Overoptimism, Boom-Bust Cycles, and Monetary Policy in Small Open Economies

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In the 1990s, several emerging market economies, such as Chile, Mexico, and a number of southeast Asian countries, displayed episodes of peaking growth rates combined with increasing current account deficits and appreciating currencies, which ended with abrupt reversions in capital flows and recessions.[1] In all cases, optimism about future prospects was strong prior to the recessions. Mexico was negotiating both its entrance into the North America Free Trade Agreement (NAFTA) and its membership in the Organization for Economic Cooperation and Development (OECD). Chile had undergone a smooth transition to democracy. Investors were increasingly enthusiastic about the prospects of harvesting the benefits of the market reforms introduced both in the previous period and under the new democracy. The southeast Asian economies, in turn, had their own reasons for optimism based on their impressive growth record of previous years. In all cases, optimism was grounded on reasonable arguments, but the prospects of future economic growth could not be estimated accurately.

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1. A similar pattern can also be observed in industrial economies, such as the United States at the end of the 1990s, and in emerging markets in the late 1970s.

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In this paper, we show that overoptimistic perceptions of the future by domestic private agents—that is, domestic "exuberance"—could have been a cause of the boom-bust cycles observed in some emerging economies in the 1990s. To that end, we develop a multi-sector dynamic stochastic general equilibrium (DSGE) model for a small economy with short-run stickiness in prices and wages and with expectations-driven boom-bust cycles. We show that under standard parameterization, the model is able to closely match most of the stylized facts observed in the boom-bust episodes in emerging markets. In the model, private agents are rational and forward looking, so their current decisions rely on their assessment of future productivity prospects. An overoptimistic assessment of future productivity makes them accumulate excess capital and over-increase their consumption, leading to a boom that is accompanied by a current account deficit. When agents realize that productivity will grow by less than expected, they must readjust their investment and consumption profiles, generating a current account reversal and a recession.

Our analytical approach closely follows Christiano and others (2007). We diverge from their work, however, in arguing that overoptimism about productivity trends, rather than productivity level changes, is the source of boom-bust cycles in open economies, as occurred in the 1990s. We show that if productivity levels follow a stationary process, then news about future productivity improvements are not able to replicate the real currency appreciation and the current account deterioration along the boom, as observed in the data. This result is related to the work of Aguiar and Gopinath (2007), who show that the observed countercyclicality of the current account in emerging economies can be explained by productivity trend shocks in a standard real business cycle model.

According to our model, a boom-bust cycle generated by domestic agents' overoptimism is observationally equivalent to a cycle driven by exogenous fluctuations in foreign financial conditions. Several authors claim that swings in external financial conditions were significant factors behind the observed patterns of macroeconomic variables in the 1990s in many emerging markets (Neumeyer and Perri, 2005; Uribe and Yue, 2006; Valdés, 2007). In this sense, our results can be interpreted as a plausible complementary explanation for the episodes of abrupt current account deterioration in emerging markets in the 1990s.[2] Among the policy implications, our model

2. Our results do not provide a formal test in favor of overoptimism as an explanation of boom-bust cycles in emerging economies against other theories based on fluctuations in the fundamentals.

shows that the trade-offs faced by monetary policy in a boom-bust cycle driven by expectations are not trivial. If the central bank tries to stabilize output, the result will be a large fall in inflation and a contraction in output in the tradable goods sector. On the other hand, if the central bank targets inflation strictly, then the boom in activity, the current account deterioration, and the exchange rate appreciation will be larger, and the subsequent recession more severe. Finally, if the monetary authority adjusts the interest rate to reduce exchange rate fluctuations, then the perverse effects on the domestic tradable goods sector are only prevented in the short run, while the boom-bust cycle is amplified in other variables.

The idea of expectations-driven macroeconomic fluctuations goes back at least to Pigou (1926). Recently, this hypothesis has received renewed attention in modern macroeconomics. Marfán (2005) analyzes boom-bust cycles provoked by excess optimism and concentrates mainly on the role of fiscal policy in an extended Mundell-Fleming context. The optimist-pessimist mood of the private sector in his model is completely exogenous. Beaudry and Portier (2004, 2007), Jaimovich and Rebelo (2006, 2007), Mertens (2007), and Christiano and others (2007) present different unique-equilibrium rational expectation models in which business cycles are generated by changes in expectations regarding productivity prospects. Jaimovich and Rebelo (2006, 2007), in particular, analyze the comovements of a set of variables generated in response to unmaterialized productivity shocks. They show that in a closed economy, adjustment costs in investment or labor (or both), variable capital utilization, and weak wealth effects on labor supply are key to replicating the comovements observed in the data. In an open economy, variable capital utilization turns out to be unimportant. Christiano and others (2007) emphasize the role played by the monetary policy at generating expectation-driven boom-bust cycles. Using a sticky-price, sticky-wages model they show that to generate a sizeable output expansion and a boom in stock prices in response to news about increased future productivity, monetary policy has to respond aggressively to the fall in inflation. The boom generated by overoptimistic perceptions about future productivity is thus amplified by a loose monetary policy. Mertens (2007) shows that an expectations-driven real business cycle (RBC) model is able to replicate relevant stylized facts of Korea's sudden stop in the late 1990s. Some studies on the Chilean crisis of 1982 also assign a responsibility to this boom-bust episode to an erroneous perception by private agents regarding their wealth (Barandiarán 1983, Schmidt-Hebbel, 1988).

The expectations-driven business cycle approach in this literature is related to the literature on multiple equilibria and sunspot cycles (Farmer, 1993). It can also be viewed as complementary to the literature on rational herding and information cascade cycles, which emphasizes how improper aggregation of information may occasionally result in cycles led by nonfundamentals (Banerjee, 1992; Chamley and Gale, 1994; Caplin and Leahy, 1993; Zeira, 1994). In this paper, we examine whether the quantitative implications of (rational/nonsystematic) aggregate forecast errors can explain the observed pattern of boom-bust cycles in small open economies within a fully specified dynamic model that features a unique equilibrium.

The remainder of the paper is divided into four sections. Section 1 provides a motivation on the effects of economic reforms and innovations on the expected path for productivity, and describes some stylized facts for economies that went through boom-bust cycle episodes in the 1990s: namely, Chile, Korea, and Mexico. Section 2 presents a detailed description of the theoretical model used to evaluate the effects of overoptimism in small open economies. Section 3 analyzes the dynamics of the model and discusses the tradeoffs faced by monetary policy. The final section summarizes our main findings.

1. Structural Reforms and Boom-bust Cycles in Emerging Markets

Several emerging market economies engaged in reforms in the 1980s and the 1990s. Moreover, with the fall of the Berlin wall, at the beginning of the 1990s, a generalized stimulus for accelerating and expanding market globalization was perceived. At the same time, emerging economies had resumed access to voluntary financial flows under favorable conditions, and trade markets were mutating toward increasing levels of regional integration. In this context, the international forums increasingly concentrated on the new international financial architecture, and the expansion of market institutions. While this macroeconomic context was prone to boost productivity, the actual effect of the reforms was hard to evaluate, given that the scenario was without precedent. It is possible, therefore, that private agents would have overestimated the effects of the reforms on future productivity.

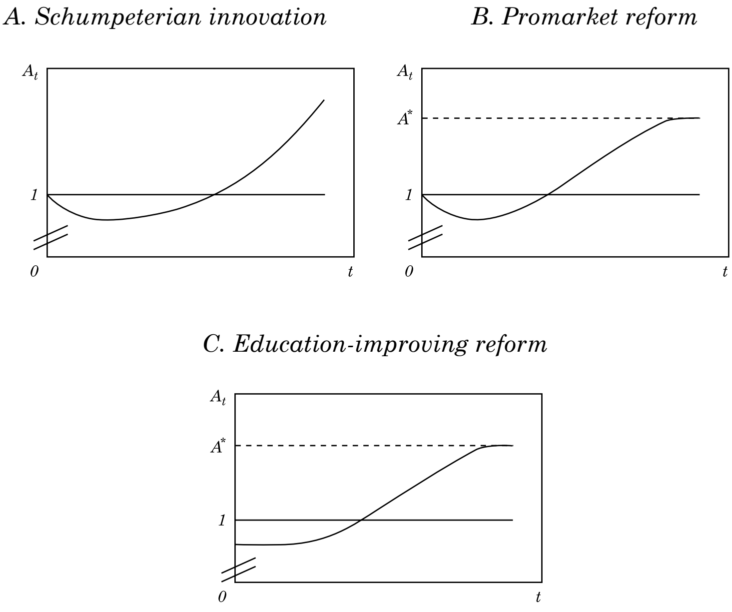
1.1 Structural Reforms, Innovations, and Productivity

Both, structural reforms and innovations give rise to delayed changes in productivity. For example, if $F_{i,t}$ denotes the production function of a generic firm i at time t, the concomitant production function after a reform or a systemic innovation that stimulates productivity would be $F'_{i,t} = F_{i,t} A_t$, where A_t measures the impact of the reform or innovation on productivity at time t. Figure 1 presents examples of the effect on productivity of different types of innovations and reforms initiated at $t = 0$. First, we illustrate the effect on productivity of a Schumpeterian innovation –i.e. the steam machine, electricity, information and communication technology, and so forth. Initially, the destruction of capital, jobs, skills, and public goods related to the old technology dominates the creation process of the blossoming innovation. This would reduce measured productivity. At longer horizons, the benefits of the new technology outpace the costs of destroying the old one and measured productivity rises (the A_t curve could potentially turn concave at a very long horizon, showing decreasing returns).

Second, we present the case of a promarket reform (such as a trade-opening reform). Initially, measured productivity may fall as costly reallocation of resources from different sectors lead to temporary decreases in output. As time goes by, measured productivity increases and converges to a long-term productivity gain, A^*, once the reform is completely internalized. A similar pattern would follow from a reform intended to improve human capital (education-improving reform). There is an initial period in which significant resources are diverted from other activities to implement the reform, with no immediate productive effects. The benefits of the reform start to be harvested when the new well-educated generations graduate, and the reform is completed once the labor force is entirely educated.

In all the innovations or reforms described, there is no prior history to provide economic agents with the basis for accurately predicting its impact through time. Agents may know the functional form followed by A_t through time, but the values of certain parameters such as A^* are initially uncertain. In this context, agents react first by setting notional values for A^*, which may differ from their actual values. In all cases, it takes time for the reforms to materialize into actual productivity gains, making it hard to evaluate ex ante their real impact.

Figure 1. Reforms and Their Impact on Productivity



Source: Authors' drawings.

1.2 Some Stylized Facts

There is a set of stylized facts that characterizes the boom-bust episodes in emerging market that engaged in reforms. In this subsection we describe some of them for three cases: Chile, Korea, and Mexico in the 1990s.

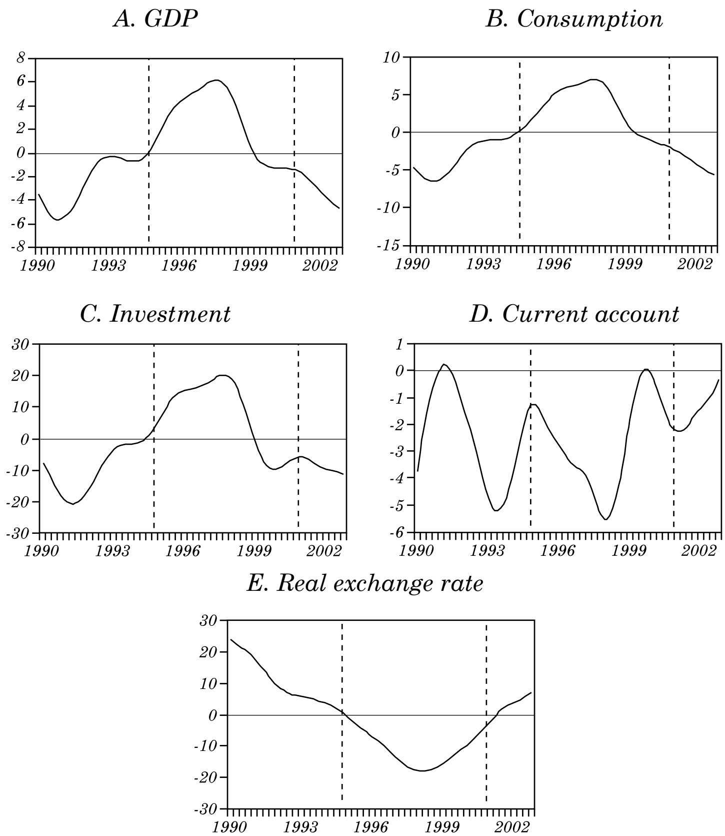
Chile introduced a number of reforms in the 1970s and 1980s. The democratic administrations that started in 1990 reinforced and deepened the structural reforms and gave a high priority to overall macroeconomic equilibrium. The signal to economic agents was that a strong stimulus to productivity growth was coming. Jadresic and Zahler (2000) claim based on time-series modeling, that key factors underlying the rapid productivity growth in the 1990s were precisely the deepening of democracy and the introduction of new structural reforms. Mexico implemented a privatization plan in the late 1980s, followed by a trade liberalization policy in the 1990s that involved the future opening of its economy to trade and capital flows with the United States and Canada. Korea experienced a long period of rapid growth, low inflation, and a sustained improvement in living standards before being hit by the financial crisis of 1997. High domestic savings and investment contributed to Korea's rapid transformation. The government had begun an economic reform program, which gained momentum in 1993–96, to gradually liberalize financial markets and the capital account.

Figures 2, 3, and 4 present some stylized facts for the three economies for the period 1990–2002.[3] In all three cases, we identify a phase in which output rises above trend together with an increase in investment and consumption. During the boom phase, we also observe a real currency appreciation and current account deterioration in the three countries. For Mexico, the expansion in output was less dramatic than in Korea and Chile, but the consumption boom was comparable to those countries. All three cases experienced an abrupt reversion of the boom, with a fall in output, consumption, and investment and a steep reversion of the current account deficit. In Mexico and Korea, the bust coincided with a depreciation of the currency of almost 40 percent. In Chile, the depreciation of the currency during the bust was slower than in the other two countries.

The boom-bust cycle in these three countries involved swings in output and consumption of about 10 percent in a brief period of time. The swings were much larger in the case of investment, with differences of more than 20 percent from peak to trough. In Mexico and Chile, the contraction of the current account deficit did not lead to a surplus in this variable. For Korea, the current account deficit of almost 6 percent of gross domestic product (GDP) was followed by a similar surplus a couple of years after the peak of the boom. Unlike Chile and Mexico, Korea had a stunning recovery from the crisis and output regained its precrisis level. In the case of Chile, growth has not recovered the 1990s rate.

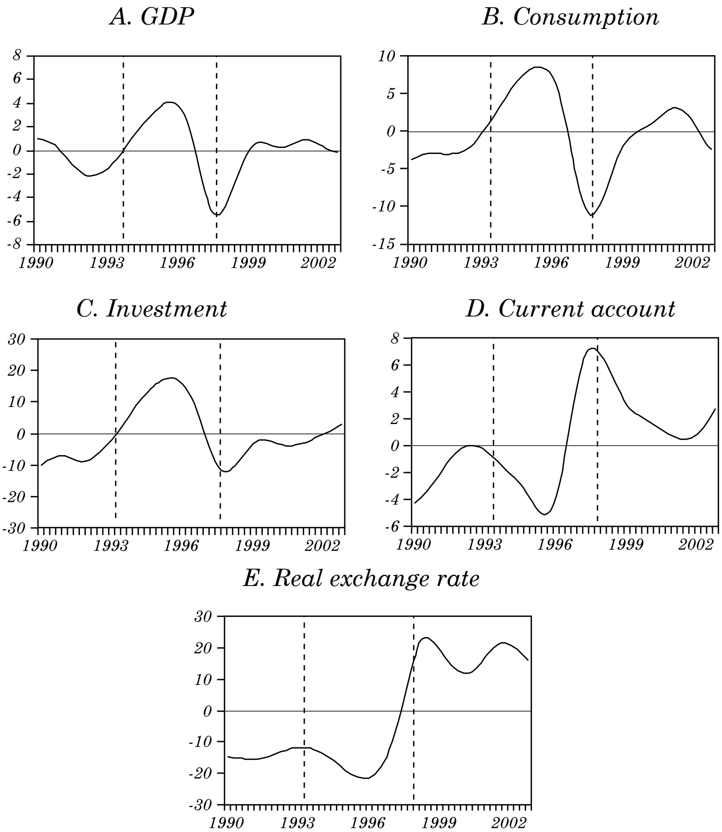
3. To build the stylized facts, we use Chilean quarterly data for the period 1990:1 to 2002:4 from the Central Bank of Chile and the National Institute of Statistics (INE). For Mexico and Korea, the source is the International Monetary Fund's *International Financial Statistics* (IFS). For all series, we applied a Hodrick-Prescott filter with a large smoothing parameter ($\lambda = 3 \times 10^6$) to obtain an almost lineal trend. Once we filtered the series, we computed the respective cycles. We then proceeded to filter these series again to obtain a smoother pattern.

Figure 2. Stylized Facts: Chile



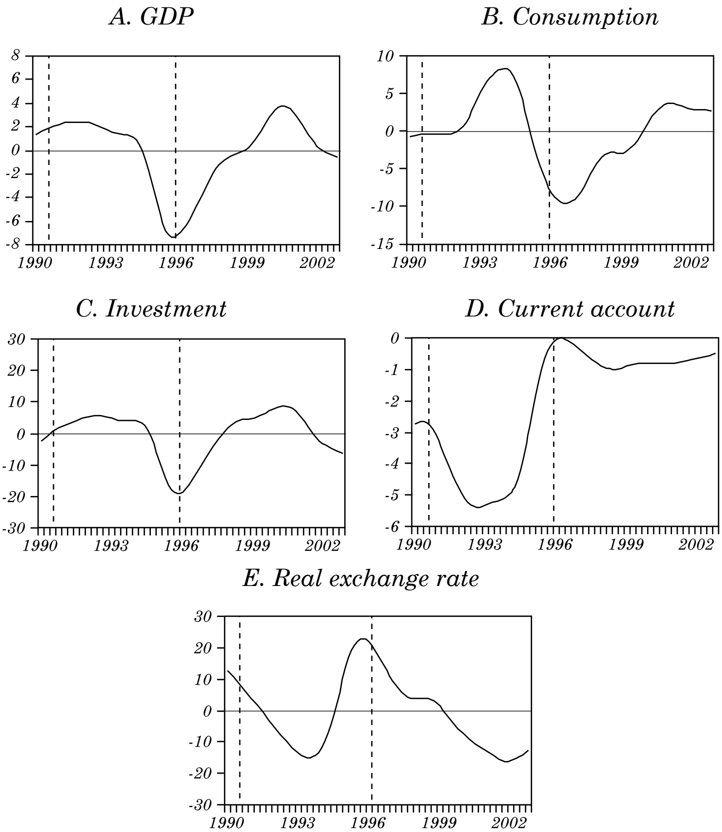
Source: Authors' calculations.

Figure 3. Stylized Facts: Korea



Source: Authors' calculations.

Figure 4. Stylized Facts: Mexico



Source: Authors' calculations.

2. Model Economy

In this section, we present a multi-sector small open economy model with short-run nominal and real rigidities. The model is aimed at replicating prominent features of the business cycles of emerging market economies. There are two domestic productive sectors: one that produces tradable goods (*H*) and another that produces nontradable goods (*N*). Domestic agents also import foreign goods (*F*). Prices and wages are sticky in the short run, and the exchange rate pass-through to imported goods price is incomplete in the short run. Households exhibit habits in their preferences, investment is subject to incremental adjustment costs, and the capital utilization rate is variable. The introduction of nominal and real rigidities is meant to generate richer and more realistic propagation mechanisms.

2.1 Households

The domestic economy is inhabited by a continuum of households indexed by $j \in [0,1]$. At time t, household j maximizes the expected present value of its utility, which is given by

$$U_t(j) = E_t \left\{ \sum_{i=0}^{\infty} \beta^i \left[\begin{array}{l} \log\left(C_{t+i}(j) - hC_{t+i-1}\right) \\ + \dfrac{\zeta_M}{\mu} \left(\dfrac{M_{t+i}(j)}{P_{C,t+i}} \right)^{\mu} - \zeta_L \dfrac{l_{t+i}(j)^{1+\sigma_L}}{1+\sigma_L} \end{array} \right] \right\}, \quad (1)$$

where $l_t(j)$ is labor effort, $C_t(j)$ is the household's total consumption, and $M_t(j)$ corresponds to nominal balances held at the beginning of period t. Parameter σ_L is the inverse real-wage elasticity of labor supply. Habit formation in preferences is determined by parameter h. Household j consumes a basket composed of tradable goods, C_T, and nontradable goods, C_N:

$$C_t(j) = \left[\alpha_C^{1/\eta_C} \left(C_{T,t}(j)\right)^{\frac{\eta_C - 1}{\eta_C}} + (1-\alpha_C)^{1/\eta_C} \left(C_{N,t}(j)\right)^{\frac{\eta_C - 1}{\eta_C}} \right]^{\frac{\eta_C}{\eta_C - 1}}.$$

Traded goods are a composite of domestically produce tradable goods (H) and imported goods (F),

$$C_{T,t}(j)=\left[\gamma_C^{1/\omega_C}(C_{H,t}(j))^{\frac{\omega_C-1}{\omega_C}}+(1-\gamma_C)^{1/\omega_C}(C_{F,t}(j))^{\frac{\omega_C-1}{\omega_C}}\right]^{\frac{\omega_C}{\omega_C-1}}.$$

Parameters α_C and γ_C determine the share of each type of goods in the consumption basket, while η_C and ω_C are the associated price elasticities. By minimizing the cost of the consumption basket and aggregating all households, we obtain the aggregate demands for the three types of goods. The consumer price index (CPI) is given by

$$P_{C,t}=(\alpha_C P_{T,t}^{1-\eta_C}+(1-\alpha_C)P_{N,t}^{1-\eta_C})^{\frac{1}{1-\omega_C}},$$

where $P_{T,t}$ is the price index of the tradable consumption basket (which includes imported and domestic tradable goods), and $P_{N,t}$ is the price index of nontradable goods.

2.1.1 Consumption-savings decisions

Households have access to three types of assets: money, $M_t(j)$; one-period noncontingent foreign bonds (denominated in foreign currency), $B_t^*(j)$; and one-period domestic contingent bonds, $D_{t+1}(j)$, which pays out one unit of domestic currency in a particular state (that is, state-contingent securities). The budget constraint of household j is given by

$$P_{C,t}C_t(j)+E_t\{d_{t,t+1}D_{t+1}(j)\}+\frac{e_tB_t^*(j)}{(1+i_t^*)\Theta(b_t)}+M_t(j)=$$
$$W_t(j)l_t(j)+\Pi_t(j)-\tau_t+D_t(j)+e_tB_{t-1}^*(j)+M_{t-1}(j),$$

where $\Pi_t(j)$ are profits received from domestic firms, $W_t(j)$ is the nominal wage set by the household, τ_t is per capita lump-sum net taxes from the government, and e_t is the nominal exchange rate (expressed as units of domestic currency per one unit of foreign currency). Variable $d_{t,t+1}$ is the period t price of one-period domestic contingent bonds normalized by the probability of the occurrence of the state.

Assuming the existence of a full set of contingent bonds ensures that the consumption of all households is the same, independently of the labor income they receive each period. Variable i_t^* is the interest rate on foreign bonds denominated in foreign currency, and $\Theta(.)$ is a premium domestic households have to pay when borrowing abroad. This premium is a function of the net foreign asset positions relative to GDP, $b_t = e_t B_t^*/P_{Y,t}Y_t$ where $P_{Y,t}Y_t$ is nominal GDP and B_t^* is the aggregate net asset position of the economy.[4]

Each household chooses a consumption path and the composition of its portfolio by maximizing equation (1) subject to its budget constraint. The first-order conditions on different contingent claims over all possible states define the following Euler equation for consumption:

$$\beta E_t \left\{ (1+i_t) \frac{P_{C,t}}{P_{C,t+1}} \left(\frac{C_{t+1}(j) - hC_t}{C_t(j) - hC_{t-1}} \right) \right\} = 1, \tag{2}$$

where i_t is the domestic risk-free interest rate. From this expression and the first-order condition with respect to foreign bonds denominated in foreign currency, we obtain the following expression for the uncovered interest parity (UIP) condition:

$$\frac{1+i_t}{(1+i_t^*)\Theta(b_t)} = E_t \frac{e_{t+1}}{e_t} + \text{cov}_t, \tag{3}$$

where cov_t is a covariance term that disappears in the log-linear version of the model.

2.1.2 Labor supply and wage setting

Each household j is a monopolistic supplier of a differentiated labor service. There is a set of perfectly competitive labor service assemblers that hire labor from each household and combine it into an aggregate labor service unit. This labor unit is then used as an input in production in the domestic tradables (H) and nontradables

4. We assume that $\Theta(.) = \Theta$ and $\Theta' b/\Theta = \theta$ in the steady state. When the country is a net debtor, θ corresponds to the elasticity of the upward-slopping supply of international funds. This premium is introduced mainly as a technical device to ensure stationarity (see Schmitt-Grohé and Uribe, 2003).

(N) sectors. Cost minimization by labor unit assemblers gives rise to demands for each type of labor service, which are a function of the corresponding relative wages.

Following Erceg, Henderson, and Levin (2000), we assume that wage setting is subject to a nominal rigidity à la Calvo (1983). In each period, each type of household faces a probability $1 - \phi_L$ of being able to reoptimize its nominal wage. In this setup, the parameter ϕ_L determines the degree of nominal rigidity in wages. We assume that all those households that cannot reoptimize their wages follow an updating rule considering a geometric weighted average of past CPI inflation and the inflation target set by the authority, $\overline{\pi}$. Once a household has set its wage, it must supply any quantity of labor service demanded at that wage. A particular household j that is able to reoptimize its wage at t must solve the following problem:

$$\max_{W_t(j)} = E_t \left\{ \sum_{i=0}^{\infty} \phi_L^i \Lambda_{t,t+i} \left[\begin{array}{l} \dfrac{\Gamma_{W,t}^i W_t(j)}{P_{C,t+i}} l_{t+i}(j) \\ -\zeta_{L,t} \dfrac{l_{t+i}(j)^{1+\sigma_L}}{1+\sigma_L} (C_{t+i} - hC_{t+i-1}) \end{array} \right] \right\},$$

subject to labor demand and the updating rule for the nominal wage of agents who do not optimize, defined by function

$$\Gamma_{W,t}^i = \Gamma_{W,t}^{i-1} \left(1 + \pi_{t+i-1}\right)^{\chi_L} \left(1 + \overline{\pi}\right)^{1-\chi_L}$$

Variable $\Lambda_{t,t+i}$ is the relevant discount factor between periods t and $t + i$.[5] These elements give rise to a Phillips curve for nominal wages that has backward- and forward-looking components.

2.2 Investment and Capital Goods

A representative firm owns and rents capital to firms producing in the domestic tradables (H) and nontradables (N) sectors. We assume that capital is specific to the sector that rents it. Hence, the representative firm decides how much of each type of capital to

5. Since utility exhibits habit formation in consumption, the relevant discount factor is given by $\Lambda_{t,t+i} = \beta^i[(C_t(j) - hC_{t-1}) / (C_{t+i}(j) - hC_{t+i-1})]$.

accumulate over time. The flow of investment devoted to produce new capital goods for sector J, $I_t(J)$, is assembled using the following technology:

$$I_t(J) = \left[\alpha_I^{1/\eta_I} I_{T,t}(J)^{\frac{\eta_I - 1}{\eta_I}} + (1-\alpha_I)^{1/\eta_I} I_{N,t}(J)^{\frac{\eta_I - 1}{\eta_I}}\right]^{\frac{\eta_I}{\eta_I - 1}},$$

for $J = H, N$, where

$$I_{T,t}(J) = \left[\gamma_I^{1/\omega_I} I_{H,t}(J)^{\frac{\omega_I - 1}{\omega_I}} + (1-\gamma_I)^{1/\omega_I} I_{F,t}(J)^{\frac{\omega_I - 1}{\omega_I}}\right]^{\frac{\omega_I}{\omega_I - 1}}$$

is a composite of tradable goods devoted to investment in sector J. Variable $I_{D,t}(J)$ corresponds to the amount of good $D = H, F, N$ used in assembling new capital goods for sector J.

The representative firm may adjust investment each period, but changing the flow of investment is costly. This assumption is introduced as a way to obtain more inertia in the demand for investment (see Christiano, Eichenbaum, and Evans, 2005).[6] Let $Z_t(J)$ and $u_t(J)$ be the rental price and the utilization rate of capital in sector J, respectively. The representative firm must solve the following problem for each type of capital:

$$V_t(J) = \max_{K_{t+i}(J), I_{t+i}(J), u_{t+i}(J)} E_t\left\{\sum_{i=0}^{\infty} \Lambda_{t,t+i} \frac{\begin{matrix} u_{t+i}(J) Z_{t+i}(J) K_{t+i}(J) \\ - P_{I,t+i} I_{t+i}(J) \end{matrix}}{P_{C,t+i}}\right\},$$

subject to the law of motion of the capital stock for sector J,

$$K_{t+1}(J) = \left[1 - \delta(u_t(J))\right] K_t(J) + S\left(\frac{I_t(J)}{I_{t-1}(J)}\right) I_t(J), \tag{4}$$

6. This assumption is a shortcut to more cumbersome approaches to modeling investment inertia, such as time-to-build models.

where $\delta(u_t)$ is the depreciation rate, which is a function of the capital utilization rate. We assume that $\delta(u_t)$ is an increasing function, which implies that a higher utilization rate depreciates physical capital faster than a lower rate. Function $S(.)$ characterizes the adjustment cost for investment. This adjustment cost function satisfies the following conditions: $S(1 + g_y) = 1$, $S'(1 + g_y) = 0$, $S''(1 + g_y) = -\mu_S < 0$, where g_y is the per capita growth rate of the economy in the steady state.

The optimality conditions for the above problem are as follows:

$$\frac{P_{I,t}}{P_{C,t}} = \frac{Q_t(J)}{P_{C,t}}\left[S\left(\frac{I_t(J)}{I_{t-1}(J)}\right) + S'\left(\frac{I_t(J)}{I_{t-1}(J)}\right)\frac{I_t(J)}{I_{t-1}(J)}\right] - E_t\left\{\Lambda_{t,t+1}\frac{Q_{t+1}(J)}{P_{C,t+1}}\left[S'\left(\frac{I_{t+1}(J)}{I_t(J)}\right)\left(\frac{I_{t+1}(J)}{I_t(J)}\right)^2\right]\right\}, \tag{5}$$

$$\frac{Q_t(J)}{P_{C,t}} = E_t\left\langle\Lambda_{t,t+1}\left\{\frac{Z_{t+1}(J)}{P_{C,t+1}} + \frac{Q_{t+1}(J)}{P_{C,t+1}}\left[1 - \delta(u_t(J))\right]\right\}\right\rangle, \tag{6}$$

and

$$\frac{Z_t(J)}{P_{C,t}} = \delta'(u_t(J))\frac{Q_t(J)}{P_{C,t}}. \tag{7}$$

The ratio $P_{I,t} / P_{C,t}$ is the real cost of producing new capital goods (that is, the price of the investment bundle deflated by the CPI), where

$$P_{I,t} = \left[\alpha_I P_{I_T,t}^{1-\eta_I} + (1-\alpha_I)P_{N,t}^{1-\eta_I}\right]^{\frac{1}{(1-\eta_I)}}$$

and

$$P_{I_T,t} = \left[\gamma_I P_{H,t}^{1-\omega_I} + (1-\gamma_I)P_{F,t}^{1-\omega_I}\right]^{\frac{1}{(1-\omega_I)}}.$$

Equations (5), (6), and (7) simultaneously determine the evolution of the shadow price of capital, $Q_t(J)$, real investment expenditure, and the capital utilization rate for each sector.

2.3 Domestic Production

There is a large set of firms that use a constant elasticity of substitution (CES) technology to assemble intermediate varieties into home goods sold to households, to firms producing new capital goods, and to foreign agents. There is also a large set of firms that use a similar CES technology to assemble intermediate varieties into nontradable goods sold to households and to firms producing new capital goods.

Let $Y_{N,t}$ be the total quantity of nontradable goods sold to domestic agents (households and the representative firm assembling new capital goods). The demand for a generic variety z_N to assemble nontradable goods is given by

$$Y_{N,t}(z_N) = \left(\frac{P_{N,t}(z_N)}{P_{N,t}}\right)^{-\varepsilon_N} Y_{N,t}, \tag{8}$$

where $P_{N,t}(z_N)$ is the price of variety z_N. Analogously, let $Y_{H,t}$ be quantity of home goods sold domestically, and $Y^*_{H,t}$ the quantity sold abroad. The demands for a particular variety z_H to assemble these goods are given by

$$Y^*_{H,t}(z_H) = \left(\frac{P^*_{H,t}(z_H)}{P^*_{H,t}}\right)^{-\varepsilon_H} Y^*_{H,t},$$

and (9)

$$Y_{H,t}(z_H) = \left(\frac{P_{H,t}(z_H)}{P_{H,t}}\right)^{-\varepsilon_H} Y_{H,t},$$

where $P_H(z_H)$ is the price of the variety z_H when used to assemble home goods sold in the domestic market, and $P^*_{H,t}(z_H)$ is the foreign-currency price of this variety when used to assemble home goods sold abroad. Variables $P_{H,t}$ and $P^*_{H,t}$ are the corresponding aggregate price indexes. The foreign demand for home goods, $Y^*_{H,t}$ is given by

$$Y^*_{H,t} = \zeta^* \left(\frac{P^*_{H,t}}{P^*_t}\right)^{-\eta^*} Y^*_t,$$

where Y_t^* is foreign output, ζ^* corresponds to the share of domestic intermediate goods in the consumption basket of foreign agents, and η^* is the price elasticity of demand.

Intermediate varieties in the tradables and nontradables sectors are produced by monopolistically competitive firms. These firms maximize profits by choosing the prices of their differentiated variety subject to the corresponding demands and the available technology. Let $Y_{J,t}(z_J)$ be the total quantity produced of a particular variety z_J in sector $J = H, N$. The available technology is given by

$$Y_{J,t}(z_J) = A_{J,t}\left[T_t l_t(z_J)\right]^{\eta_J}\left[u_t(J)K_t(z_J)\right]^{1-\eta_J}, \tag{10}$$

for $J = H, N$, where $l_t(z_J)$ is the amount of labor and $K_t(z_J)$ is the amount of physical capital used in production. Parameter η_J defines the shares of the different factors in production. The variable $A_{J,t}$ represents a stationary productivity shock common to all firms in sector J, while T_t is a stochastic trend in labor productivity that is common to both domestic sectors (H and N). Below we discuss the process followed by these shocks.

We assume that the price adjustment of the domestic varieties faces nominal rigidities à la Calvo. In every period, the probability that a firm producing home goods receives a signal for adjusting its price for the domestic market is $1-\phi_{H_D}$, and the probability of adjusting its price for the foreign market is $1-\phi_{H_F}$. Analogously, the probability that a firm producing nontradable varieties receives a signal for adjusting its price is $1-\phi_N$. 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. Thus, when a firm receives a signal to adjust its price, it maximizes the discounted expected value of its profits, conditional on having to passively update its price for a number of periods and subject to equation (9) or (8). Given this pricing structure, the paths for inflation of domestic tradable (H) and nontradable (N) goods are given by new Keynesian Philips curves with indexation. In its log-linear form, inflation in sector J depends on both last period's inflation, expected inflation next period, and marginal cost in sector J.

2.4 Import Goods Retailers

We introduce local-currency price stickiness to allow for incomplete exchange rate pass-through into import prices in the short run. This feature of the model mitigates the expenditure-switching effect of exchange rate movements for a given degree of substitution between foreign and home goods.

There is a set of competitive assemblers that use a CES technology to combine a continuum of differentiated imported varieties to produce a final foreign good, Y_F. This good is consumed by households and used for assembling new capital goods. The optimal mix of imported varieties in the final foreign good defines the demands for each of them. In particular, the demand for variety z_F is given by

$$Y_{F,t}(z_F) = \left(\frac{P_{F,t}(z_F)}{P_{F,t}} \right)^{-\varepsilon_F} Y_{F,t}, \tag{11}$$

where ε_F is the elasticity of substitution among imported varieties, $P_{F,t}(z_F)$ is the domestic-currency price of imported variety z_F in the domestic market, and $P_{F,t}$ is the aggregate price of import goods in this market.

Importing firms buy varieties abroad and resell them domestically to assemblers. Each importing firm has monopoly power in the domestic retailing of a particular variety. They adjust the domestic price of their varieties infrequently, only when they receive a signal. The signal arrives with probability $1 - \phi_F$ each period. As in the case of domestically produced varieties, if a firm does not receive a signal, it updates its price following a passive rule that weights past inflation and the inflation target set by the central bank. Therefore, when a generic importing firm z_F receives a signal, it chooses a new price by maximizing the discounted sum of expected profits subject to the domestic demand for variety z_F (equation 11) and the updating rule.

Under this specification, changes in the nominal exchange rate will not immediately be passed through to prices of imported good sold domestically. Therefore, exchange rate pass-through will be incomplete in the short run. In the long run, firms freely adjust their prices, so the law of one price for foreign goods holds up to a constant.[7]

7. Formally, in the long run, $P_F = [\varepsilon_F / (\varepsilon_F - 1)]\, eP_F^*$.

2.5 Monetary Policy Rule

Monetary policy is modeled as a simple feedback rule for the interest rate. Under the baseline specification of the model, we assume that the central bank adjusts the policy rate in response to contemporaneous deviations of CPI inflation from the target and to deviations of total output from its balanced growth trend:

$$\frac{1+i_t}{1+i} = \left(\frac{1+i_{t-1}}{1+i}\right)^{\psi_i} \left(\frac{Y_t}{\overline{Y}_t}\right)^{(1-\psi_i)\psi_y} \left(\frac{1+\pi_t}{1+\overline{\pi}}\right)^{(1-\psi_i)\psi_\pi},$$

where $\pi_t = P_{C,t} / P_{C,t-1} - 1$ is consumer price inflation, i is the steady-state value of the nominal interest rate, $\overline{\pi}$ is the inflation target, and $\overline{Y}_t$ is the output trend.

2.6 Aggregate Equilibrium

Once firms producing domestic varieties set their prices, they must supply any quantity demanded at those given prices. Therefore, the market clearing condition for each variety implies that

$$Y_{N,t}(z_N) = \left(\frac{P_{N,t}(z_N)}{P_{N,t}}\right)^{-\varepsilon_N} Y_{N,t}$$

and

$$Y_{H,t}(z_H) = \left(\frac{P_{H,t}(z_H)}{P_{H,t}}\right)^{-\varepsilon_H} Y_{H,t} + \left(\frac{P^*_{H,t}(z_H)}{P^*_{H,t}}\right)^{-\varepsilon_H} Y^*_{H,t},$$

where $Y_{N,t} = C_{N,t} + I_{N,t}(H) + I_{N,t}(N)$ and $Y_{H,t} = C_{H,t} + I_{H,t}(H) + I_{H,t}(N)$ and where $Y^*_{H_F,t}$ was defined above. The equilibrium requires that total labor demanded by intermediate varieties producers must be equal to labor supply:

$$\int_0^1 l_t(z_H)dz_H + \int_0^1 l_t(z_N)dz_N = l_t,$$

where l_t is aggregate labor service. Also, the demand for physical capital in sector J has to be equal to the available amount:

$$\int_0^1 K_t(z_J)dz_J = K_t(J),$$

for $J = H, N$.

Using the equilibrium conditions in the goods and labor markets and the budget constraint of households and the government, we obtain the following expression for the evolution of the net foreign asset position:

$$\frac{b_t}{(1+i_t^*)\Theta(b_t)} = b_{t-1}\frac{P_{Y,t-1}Y_{t-1}}{P_{Y,t}Y_t} + \frac{P_{X,t}X_t}{P_{Y,t}Y_t} - \frac{P_{M,t}M_t}{P_{Y,t}Y_t},$$

where b_t is the aggregate net (liquid) asset position of the economy vis-à-vis the rest of the world relative to nominal GDP, and $P_{Y,t}Y_t = P_{C,t}C_t + P_{I,t}I_t + P_{X,t}X_t - P_{M,t}M_t$ is nominal GDP measured from the demand side. Nominal imports and exports are given by $P_{M,t}M_t = e_tP^*_{F,t}Y^*_{F,t}$ and $P_{X,t}X_t = e_tP^*_{H,t}Y^*_{H,t}$, respectively. The total quantity of imported goods is $Y_{F,t} = C_{F,t} + I_{F,t}(H) + I_{F,t}(N)$.

2.7 Model Calibration and Solution

To solve the model, we first tackle the nonstochastic steady state using numerical methods. We then solve the log-linearized decision rules from the behavioral equations and the equilibrium conditions of the model. To that end, we use the *QZ* factorization described in Uhlig (1997). Table 1 presents the value chosen for the structural parameters of the model. The calibration is meant to characterize quarterly data for the Chilean economy. Many of the parameters were taken directly from the literature; others were chosen to match long-run features of this economy. In our simulations, productivity shocks are calibrated to match the observed expansion in output during the Chilean boom of 1995–2001, as discussed above.

Table 1. Base Calibration

Parameter	*Description*	*Calibrated value*
β	Subjective discount factor (quarterly)	0.999
σ_L	Inverse of the elasticity of the labor supply	1.0
h	Habit formation coefficient	0.9
α_C	Share of tradable goods in the consumption basket	0.4
γ_C	Share of home goods in the tradables consumption basket	0.5
η_C	Elasticity of substitution between tradable and nontradable goods in the consumption basket	0.5
ω_C	Elasticity of substitution between home and foreign goods in the tradables consumption basket	1.0
ε_L	Elasticity of substitution among labor varieties	11
ϕ_L	Calvo probb in nominal wages	0.9
χ_L	Wage indexation to past inflation	0.9
α_I	Share of tradable goods in the investment basket [in $I(H)$ and $I(N)$]	0.6
γ_I	Share of home goods in the tradable investment basket [in $I(H)$ and $I(N)$]	0.5
η_I	Elasticity of substitution between tradable and nontradable goods in the investment basket [in $I(H)$ and $I(N)$]	0.5
ω_I	Elasticity of substitution between home and foreign goods in the tradable investment basket [in $I(H)$ and $I(N)$]	1.0
$\delta(1)$	Capital depreciation rate (annual) [in $I(H)$ and $I(N)$]	5.0 percent
μ_S	Elasticity of the adjustment cost in the flow of investment [in $I(H)$ and $I(N)$]	15
σ_I	Elasticity of the cost of capital utilization rate [$\delta''(1)/\ \delta'(1)$]	0.05
η_H	Labor share in the domestic tradable goods sector	0.65
η_N	Labor share in the nontradable goods sector	0.65
ε_N	Elasticity of substitution among nontradable varieties	11
ε_H	Elasticity of substitution among domestic tradable varieties	11
ε_F	Elasticity of substitution among imported varieties	11
ϕ_{H_D}	Calvo probb in prices of domestic tradable goods sold domestically	0.75
χ_{H_D}	Indexation to past inflation of domestic tradable goods sold domestically	0.50
ϕ_{H_F}	Calvo probb in foreign currency prices of domestic tradable goods sold abroad	0.75

Table 1. (continued)

Parameter	*Description*	*Calibrated value*
χ_{H_F}	Indexation to past inflation of domestic tradable goods sold abroad	0.50
ϕ_N	Calvo probb in prices of nontradable goods	0.75
χ_N	Indexation to past inflation of nontradable goods	0.50
ϕ_F	Calvo probb in prices of imported goods	0.75
χ_F	Indexation to past inflation of imported goods	0.50
ψ_i	Smoothing coefficient in the Taylor-type rule	0.80
ψ_π	Inflation coefficient in the Taylor-type rule	1.75
ψ_y	Output coefficient in the Taylor-type rule	0.20
η_F	Elasticity of the foreign demand for domestic tradable goods	0.50
θ	Elasticity of the external premium to the debt-to-GDP ratio	0.00001
NX/Y	Steady-state net-exports-to-GDP ratio	2 percent
CA/Y	Steady-state current-account-to-GDP ratio	–2 percent
g_y	Steady state GDP growth rate	5 percent
ρ_{a_H}	Persistence of productivity level shock in sector *H*	0.999
ρ_{a_N}	Persistence of productivity level shock in sector *N*	0.999
ρ_T	Persistence of productivity trend shock	0.999
ρ_{i*}	Persistence of productivity foreign financial conditions shock	0.999

Source: Authors' calculations.

3. Boom-Bust Cycles in Small Open Economies

We take Chile as a reference country and utilize the model described in the previous section to evaluate the qualitative and quantitative implications of boom-bust cycles driven by expectations. Before considering the case of overoptimism about future productivity, we analyze a case of favorable external financial conditions that are abruptly reversed.

In what follows, we define the real exchange rate in the model as the relative price of domestic tradable (*H*) and nontradable (*N*) goods. The implied evolution of measured total factor productivity (TFP) is estimated in the model as an aggregate Solow residual (without adjusting for the capital utilization rate). We construct a similar measure using actual data for Chile.[8] Tobin's Q is identified in the data with the stock market price, which in the case of Chile corresponds to an aggregate price index (IPSA). In the data, labor is measured as the ratio of formal employment to the working age population, and the real wage corresponds to an index of labor costs.[9]

3.1 Foreign Financial Condition Reversal

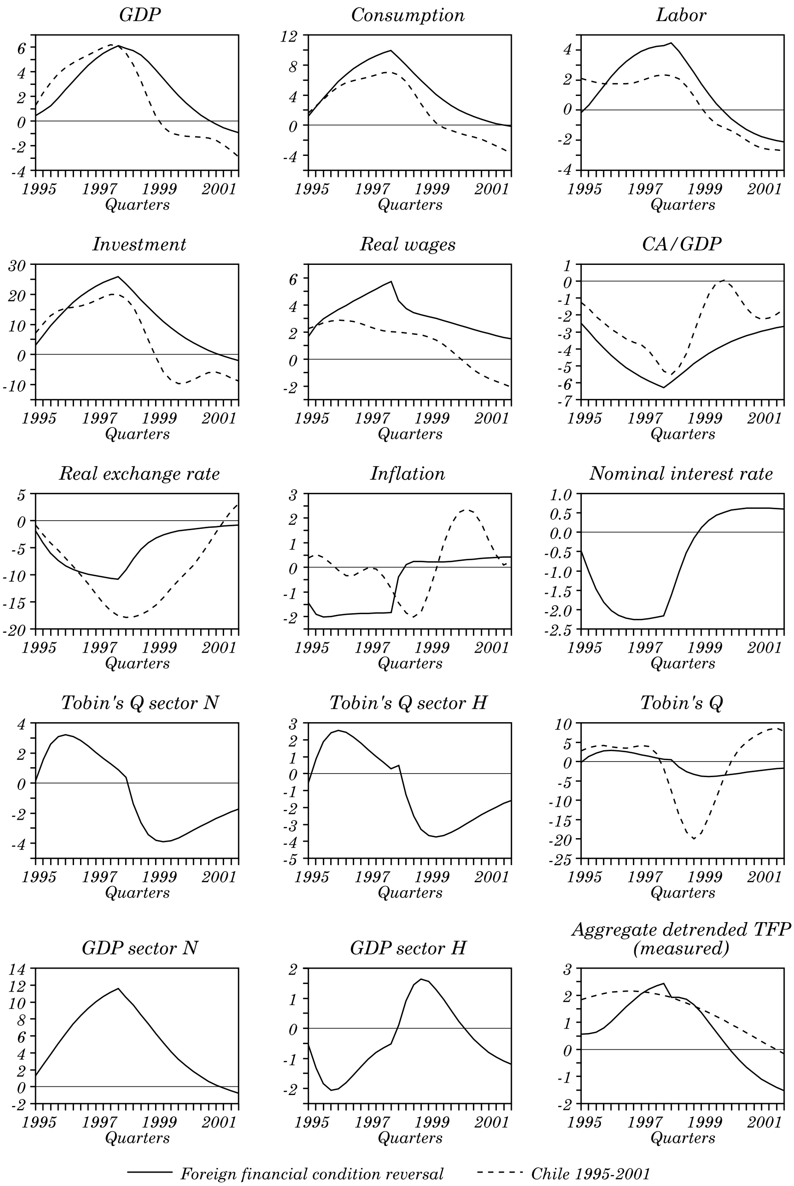
According to several authors, the boom-bust cycle in many emerging market economies in the 1990s was a consequence of changes in external financial conditions. This conclusion is based on the observation that periods of favorable external financial conditions are associated with economic expansions, while depressed economic activity coincides with periods of less beneficial foreign financial conditions (see, for example, Neumeyer and Perri, 2005; Uribe and Yue, 2006; Valdés 2007). Favorable external financial conditions in the early 1990s implied large capital flows to emerging market economies, which produced an economic boom coupled with real exchange rate appreciations and current account deficits. The boom phase was then followed by an abrupt worsening in foreign financial conditions, triggered by the Asian crisis, which would have led to recessions.

Using our model, we analyze the case of an exogenous, highly persistent decrease in the foreign interest rate (i^*). This captures the idea of a relaxation of the foreign financial conditions. Then, we assume that suddenly there is an exogenous increase on the foreign interest rate back to its original level. We calibrate the size of the shock so that the boom in output roughly coincides with the data for Chile. Figure 5 presents the results of this exercise. The model produces expansions in output, labor, consumption, and investment, which are sharply reversed when the foreign interest rate returns back to its original level. During the expansion, the real exchange appreciates by 10 percent, and the current account deficit (as a percentage of GDP) peaks near 6 percent. Contrary to what the data show, the model predicts an initial fall in inflation and a subsequent rise in this variable as the exchange rate depreciates. Despite the muted pass-through from exchange rate to domestic prices, the fall in inflation is due to the

8. Formally, $\ln(\text{TFP}_t) = \ln(Y_t) - \eta\ln(l_t) - (1 - \eta)\ln(K_t)$, where η is the labor share in aggregate output.

9. To construct the cyclical components for these series, we follow the same procedure described in footnote 3.

Figure 5. Foreign Financial Condition Reversal



Source: Authors' calculations.

initial appreciation of the currency. The episode is accompanied by a rise in Tobin's *Q* for both types of capital. The boom in total output is driven by the evolution of output in the nontradable goods sector. In fact, the real currency appreciation leads to an initial fall in output in the tradable goods sector. Overall, the story of a boom-bust cycle driven by changes in foreign financial conditions is able to satisfactorily account for the stylized facts for Chile.

3.2 Overoptimistic Perceptions

We now explore an alternative—though complementary—explanation for the boom-bust cycle based on the idea that, rather than being caused by external factors, the cycle was triggered by domestic private agents' misperception regarding future productivity prospects. As mentioned above, this idea has recently been formalized by Christiano and others (2007) in a fully specified closed economy model. We build on their approach to model overoptimistic news on future productivity improvements.

3.2.1 Productivity level shocks

We first assume that productivity in sector $J = N$, H is governed by the following stationary process:

$$a_{J,t} = \rho_{a_J} a_{J,t-1} + \zeta_{a_J,t-p} + \varepsilon_{a_J,t}, \tag{12}$$

for $J = H$, N, where $a_{J,t} = \ln A_{J,t}$ and $\varepsilon_{a_J,t} \sim N(0, \sigma^2_{a_J})$ are independent and identically distributed (i.i.d.) innovations. The varaible $\zeta_{a_J,t-p}$ is a shock to the expected future productivity level *p* periods ahead and is uncorrelated with $\varepsilon_{a_J,t}$. This shock captures the idea discussed in section 1, that structural reforms lead to expected changes in productivity. Those changes take time to materialize, however, and the agents do not exactly know their effective impact on productivity. Here, we assume that at time *t*, private agents learn that a set of reforms were carried out and, given equation (12), they expect that productivity *p* periods ahead will be given by

$$E_t\left[a_{J,t+p}\right] = \rho^p_{a_J} a_{J,t} + \zeta_{a_J,t},$$

where $\zeta_{a_J,t} > 0$. At time $t + p$, agents learn that the productivity level changed by less than expected. To this end, we introduce a shock,

$\varepsilon_{a_J,t+p} < 0$, on productivity at $t + p$. Figure 6 presents the results of this exercise, assuming $p = 12$ and $\rho_{a_J} = 0.999$ together with actual data for Chile.[10] We consider a case in which the news affects the expected productivity levels in both sectors (*H* and *N*) equally.[11]

As in Christiano and others (2007), the expected gain in productivity produces a boom in output. In our case, this is mainly due to the boom in the tradable goods sector. In fact, output in the nontradables sector falls in the short run and then increases. Consumption initially falls, but then it slowly expands in response to the expected increase in productivity. Labor rises during the boom phase, in part as a result of sticky wages that contain real wages growth. When wages are flexible in our model, the labor expansion no longer holds.[12] This is consistent with Jaimovich and Rebelo (2007), who show that under flexible wages, in order to generate a boom in labor in response to expected gains in productivity, household preferences should exhibit a weak wealth effect on labor supply. In our case, preferences are standard, but the wealth effect on the labor supply is muted because of sticky wages. Total inflation falls with the output boom. The reason is that expected future productivity gains mean lower future marginal costs. Since inflation is forward looking, firms respond by currently lowering their prices, despite the rise in actual marginal cost associated with the growth of labor and the rise in real wages.

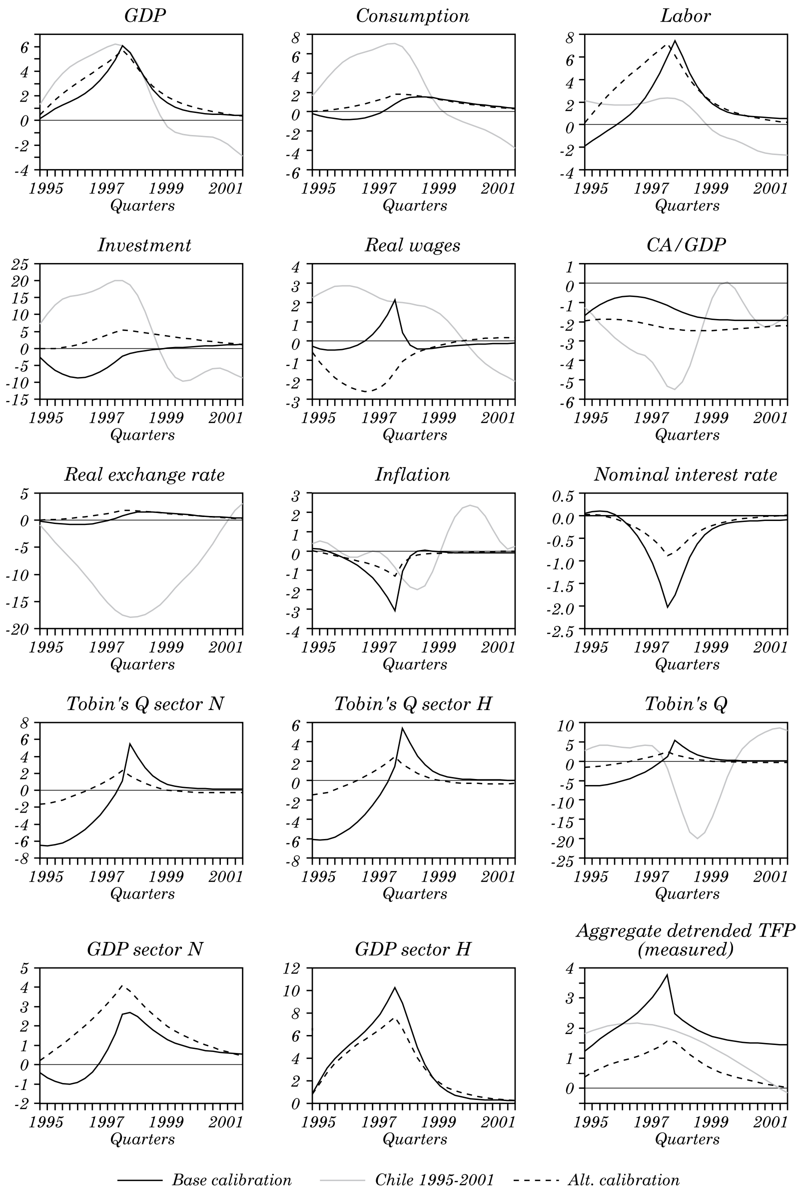
Despite the expected increase in future productivity, investment and Tobin's *Q* initially fall in both sectors when the signal on future productivity arrives. These variables then increase monotonically until the agents learn that productivity is lower than expected. These predictions on the behavior of investment and Tobin's *Q* during the news-induced boom-bust cycle are different from the predictions obtained by Christiano and others (2007). In their model, the boom-bust cycle in output coincides with a boom-bust cycle for investment and Tobin's *Q*. The reason investment responds this way to news about future productivity in Christiano and others (2007) is the presence of low wage indexation to past inflation and an aggressive inflation-targeting policy rule for the central bank. In their case, given the fall of inflation below target, monetary policy follows a

10. These productivity news shocks are highly persistent, but they are still transitory.

11. The real quantities in the figures correspond to the normalized effects of the productivity shock.

12. The simulation under flexible wages is available on request.

Figure 6. Productivity Level Signal



Source: Authors' calculations.

loose stance in response to the news shock. That helps raise Tobin's Q and induces firms to increase investment. Low indexation to past inflation, in turn, helps keep real wages rigid in the short run, amplifying the effects of overoptimistic shocks. In our calibration, we allow for a larger fraction of wages to be indexed to past inflation, and we specify a less hawkish inflation targeting regime –that is more in line with standard parameterization for the monetary policy rule. In figure 6, we also present an alternative calibration of the model, where we reduce the fraction of wages being indexed to past inflation (we set $\chi_L = 0.1$) and increase the reaction of the interest rate to deviations of inflation from target in the policy rule (we set $\psi_\pi = 2.0$). Under this alternative parameterization, the results of our simulation are in line with Christiano and others (2007): output, labor, consumption, investment, and Tobin's Q simultaneously feature a boom-bust cycle.

While the qualitative results of this last exercise resemble some features of the stylized facts discussed in section 1, they fall short in comparison with the observed size of the boom-bust cycle in investment and consumption in Chile. More importantly, the simulation misses two prominent features of the boom-bust cycles in emerging economies in the 1990s, namely, the real appreciation of the exchange rate and the current account deficit. Despite the boom in consumption and investment, which tends to produce a current account deficit, the exchange rate depreciation leads to an improvement in net exports that offsets the detrimental impact on this variable associated with the expansion in consumption and investment. In other words, the expenditure-switching effect induced by the currency depreciation dominates the intertemporal effect of the shock. The counterfactual behavior of the real exchange rate and the current account are even worse under the baseline calibration.

As we mentioned, one of the reasons for the boom after a news shock in the closed economy model of Christiano and others (2007) is the loose monetary policy response to the shock. In our model, a more expansive monetary policy is not enough to generate a sizable boom in expenditure. First, in a closed economy, the policy interest rate determines the equilibrium between domestic investment and savings. In an open economy, investment can differ from domestic saving. Moreover, both the domestic and foreign interest rates affect the cost of financing in an open economy. If the foreign interest rate is constant—and if the country does not face external borrowing constraints—then domestic monetary policy has less of an impact on the relevant cost of financing. As a result, the response of investment to a news shock is less intense. Second, the increase in private consumption in response to a future expected increase in productivity depends on the expected present value of private income. In a closed economy, the sequence of interest rates relevant for discounting future incomes is determined by monetary policy. Thus, if monetary policy is expansive in response to a signal shock, the perceived increase in the present value of income is amplified. In a small open economy facing a constant foreign interest rate, monetary policy alone does not determine the relevant interest rate for discounting expected future incomes. Hence, a loose monetary policy has a limited effect in amplifying the consumption boom.

As mentioned, the model fails at producing a real currency appreciation along the boom phase of the cycle. In a two-sector small open economy with tradable and nontradable goods, a real currency appreciation requires an increase in real wages. However, the fact that nominal wages are sticky in our model prevents an upward adjustment in real wages. This nominal stickiness is necessary to produce a sizable boom and to generate a procyclical response of employment to the shock.

3.2.2 Productivity trend shocks

Aguiar and Gopinath (2007) argue that in the case of emerging market economies, stochastic productivity trends, rather than productivity level shocks, are a major source of business cycle fluctuations. Moreover, these types of shocks are able to explain the observed comovement in major aggregate variables in these economies. In particular, shocks to the trend are better equipped to produce strongly countercyclical current accounts, as observed in emerging economies. More importantly, these shocks can generate these comovements without relying on household preferences that remove wealth effects in the labor supply.[13]

In what follows, we incorporate the approach of Aguiar and Gopinath (2007) to our analysis by assuming that news shocks refer to future changes in productivity trends. We assume that the natural logarithm of the stochastic trend of labor productivity, T_t, evolves according to the following expression:

13. See Correia, Neves, and Rebelo (1995) for an analysis of the aggregate dynamics in a small open economy without wealth effects in the labor supply.

$$s_{T,t} = s_{T,t-1} + (1 - \rho_T)\ln(1 + g_y) + \rho_T \Delta s_{T,t-1} + \zeta_{T,t-p} + \varepsilon_{T,t}, \tag{13}$$

where $s_{T,t} = \ln(T_t)$ and $\varepsilon_{T,t} \sim N(0, \sigma^2_T)$ are i.i.d. innovations. A shock $\zeta_{T,t-p}$ corresponds to a news of an increase in the labor productivity trend p periods ahead. As in the previous case, we assume that this shock is uncorrelated with $\varepsilon_{T,t}$. If agents receive a signal, $\zeta_{T,t} > 0$, at time t, they expect that productivity p periods ahead will grow faster:

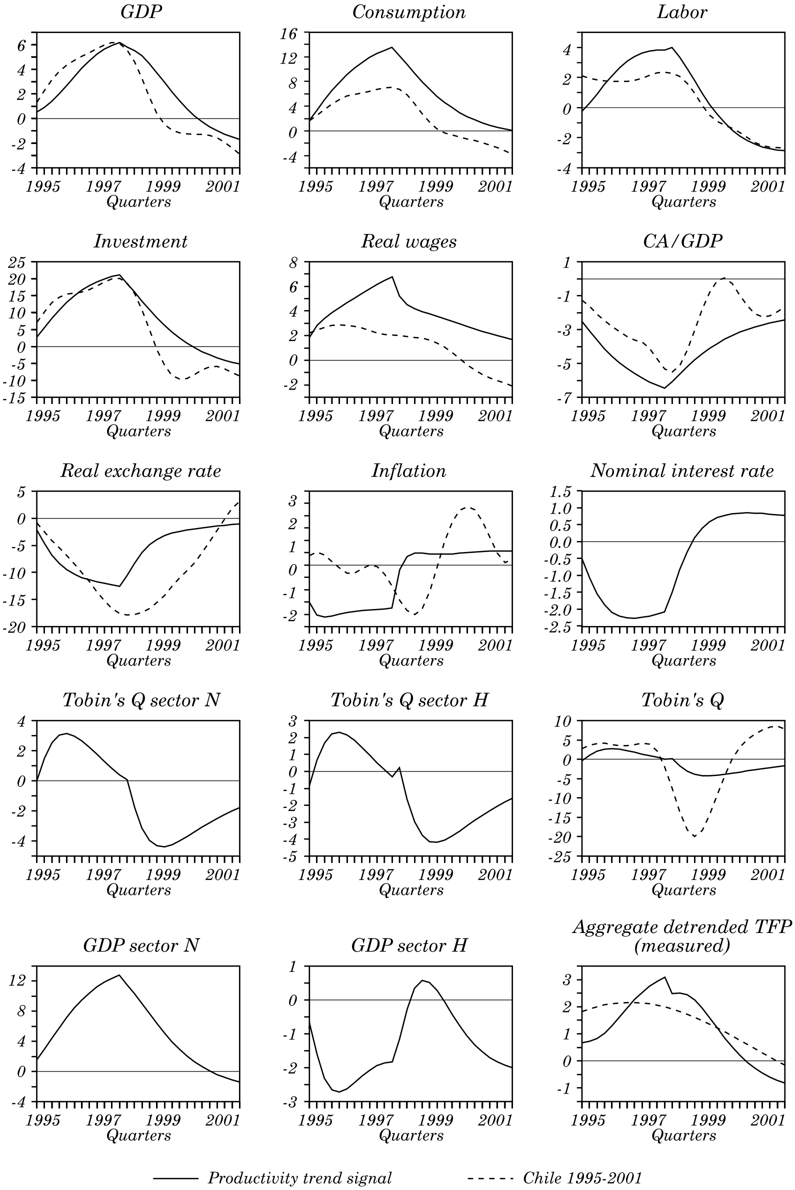
$$E_t\left[\Delta s_{T,t+p}\right] = \rho_T^p\left[\Delta s_{T,t} + (1 - \rho_T)\ln(1 + g_y)\right] + \zeta_{T,t}.$$

As in the case of news about productivity levels, we consider a shock $\varepsilon_{T,t+p} < 0$ in period $t + p$ to capture the idea that the news about expected productivity growth turns out to be overoptimistic ex post.

Figure 7 presents the trajectories of the endogenous variables to an expected shock to the trend in the future that does not materialize when $p = 12$ and $\rho_T = 0.999$. These trajectories were obtained using the baseline calibration of the model. The qualitative results of this shock are similar to those obtained with a positive signal to the productivity level in the future. We observe a boom-bust episode in output, labor, investment, and consumption. The quantitative pattern followed by the last three variables more closely resembles the data than in the previous case. Positive news regarding future productivity trend also generates a real appreciation of the exchange rate, as in the stylized facts reported earlier. The current account deficit reaches almost 7 percent, which is also very similar to what happened in Chile in the late 1990s, before the Asian crisis. In our model, the real appreciation explains why the output boom is mainly concentrated in the nontradable goods sector. This is completely different from the case of a productivity level signal, where the boom is explained by the expansion of the tradable goods sector. In the bust phase, as the expected increase in productivity growth does not materialize, the real exchange rate depreciates and the current account deficit reverses. There is a recession in output, and aggregate demand falls.

Despite the fact that productivity does not change, the measured TFP in the model rises above trend during the boom phase and falls during the bust phase. This pattern resembles the observed evolution of TFP constructed with actual Chilean data, which highlights the strong procyclicality of this variable. The model also predicts an

Figure 7. Productivity Trend Signal



Source: Authors' calculations.

increase in Tobin's *Q* during the boom and a subsequent fall during the recession. However, the size of the cycle of this variable is smaller than the observed pattern in Chilean stock prices in the 1990s. The model is also not able to closely replicate the behavior of inflation in Chile.

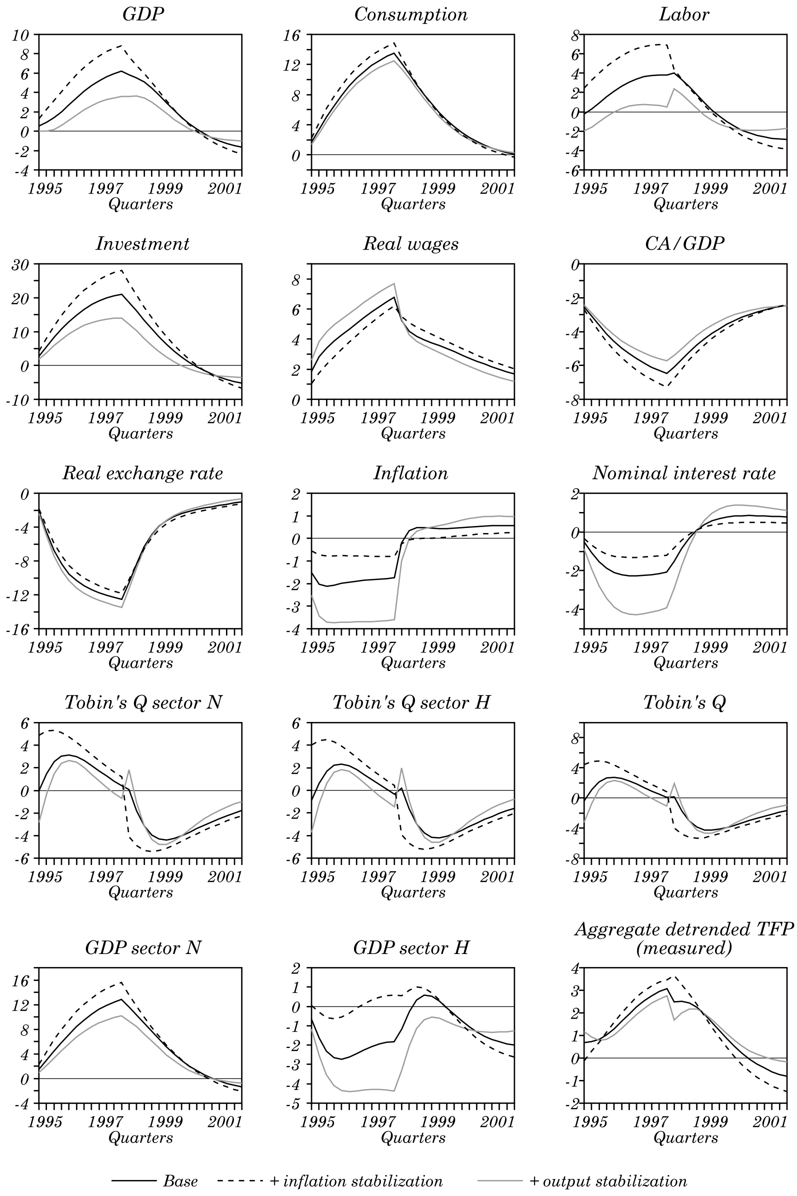
In our model, the boom-bust episode does not arise as a consequence of a loosening in monetary policy in response to a fall in inflation, as in Christiano and others (2007). Moreover, the dynamics of several variables in response to an overoptimistic signal regarding future productivity trends are observational equivalent to those obtained from a reversal in foreign financial conditions. Thus, overconfidence in productivity prospects is able to satisfactorily generate the boom-bust episode observed in emerging economies without any actual change in the economic fundamentals.

3.3 Monetary Policy Trade-offs

To explore the different monetary policy trade-offs in a boom-bust episode such as the one described here, we analyze the implications of alternative policy rules. First, we consider two alternative rules: one that reacts strongly to inflation and another that responds strongly to output. Second, we consider a rule in which monetary policy responds not only to output and inflation, but also to real exchange rate fluctuations. In all simulations below, we consider the responses after news about a future change in the productivity trend.

Figure 8 presents the baseline scenario, together with the results under a rule that is more aggressive to inflation and under a rule that is more aggressive to output fluctuations. If monetary policy focuses on following a more strict inflation target ($\psi_{\pi} = 3$), the boom in output, consumption, and investment would be larger because monetary policy takes a more expansive stance. The current account deficit would therefore also be larger, and the real appreciation would be slightly smaller. On the other hand, if monetary policy aggressively tries to stabilize output ($\psi_{y} = 0.8$), then it would induce a larger negative deviation of inflation from target and a larger currency appreciation. Given this currency appreciation, output stabilization is based proportionally more on tradables output than on nontradables output. The higher interest rate implied by this policy reduces the boom in Tobin's *Q* in both sectors and the current account deficit.

Figure 8. Stabilization of Inflation versus Output



Source: Authors' calculations.

In the case of a central bank that responds to exchange rate fluctuations, we modify the policy rule as follows:

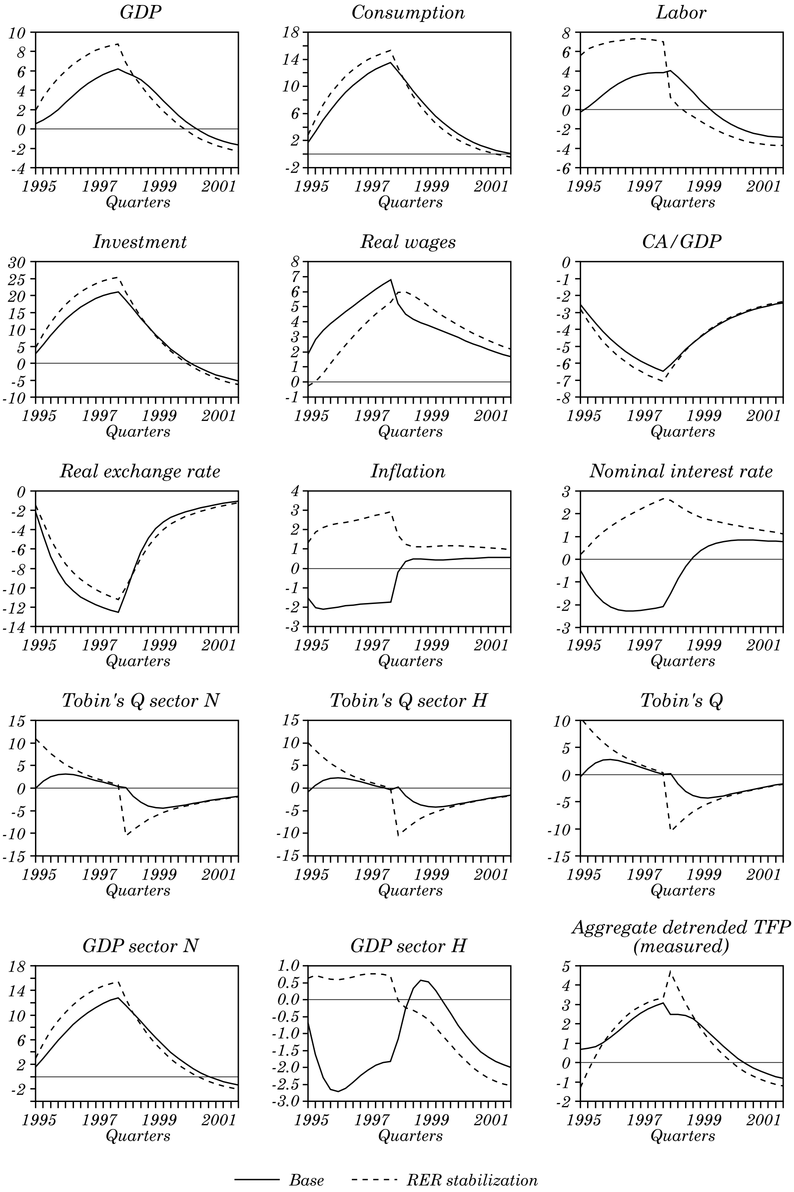
$$\frac{1+i_t}{1+i} = \left(\frac{1+i_{t-1}}{1+i}\right)^{\psi_i} \left(\frac{Y_t}{\overline{Y}_t}\right)^{(1-\psi_i)\psi_y} \left(\frac{1+\pi_t}{1+\overline{\pi}}\right)^{(1-\psi_i)\psi_\pi} \left(\frac{\mathrm{RER}_t}{\overline{\mathrm{RER}}}\right)^{(1-\psi_i)\psi_{rer}},$$

where RER_t is the real exchange rate and $\overline{\mathrm{RER}}$ is its steady-state value. We calibrate ψ_{rer} to 0.2. The rest of the parameters of the rule are same as in the baseline calibration. This policy rule is motivated by the Chilean experience in the 1990s, when the Central Bank of Chile simultaneously specified an inflation target and a target zone for the exchange rate to avoid excessive fluctuation in the latter. Figure 9 presents the results. Under this policy, monetary policy tends to be more expansive in response to the expected productivity gain. As a result, the increases in output, consumption, investment, and labor are larger than in the baseline case. The alternative rule reduces the volatility of the exchange rate, which prevents the perverse effects of the boom on the domestic tradable goods sector in the short run, but the current account deficit responds more sharply to the shock than in the baseline case, as a result of the investment and consumption booms. Inflation initially rises, but it falls after the bust because the reduction in marginal cost dominates the inflationary effects of the subsequent currency depreciation. Finally, by stabilizing the real exchange rate, the monetary policy exacerbates the boom-bust cycle in Tobin's Q and makes the predictions of the model quantitatively closer to the evolution of stock prices in Chile in the 1990s.

4. Conclusions

Using a small open economy DSGE model, we have shown that expected future gains in productivity that are not materialized ex post can generate a boom-bust cycle in output similar to what occurred in several emerging market economies in the 1990s. However, when people expect future productivity gains to be transitory level changes, the model predictions for the current account and the real exchange rate are not consistent with the observed pattern in those episodes. Moreover, the quantitative predictions for investment and consumption fall short with respect to what we observe in the data. This is the case even if we assume a strong monetary policy response to inflation and a low degree of wage indexation to past

Figure 9. Stabilization of the Real Exchange Rate



Source: Authors' calculations.

inflation. The reason is that in an open economy setup, the amplifying mechanism of monetary policy is unable to induce large consumption and investment booms.

When the expected future improvement in productivity corresponds to a trend shock, for which the productivity growth rate is expected to increase above its steady-state rate during some periods, the model predictions satisfactorily match the stylized facts observed in the data. Also, the boom generated by a news shock about future productivity trend affects the nontradable goods sector more deeply than the tradables sector. In fact, the real currency appreciation induced by the shock leads to a fall in output in the tradable goods sector. These results almost exactly replicate the results obtained under an exogenous reversal in the foreign financial conditions faced by the country.

Monetary policy faces important trade-offs in a boom-bust episode driven by overoptimistic perceptions about productivity improvements. On the one hand, if the central bank tries to stabilize output, it will exacerbate the fall in inflation and contraction in output in the tradable goods sector. On the other, if the central bank targets inflation more strictly, then the boom in activity, the current account deterioration, and the exchange rate appreciation will be larger and the subsequent recession more severe.

In the period under study, the Central Bank of Chile simultaneously pursued a target zone for the exchange rate and an inflation target. If we modify the policy rule in our model to capture this behavior by including an endogenous response of the interest rate to exchange rate fluctuations, then it does a better job of fitting the data. This type of policy only prevents the perverse effects of the boom on the domestic tradable goods sector in the short run, but it amplifies the boom-bust cycle in the other aggregate variables.

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