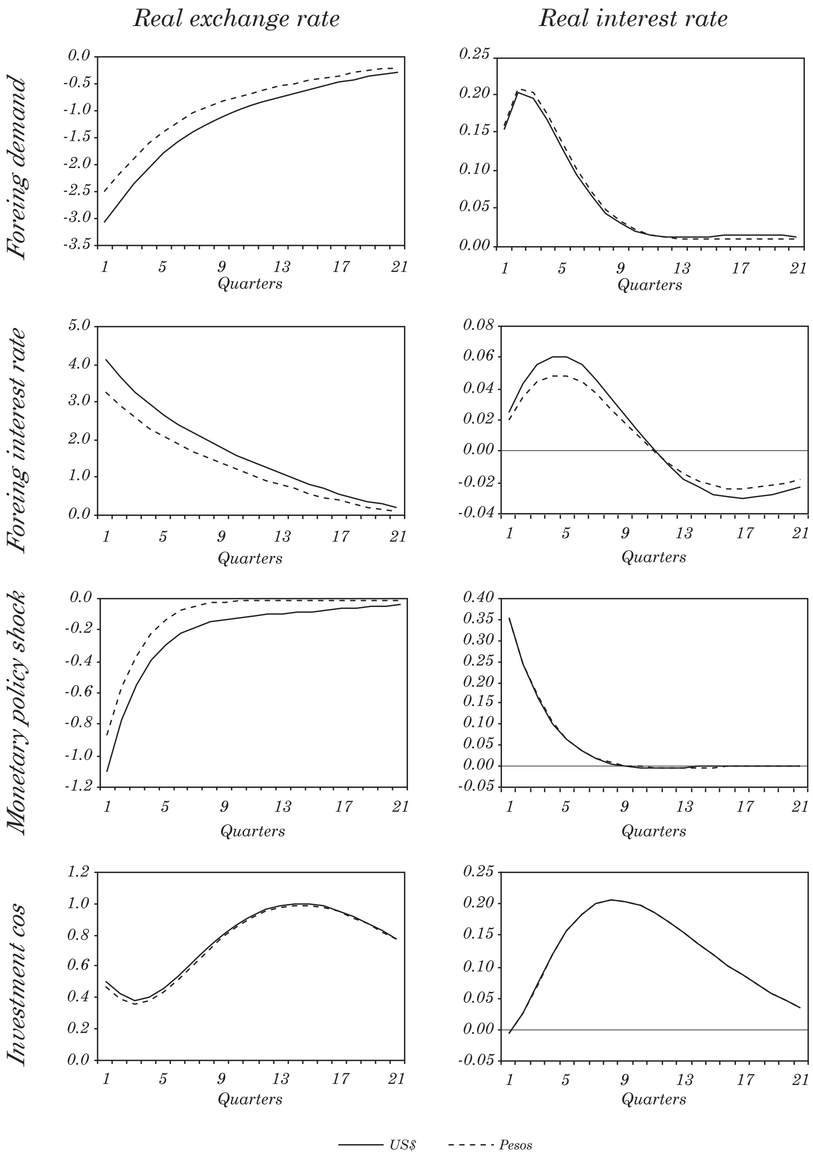


Figure 6. (continued)



Source: Authors' computations.

is denominated in pesos. This response is similar to the one found in the estimated model for New Zealand. A domestic-currency denomination for the external debt makes foreign investment income more related to the domestic interest rate. Thus, a tighter monetary policy directly increases debt service payments, offsetting its impact on the trade balance.

6.2 The Effect of a More or Less Aggressive Monetary Policy in New Zealand

While we don't usually associate the current account with monetary policy, in an open economy tight monetary policy may spill demand into the current account by putting upward pressure on the exchange rate and providing cheap imports. The variance and historical decompositions in the previous sections attribute almost no role to monetary policy shocks in explaining the exchange rate and the current account. It is still possible, however, that the endogenous monetary policy response embodied in the reaction function may be relevant to the behavior of the exchange rate and the current account.[23] There is a perception in some circles that the strong exchange rate, supported by high domestic interest rates, has been detrimental for exporters and is responsible for New Zealand's large imbalances. This suggests that a less aggressive monetary policy response might help moderate the effects of shocks on the current account dynamics. Others argue that, to avoid large exchange rate fluctuations, monetary policy should aim to avoid being out of phase with the foreign business cycle, suggesting that a more aggressive monetary policy response is appropriate. The experiments in this subsection address these opposing claims. We conduct the two counterfactual experiments by adjusting the interest-rate-smoothing parameter. The results are shown in figure 7.

First, we increase the smoothing parameter from the estimated 0.90 to 0.95, which heightens the degree of smoothing and correspondingly softens the response to inflation and output. Since the estimated smoothing parameter is already high, the differences are not great. We are most interested in the shocks that account for the bulk of current account and exchange rate variance: namely, the foreign interest rate, investment cost, foreign output, and commodity price shocks. In the

23. Edwards (2006b) discusses the relationship between monetary policy and external imbalances in New Zealand and explores the potential benefits of changing the current monetary policy framework.

Figure 7. Impulse-Responses: Changing the Aggressiveness of Monetary Policy in New Zealand

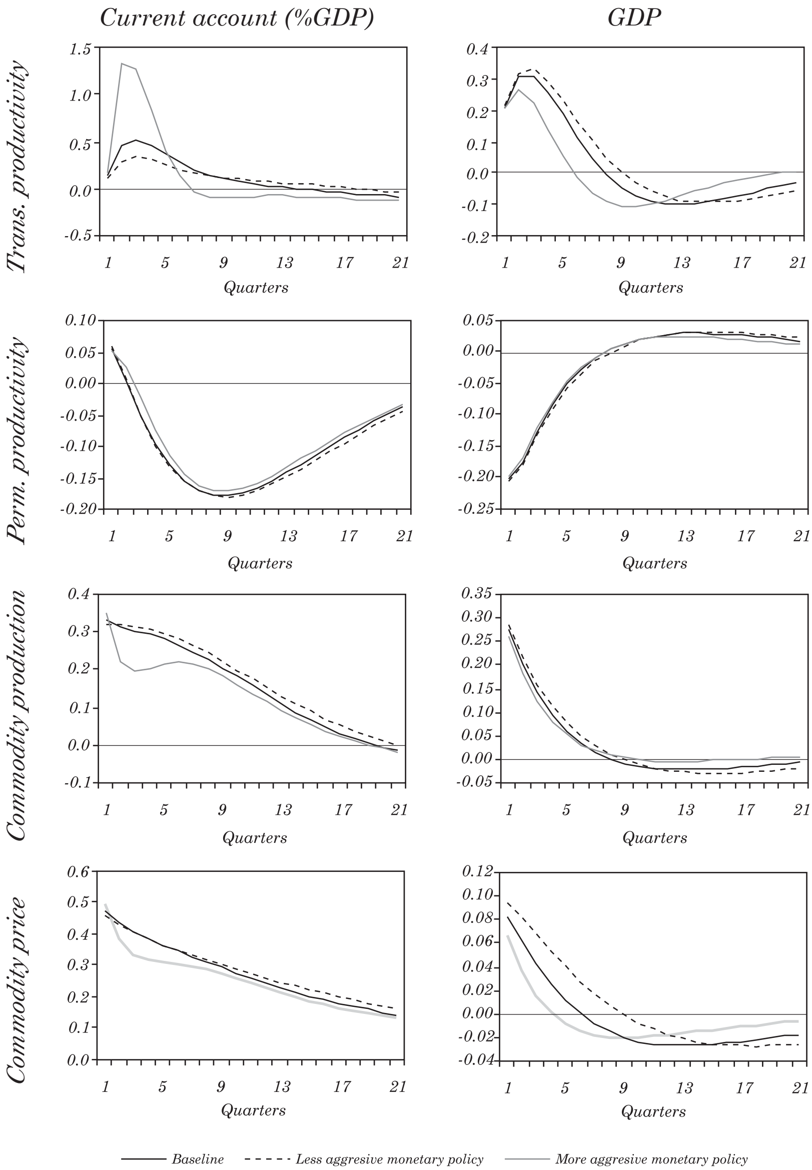


Figure 7. (continued)

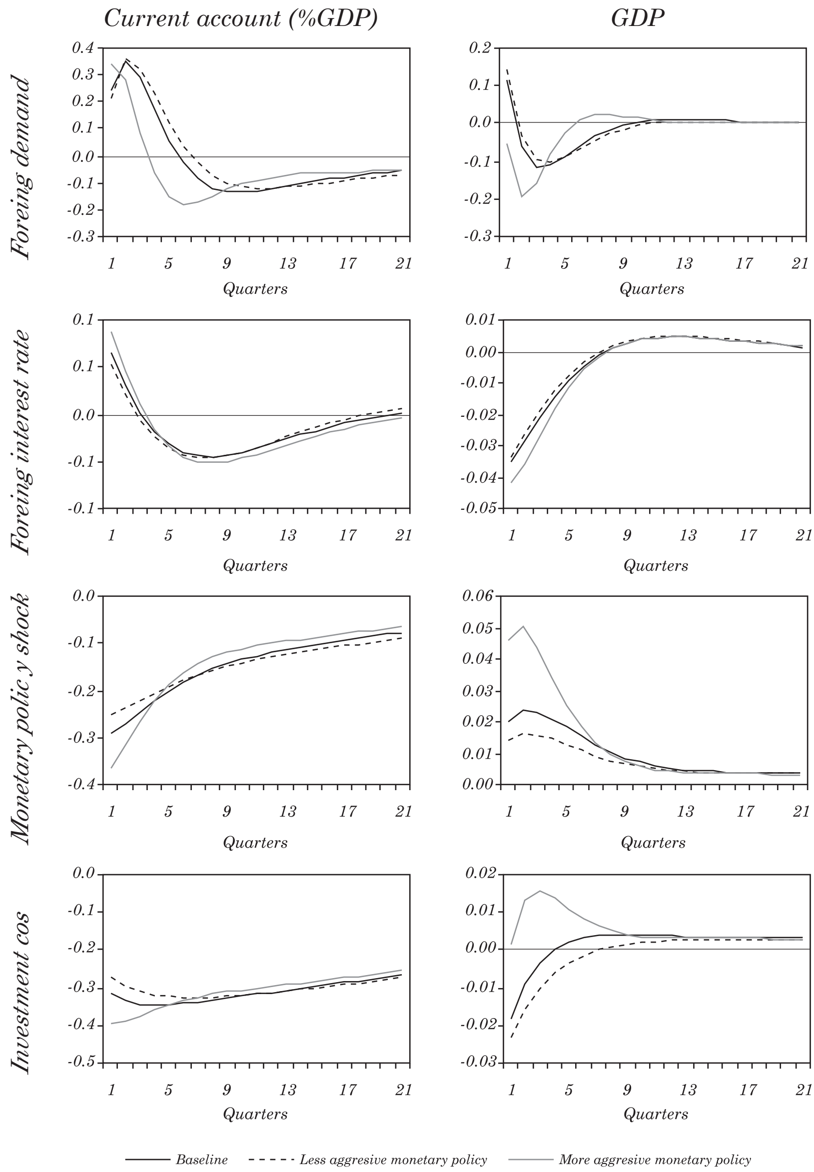


Figure 7. (continued)

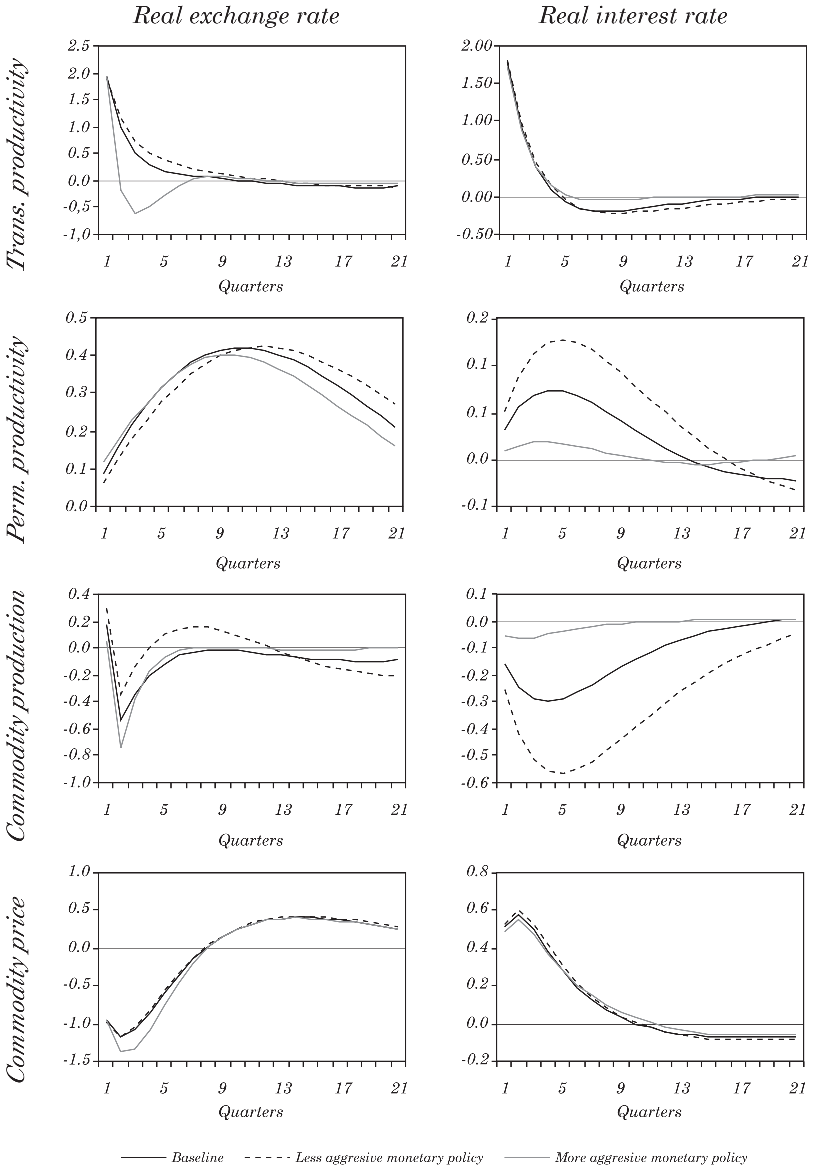
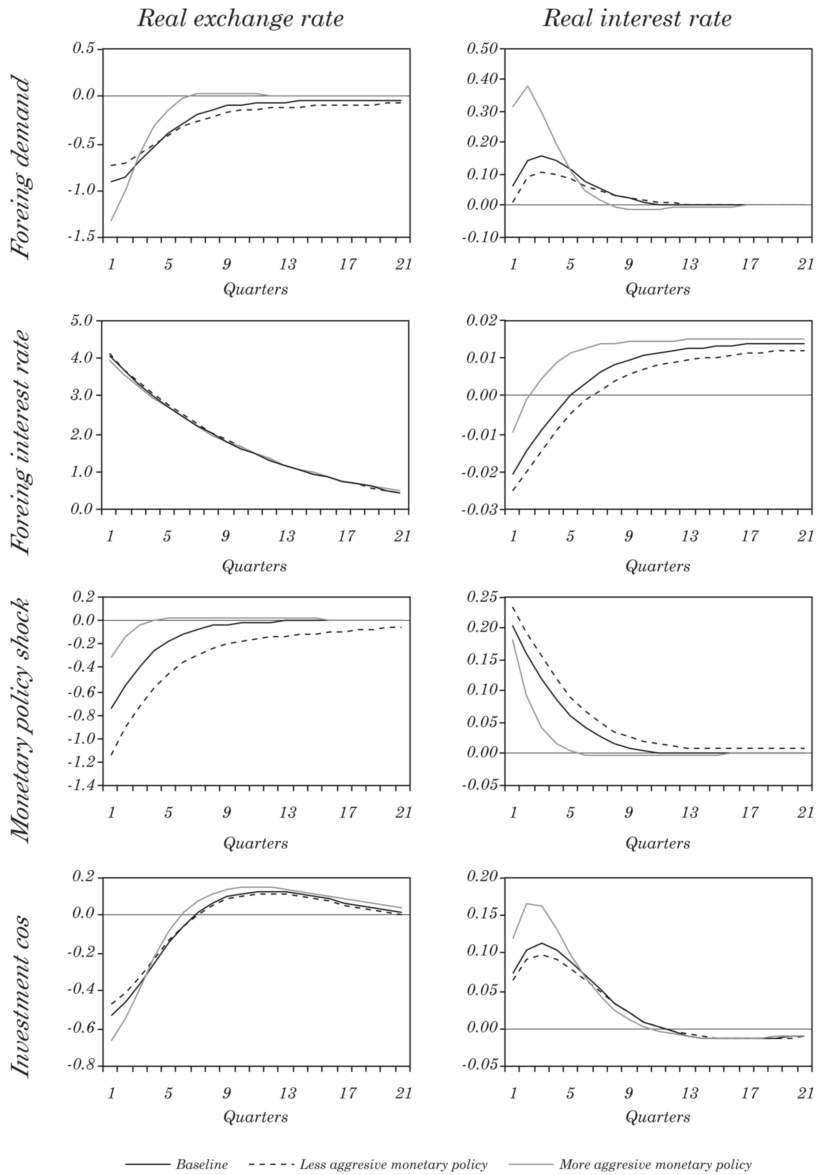


Figure 7. (continued)



Source: Authors' computations.

face of a foreign cost of capital (UIP) shock, which accounts for the bulk of exchange rate variance, there is hardly any difference in the exchange rate response. The current account responds a little later and is more persistent. The less aggressive response slightly reduces exchange rate volatility in the other three cases, while the effect on the current account is small.

Second, we reduce the degree of smoothing to 0.60, implying a substantially stronger monetary response to inflationary pressure and output fluctuations in an effort to aggressively stabilize the business cycle. In the face of a foreign cost of capital (UIP) shock (which accounts for the bulk of exchange rate variance), there is almost no difference in the real exchange rate response. For the other three shocks of interest, the more aggressive monetary policy response increases real exchange rate volatility. The effect on the current account works mainly through the effect of sharper interest rate movements on the investment income account. In the case of a commodity price shock and a foreign output shock, the deterioration works to offset the improvement in the trade balance. For the investment-specific shock, the investment income deterioration reinforces the trade balance deterioration.

7. Conclusions

This paper used an open economy DSGE model with a commodity sector and nominal and real rigidities to investigate the factors that account for current account developments in two small commodity-exporting countries. We are interested in assessing these factors in a coherent framework to better understand the macroeconomic and financial stability risks associated with the increase in both external stocks and external flows that has resulted from financial market integration.

We estimated the model with Bayesian techniques, using Chilean and New Zealand data. The structural factors that explain the behavior of the current account were fairly similar for the two countries. We find that foreign financial conditions, investment-specific shocks, and foreign demand account for the bulk of the variation of the current accounts in both cases. Monetary and fiscal policy shocks (that is, deviations from policy rules) are estimated to have relatively small effects. For New Zealand, fluctuations in export commodity prices have also been important in explaining the current account. In both countries, foreign shocks account for about half, or more than half, of current account variation at horizons up to four years.

We carried out policy experiments to explore counterfactual experiments on the current account dynamics. If Chile's external debt was denominated in Chilean pesos, GDP and aggregate demand components would be more resilient to external shocks (commodity price, foreign demand, and interest rate). Monetary policy innovations would also have less effect on the current account. Moreover, the required movement in the real exchange rate to generate an adjustment in the current account would tend to be smaller. Our counterfactual experiment for New Zealand revealed that, in the framework of our model, a more or less aggressive monetary policy can do little to offset the effects of shocks to foreign financial conditions, which account for the vast bulk of exchange rate variance. For the other three shocks that are important for the current account, a less aggressive monetary policy response reduces exchange swings, while having little effect on the current account. However, the scope for more smoothing is limited by the already-high estimated coefficient in the policy rule.

Appendix

Description of the Parameters

Table A1. Description of the Estimated Parameters

Parameter	*Country*	*Description*
σ_L	Both	Inverse of the labor supply elasticity
h	Both	Habit-formation coefficient
ϕ_L	Both	Calvo probability of reoptimizing nominal wages
χ_L	Both	Weight of past inflation in indexation of nominal wages
η_C	Both	Elasticity of substitution between home and imported goods in consumption
η_I	Both	Elasticity of substitution between home and imported goods in investment
μ_S	Both	Adjustment cost in investment coefficient
ϕ_{HD}	Both	Calvo probability of reoptimizing home goods prices sold domestically
χ_{HD}	Both	Weight of past inflation in indexation of prices of home goods sold domestically
ϕ_{HF}	Both	Calvo probability of reoptimizing home goods prices sold abroad
χ_{HF}	Both	Weight of past inflation in indexation of prices of home goods sold abroad
ϕ_F	Both	Calvo probability of reoptimizing imported goods prices
χ_F	Both	Weight of past inflation in indexation of imported goods prices
$\psi_{i,1}$	Chile	Smoothing coefficient in monetary policy rule, 1990–99
$\psi_{\pi,1}$	Chile	Reaction to inflation deviation in monetary policy rule, 1990–99
$\psi_{y,1}$	Chile	Reaction to GDP growth deviation in monetary policy rule, 1990–99
$\psi_{rer,1}$	Chile	Reaction to RER deviation in monetary policy rule, 1990–99
$\psi_{i,2}$	Chile	Smoothing coefficient in monetary policy rule. 2000 onward
$\psi_{\pi,2}$	Chile	Reaction to inflation deviation in monetary policy rule, 2000 onward
$\psi_{y,2}$	Chile	Reaction to GDP growth deviation in monetary policy rule, 2000 onward

Table A1. (continued)

Parameter	*Country*	*Description*
ψ_i	New Zealand	Smoothing coefficient in monetary policy rule
ψ_π	New Zealand	Reaction to inflation deviation in monetary policy rule
ψ_y	New Zealand	Reaction to GDP growth deviation in monetary policy rule
$\eta*$	Both	Foreign demand elasticity to home goods
θ	Both	Elasticity of the external premium to NFA-GDP ratio
$\rho_{\alpha H}$	Both	Persistence of transitory productivity shock
ρ_{Ys}	Both	Persistence of commodity production shock
ρ_{Y*}	Both	Persistence of foreign demand shock
$\rho_{\zeta C}$	Both	Persistence of preference shock
$\rho_{\zeta I}$	Both	Persistence of investment adjustment cost shock
ρ_G	Both	Persistence of government expenditure shock
$\rho_{\iota*}$	Both	Persistence of foreign interest rate shock
ρ_T	Both	Persistence of permanent productivity shock
$\sigma_{\alpha H}$	Both	Standard deviation of transitory productivity shock
σ_{Ys}	Both	Standard deviation of commodity production shock
σ_{Y*}	Both	Standard deviation of foreign demand shock
$\sigma_{\iota*}$	Both	Standard deviation of foreign interest rate shock
σ_μ	Both	Standard deviation of monetary policy shock
$\sigma_{\zeta C}$	Both	Standard deviation of preference shock
$\sigma\ G$	Both	Standard deviation of government expenditure shock
$\sigma_{\zeta I}$	Both	Standard deviation of investment adjustment cost shock
σ_T	Both	Standard deviation of permanent productivity shock

Source: Authors' construction.

Table A2. Calibrated Parameters
Percent

Parameter	*Chile*	*New Zealand*	*Definition*
g_y (annual basis)	3.0	1.5	Steady-state per capita productivity growth
π (annual basis)	3.0	2.0	Steady-state inflation rate
r (annual basis)	4.1	3.0	Steady-state real interest rate
δ (annual basis)	6.8	8.0	Depreciation rate of capital
χ	0.40	0.90	Domestic ownership of commodity production
$(X - M) / Y$	2	1.3	Steady-state ratio of net exports to GDP
CA / Y	−1.8	−5.0	Steady-state ratio of current account to GDP
B	0.30	0.70	Steady-state debt-GDP ratio
G / Y	12	17	Steady-state ratio of government expenditure to GDP
Y_S / Y	10	14	Steady-state ratio of commodity production to GDP
I / Y	26.6	22.8	Steady-state investment-GDP ratio
C / Y	59.3	58.8	Steady-state consumption-GDP ratio
γ_C	70	70	Home goods share in consumption
γ_I	40	25	Home goods share in investment
ρ_{pS^*}	0.98	0.99	Autoregressive coefficient of commodity price
σ_{pS^*}	8.85	3.51	Standard deviation of commodity price innovation
ρ_{ν}	0.00	0.00	Autoregressive coefficient of monetary policy shocks
η_H	0.66	0.68	Labor share in the home goods production
λ	0.50	0.00	Fraction of non-Ricardian households

Source: Authors' construction.

Table A3. Prior Distributions

Parameter	*Country*	*Mean/mode*	*Standard dev./ d.f.*	*Shape*	*90% interval*
σ_L	Both	1000	1000	Gamma	0.051 – 2.996
h	Both	0.500	0.250	Beta	0.097 – 0.903
ϕ_L	Both	0.750	0.100	Beta	0.570 – 0.897
χ_L	Both	0.500	0.250	Beta	0.097 – 0.903
η_C	Both	1000	5.000	Inv. gamma	0.655 – 3.045
η_I	Both	1000	5.000	Inv. gamma	0.655 – 3.045
μ_S	Both	2000	3.000	Inv. gamma	1.271 – 9.784
ϕ_{HD}	Both	0.750	0.100	Beta	0.570 – 0.897
χ_{HD}	Both	0.500	0.250	Beta	0.097 – 0.903
ϕ_{HF}	Both	0.750	0.100	Beta	0.570 – 0.897
χ_{HF}	Both	0.500	0.250	Beta	0.097 – 0.903
ϕ_F	Both	0.750	0.100	Beta	0.570 – 0.897
χ_F	Both	0.500	0.250	Beta	0.097 – 0.903
$\psi_{i,1}$, $\psi_{i,2}$	Chile	0.700	0.100	Beta	0.524 – 0.853
$\psi_{p,1}$, $\psi_{p,2}$	Chile	1500	0.150	Gamma	1.262 – 1.755
$\psi_{y,1}$, $\psi_{y,2}$	Chile	0.500	0.150	Gamma	0.281 – 0.770
$\psi_{rer,1}$, $\psi_{rer,2}$	Chile	0.200	0.100	Gamma	0.068 – 0.388
ψ_i	New Zealand	0.750	0.100	Beta	0.570 – 0.897
ψ_π	New Zealand	1500	0.100	Gamma	1.339 – 1.668
ψ_y	New Zealand	0.500	0.100	Gamma	0.348 – 0.675
η^*	Both	1000	4.000	Inv. gamma	0.645 – 3.659
θ	Chile	0.010	4.000	Inv. gamma	0.006 – 0.037
θ	New Zealand	0.001	4.000	Inv. gamma	0.001 – 0.004
ρ_{aH}	Both	0.700	0.200	Beta	0.321 – 0.965
ρ_{yS}	Both	0.700	0.200	Beta	0.321 – 0.965
ρ_{Y*}	Both	0.700	0.200	Beta	0.321 – 0.965
$\rho_{\zeta C}$	Both	0.700	0.200	Beta	0.321 – 0.965
$\rho_{\zeta \mathrm{I}}$	Both	0.700	0.200	Beta	0.321 – 0.965

Table A3. (continued)

Parameter	*Country*	*Mean/mode*	*Standard dev./ d.f.*	*Shape*	*90% interval*
ρ_G	Both	0.300	0.050	Beta	0.221 – 0.385
ρ_{i*}	Both	0.950	0.050	Beta	0.849 – 0.998
ρ_T	Both	0.700	0.200	Beta	0.321 – 0.965
σ_{aH}	Both	1000	3.000	Inv. gamma	0.635 – 4.892
σ_{yS}	Both	1000	3.000	Inv. gamma	0.635 – 4.892
σ_{Y*}	Both	1000	3.000	Inv. gamma	0.635 – 4.892
σ_{i*}	Chile	0.250	3.000	Inv. gamma	0.159 – 1.223
σ_{i*}	New Zealand	0.500	3.000	Inv. gamma	0.318 – 2.446
σ_m	Both	0.200	3.000	Inv. gamma	0.127 – 0.978
$\sigma_{\zeta C}$	Both	1000	3.000	Inv. gamma	0.635 – 4.892
σ_G	Both	1000	3.000	Inv. gamma	0.635 – 4.892
$\sigma_{\zeta I}$	Both	1000	3.000	Inv. gamma	0.635 – 4.892
σ_T	Both	0.200	3.000	Inv. gamma	0.127 – 0.978

Source: Authors' calculations.

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