Business Cycle Responses and the Resilience of the Chilean Economy

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After marked fluctuations in the business cycle over the last fifty years, the Chilean economy now appears to be less volatile and more resilient to external shocks. Because Chile is a small and increasingly open economy, analysts have long suspected that the amplitude of the cyclical fluctuations in the business cycle is closely related to changes in external conditions.[1]

However, many open questions remain in this regard. To what extent are the pronounced output fluctuations associated with ups and downs in external conditions, and to what extent can they be attributed to domestic sources? Are real or financial external shocks the most important source of fluctuations? Has the increasing international integration implied greater synchronization of the

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The paper was written when Mr. Parrado and Mr. Le Fort were working at the International Monetary Fund.

1. For a review of empirical regularities characterizing business cycles in Chile, see Belaisch and Soto (1998) and Bergoeing and Suarez (2001). For a real business cycle (RBC) model applied to Chilean data, see Bergoeing and Soto (2005).

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domestic cycle with external economic conditions? If so, does this imply greater external vulnerability, or has resilience to external shocks improved somewhat?

To address these questions, we adopt an empirical approach using a vector autoregressive (VAR) model with block exogeneity. We adapt the VAR model to the behavior of a small open economy and then use it to characterize and decompose the behavior of the Chilean business cycle. Since our model includes a comprehensive set of variables, we can evaluate the importance of external, policy, and other domestic variables for the business cycle. We are thus able to assess how the economy has responded to different stochastic disturbances, measure the contribution of these variables to the business cycle fluctuations, and analyze the resilience of the Chilean economy over the last half century.

A key feature in our analysis is that we impose some plausible restrictions on relations among variables, following recent developments in model specification and VAR estimation procedures. Following Cushman and Zha (1997), Dungey and Pagan (2000), Hoffmaister and Roldós (2001), and Buckle and others (2002), we use block exogeneity for international variables to capture the small open economy feature in the associated dynamic responses and for domestic policy variables to deal with identification issues.

Several interesting results emerge from this analysis. First, real and financial external shocks have significant effects on domestic economic activity. The significant impact on the cyclical behavior of the economy following external financial shocks (represented by the volatility of the international financial markets and net capital inflows) reflects the financial restrictions faced by an emerging economy like Chile. Among domestic policy shocks, demand management policies and structural policies affect business cycle fluctuations, as do other domestic shocks such as investors confidence. Altogether, however, foreign shocks have been the dominant source of domestic output fluctuations, followed by monetary policy and structural policies. Fiscal policy and domestic equity explain a relatively low fraction of the volatility of the business cycle. Second, we provide evidence of an increase in the Chilean economy's resilience to external shocks in the 1990s. This positive development has taken place even as the economy's deepening integration with the rest of the world has increased the synchronization of the domestic business cycle with international conditions. This trend underscores the significant countercyclical role played by policies.

The paper is organized as follows. Section 1 provides a historical overview of the Chilean economy since 1950, outlining the main issues related to growth, recessions, and cyclical behavior. Section 2 describes the data and the methodological issues associated with the VAR framework. Section 3 analyzes the impact of foreign, policy, and other domestic shocks on the business cycle and the sources of its fluctuations, while section 3 uses historical decomposition analysis to provide insights on the economy's resilience to shocks. The final section summarizes our results and their implications for economic policy.

1. Historical Overview of the Chilean Economy since 1950

The GDP growth rate of the Chilean economy displayed an upward-sloping trend over the last half of the century, starting at around 3 percent in the early 1950s, hitting a midpoint of around 4 percent in the early 1970s, and ending at around 5 percent in 2003 (the last year of the sample period). The initial period was characterized by frequent, but relatively moderate peaks and troughs, with a somewhat low, but stable medium-term growth rate. Between the 1970s and the 1990s, however, two very deep recessions took place, with troughs in 1975 and 1982, respectively.[2] From 1990 onward, the peaks and troughs were as moderate as in the first period, but with a significantly higher medium-term growth rate (see figure 1).

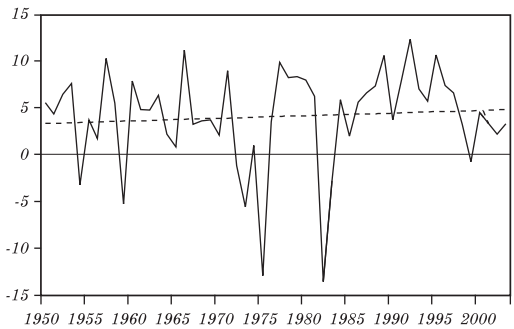
Recessions were not uncommon during the period covered by our sample (1950–2003). The sample includes six periods of negative growth: two in the 1950s (1954 and 1959), three between the early 1970s and early 1980s (1972–73, 1975, and 1982–83) and only one in the late 1990s (1999). The relatively moderate recessions of the 1950s are associated with important domestic economic policy events. The recession of 1954 came about after the very large monetary expansion at the beginning of the Ibañez administration (1952–58), which led to a surge in inflation and a subsequent stabilization program under the Klein-Sacks mission.[3] Price stability was not achieved, however.

2. Observed fluctuations in the annual growth rate were as large as 24 percent (for example, from –13.6 percent in 1982 to 10.6 percent in 1989).

3. Ffrench-Davis (1973) and Zahler and others (1978) contain detailed discussions of the economic policies applied in Chile in the 1950s and 1960s.

The Alessandri administration (1958–64) tried to use the exchange rate to control inflation, but these efforts ended in a second recession in 1959, when the fixed parity of the Chilean currency against the U.S. dollar collapsed.[4] After that period, the economy underwent slowdowns in activity, but no other recession took place until the early 1970s.[5]

Figure 1. Chile's Annual GDP Growth, 1950–2003



Source: See table 2 and section 2 for details.

The recessions of the 1970s and 1980s were more frequent and much deeper than those of the 1950s, and they included a full-blown economic and financial crisis. The 1972–73 recession resulted from the deep social and political crisis of the Allende administration (1970–73), which ended with a military coup and seventeen years of authoritarian rule.[6] The 1975–76 recession was triggered by a sharp deterioration in external conditions, particularly of the terms of trade, in a period with very limited access to external financing owing to the recent political turmoil of the early 1970s. This recession was followed by a period of rapid growth, which ended suddenly with the deep and prolonged recession of 1982–83—the second of the Pinochet regime (1973–90) and the worst in the period under analysis. This recession resulted from a sudden stop in capital inflows that forced the reversal of the (unsustainable) current account deficit. As the

4. The Chilean currency in that period was the escudo.
5. The period 1964–70 corresponds to the Frei Montalva administration.
6. Edwards and Cox Edwards (1987) provide a complete discussion of the policies of the Allende administration and the economic reforms of the Pinochet regime.

terms of trade deteriorated and the international real interest rates peaked, the adjustment required a sharp real exchange rate depreciation. The vulnerabilities of the banking system aggravated the recession. The very rapid increase in bank credit in the late 1970s and early 1980s—largely associated with foreign currency loans and connected lending—resulted in a severe deterioration of the loan portfolio and very high exposure to exchange rate risk. Although the fiscal balance was in surplus and public debt was nil, the peso came under severe market pressures that precipitated the second collapse of a fixed parity in the last fifty years of Chilean economic history. Notwithstanding the economywide crisis, a default on external debt was avoided largely thanks to the initial low level of public debt.

The only recession of the 1990s was the short-lived and quite mild one of 1999. This may reflect the increased resilience built through years of significant reforms and institutional changes, including the contributions of a solid banking system and a coherent macroeconomic policy framework.[7] The 1998–99 episode, like those of 1975 and 1982, featured a sharp deterioration in external conditions that required a reversal in the current account deficit, though at a much more moderate level. The private sector reacted by reducing domestic demand and adjusting asset portfolios to increase net foreign asset holdings. The latter, together with the sharp contraction in the supply of external financing, exerted strong pressures on the exchange rate. The recession might possibly have been avoided if monetary policy had not overreacted by narrowing the exchange rate band to limit currency depreciation.[8] The monetary authority feared that the currency depreciation could lead to an acceleration of inflation above the target and to financial system distress associated with the foreign currency exposures. Thus, domestic real interest rates reached extraordinarily high levels, and economic activity dipped. The overreaction became evident the following year, when inflation fell below the floor of the target range while the financial system did not experience substantial problems. The move was rapidly corrected, however, as the exchange rate was allowed to float in the last quarter of 1999 and interest rates entered a prolonged phase of sustained reductions that were instrumental for the recovery.

7. The prolonged slowdown of the economy that followed the downturn, which is only recently coming to an end, has mirrored the unsupportive external environment that prevailed until recently.

8. See Le Fort (2000).

Most observers of the Chilean economy are of the view that the economy's outstanding performance in the 1990s can be explained in terms of the reforms and stabilization process that began in the 1970s and continued through most of the 1980s and the 1990s. The legitimacy offered by a peaceful transition to democracy, continued opening up of the economy, further development of domestic financial markets (including deeper integration with international financial markets), and a significant strengthening of the macroeconomic policy framework (including fiscal consolidation and successful price stabilization) are all considered key factors. In the late 1990s, the fiscal authorities adopted a self-imposed rule that targets a structural surplus of 1 percent of GDP while allowing the automatic stabilizers to operate throughout the cycle. Moreover, the Central Bank was given full operational and administrative independence in the early 1990s, and its Board of Directors adopted an inflation targeting regime that has been improved over the years. Given the currently supportive external environment, and the strength of its policy framework and institutional arrangements, Chile is very well positioned to quickly return to faster medium-term growth.

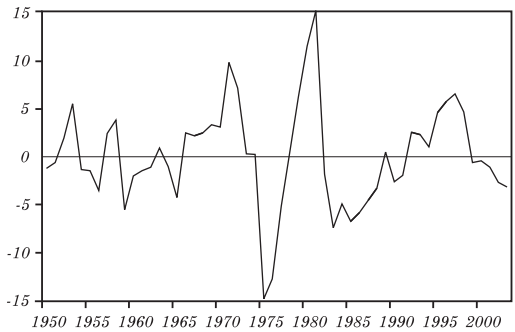
1.1 GDP Cycles

In this paper, we measure the Chilean business cycle over the last half century as the deviations of GDP from its long-term trend, using a Hodrick-Prescott (HP) filter (see Hodrick and Prescott, 1997). As shown in figure 2, the evolution of the output gap over the sample period is anything but monotonous, with marked fluctuations and changing patterns. Cycles can be dated in a number of ways, which can deliver different results in terms of identifying specific cycles. The approach followed herein identifies eight different cycles, as presented in table 1.[9] The average length of the cycle—which includes a low and a high phase—is seven years. One clear pattern is that the cycles were much shorter before the mid-1960s than after (around five years on average). The amplitude of the cycles also increased over time, reaching a maximum in the fifth and sixth cycles (1969–76 and 1976–84) and then declining substantially in the last two cycles.

In the 1950s and 1960s the economy was fairly closed to the rest of the world, with external demand conditions displaying very

9. The discussion in Cashin and McDermott (2004) is illustrative in terms of how cycle dating depends on a set of self-imposed rules, the series over which those rules are applied, and the starting point of the sample, among other things. The cycle dating of table 1 closely follows one set of rules contained in that paper.

Figure 2. Chile's GDP Gap with HP Filter, 1950–2003



Source: See table 2 and section 2 for details.

Table 1. Chile's GDP Cycles, 1950–2003

Period	*Duration*	*Maximum gap*	*Minimum gap*	*Volatility*
1950–55	5.5	5.6	–1.5	2.8
1955–58	4.0	3.8	–3.5	3.9
1958–64	6.0	0.9	–5.6	2.1
1964–69	5.0	3.4	–4.2	3.1
1969–76	7.0	9.8	–14.8	9.4
1976–84	8.0	15.2	–7.4	8.3
1984–90	6.0	0.5	–6.8	2.6
1990–04	14.5	6.6	–3.2	3.3
Average	7.0	5.7	–5.9	4.4

Source: See table 2 and section 2 for details.

low correlation with the Chilean business cycle. The economy was thus rather insulated despite the relatively unfavorable external demand and terms of trade, with an output gap that was close to zero, on average, and with relatively low volatility. The volatility of the output gap increased substantially between the 1970s and 1980s—along with the magnitude of the cyclical changes—and the average output gap was negative. Most of the other variables also display their highest volatility in this period, including external demand conditions, terms of trade, net capital flows, growth in real balances, and fiscal expenditure. As we show in section 4, however, the volatility of the output gap relative to that of international conditions as a whole increased substantially during

this period. Finally, in the 1990s, the output gap was positive, on average, and its volatility moderated significantly.

2. Methodological Approach

The data used in this paper are of annual frequency and cover the period 1950–2003. Our empirical model includes twelve variables, derived from both international and domestic series. International series are used to construct five variables intended to measure real and financial external shocks. Domestic variables include a proxy for the Chilean business cycle (namely, the GDP gap, which is our main object of interest), a group of five variables that control for domestic policy shocks, and a variable that captures domestically driven financial shocks.

Most of variables are measured in terms of gaps, that is, deviations from the long-term trend calculated through a Hodrick-Prescott filter.[10] Our first variable is a proxy for the external demand conditions relevant to the Chilean economy, and it is constructed from sectoral indices of World Merchandise Export Volume published by the World Trade Organization (WTO).[11] We use the sectoral share of Chilean exports to aggregate these indices into a single index that captures the dynamism of the external demand for Chilean products. As with most domestic series, our source for constructing the sectoral share of Chilean exports is Braun and others (2000), which contains many series for the Chilean economy during the 1810–1995 period.[12] We extended the export shares series through 2003 using data from the Central Bank of Chile. We used this same combination of sources to obtain the terms of trade, which represents the other real external shock in our empirical model.[13]

10. To prevent the typical tail problems common to this type of filtering process, we use data of up to five years prior to 1950, when available. We also use forecasts of up to two years for variables that are included in gaps, based on official forecasts when available. These extra observations are then dropped.

11. The sectoral indices include agricultural products, mining products, and manufactures. See WTO Statistical data sets at www.wto.org/english/res_e/statis_e/statis_e.htm.

12. The publication is part of a series of documents that includes Jeftánovic, Jofré, and Lüders, (2000) and Jeftánovic and others (2003), which compile statistics covering a long time span for a large set of variables for the Chilean economy.

13. In an alternative specification of the model, the terms of trade is replaced by two variables: the real price of oil and copper (source: IMF).

The other three external variables measure financial shocks faced by the Chilean economy. First, the foreign real interest rate corresponds to the average secondary market rate of the three-month U.S. Treasury bill minus the annual consumer price index (CPI) inflation of the U.S. economy, based on data from the International Monetary Fund (IMF). Second, we include a foreign equity variable as a proxy for the uncertainty of international financial markets. We construct this variable by taking the annual standard deviation of daily real returns from the Dow Jones index (source: New York Stock Exchange). Third, net capital inflows to the Chilean Economy as a percentage of GDP is calculated as the current account deficit net of international reserves accumulation over GDP through 1988 (Braun and others, 2000); thereafter, it is taken directly from the Central Bank of Chile's balance-of-payments statistics.

Most domestic variables are related to policy shocks. The first one—the de facto openness of the Chilean economy, measured as the share of exports and imports in GDP—is constructed through 1987 as the sum of export and imports in Chilean pesos (from Jeftánovic, Jofré, and Lüders, 2000), deflated by the Chilean CPI (from Jeftánovic and others, 2003) and divided by real GDP (from Braun and others, 2000); data after 1989 are from Central Bank of Chile's balance-of-payments statistics. The second variable—the real growth of money—is taken from the Central Bank of Chile's monetary and financial statistics, available since 1960, and complemented with Jeftánovic and others (2003) for the previous period. We use two variables as proxies for fiscal policy—namely, the real growth of fiscal revenue and fiscal expenditure. These two variables are taken from Jeftánovic, Jofré, and Lüders (2000) through 1986 and from the Budget Office of the Chilean Ministry of Finance (DIPRES) thereafter. Finally the real exchange rate is taken from Jeftánovic and others (2003) through 1989 and from the Central Bank of Chile thereafter.

We also include domestic equity to capture business confidence. This variable is constructed as the real returns of the stock index (IPSA), which are taken from Braun and others (2000) through 1969 and from the Santiago Stock Exchange thereafter.

Finally, our main variable of interest is the business cycle, which we construct from data on real GDP taken from Braun and others (2000) through 1995 and the Central Bank of Chile thereafter. Table 2 summarizes the twelve variables included in our empirical model, and table 3 presents descriptive statistics.

Table 2. List of Variables

Variable	*Type*	*Definition*	*Source*
External demand	External/real	Deviation of log from HP trend	WTO; Braun and others (2000); Central Bank of Chile
Terms of trade	External/real	Deviation of log from HP trend	Braun and others (2000); Central Bank of Chile
Foreign interest rate	External/financial	Deviation of real rate or return from HP trend	IMF
Foreign equity	External/financial	Deviation of standard deviation of real returns from HP trend; annual standard deviation calculated from daily data	NYSE
Net capital inflows	External/financial	Deviation of ratio over GDP from HP trend	Braun and others (2000); Central Bank of Chile
Openness	Domestic/policy	Ratio over GDP	Jeftánovic; Jofré; and Lüders (2000); Jeftánovic and others (2003); Braun and others (2000); Central Bank of Chile
Real exchange rate	Domestic/policy	Deviation of log from HP trend	Jeftánovic and others (2003); Central Bank of Chile
Money	Domestic/policy	Real growth rate	Jeftánovic and others (2003); Central Bank of Chile
Fiscal revenue	Domestic/policy	Real growth rate	Jeftánovic; Jofré; and Lüders (2000); DIPRES
Fiscal expenditure	Domestic/policy	Real growth rate	Jeftánovic; Jofré; and Lüders (2000); DIPRES
Domestic equity	Domestic/financial	Deviation of real rate or return from HP trend	Braun and others (2000); Central Bank of Chile
Output	Main variable of interest	Deviation of log from HP trend	Braun and others (2000); Central Bank of Chile

Table 3. Descriptive Statistics of Variables

Variable	*External demand*	*Foreign interest rate*	*Foreign equity*	*Terms of trade*	*Oil price*	*Copper price*	*Openness*	*Net capital flows*	*Real exchange rate*	*Domestic equity*	*Output*	*Money*	*Fiscal revenue*	*Fiscal expend.*
Average per period														
1950–69	–0.8	0.1	0.0	0.7	0.0	–1.0	22.1	0.1	2.4	3.0	0.1	2.1	7.0	6.8
1970–90	0.6	0.0	0.4	0.2	0.4	1.3	32.3	–0.2	–0.8	–3.0	–0.7	7.6	2.7	3.4
1991–03	0.3	–0.2	–0.2	–1.0	–1.2	–3.9	44.7	0.1	–1.5	1.0	1.4	9.6	6.3	6.9
1950–2003	0.0	0.0	0.1	0.1	–0.2	–0.8	31.5	0.0	0.2	0.2	0.1	6.1	5.2	5.5
Standard deviation per period														
1950–69	4.9	1.7	3.4	11.6	8.4	11.9	5.6	1.0	13.1	21.1	2.9	14.8	13.3	8.8
1970–90	6.4	1.6	4.7	14.1	28.5	17.6	11.7	3.3	24.7	30.6	7.6	22.9	8.7	14.6
1991–03	2.3	1.2	3.3	5.6	16.0	15.3	3.9	2.4	7.3	36.0	3.3	6.6	5.6	3.1
1950–2003	5.1	1.5	3.9	11.4	19.8	15.0	12.0	2.4	17.5	28.5	5.3	17.2	10.2	10.6
Correlation coefficient of variable against output gap per period														
1950–69	0.1	–0.2	0.2	0.2	–0.4	–0.3	0.3	0.1	0.6	0.5	1.0	0.1	–0.2	–0.1
1970–90	0.5	0.0	–0.3	0.4	0.1	0.3	–0.2	0.5	–0.4	0.3	1.0	0.4	0.1	0.4
1991–03	0.5	0.5	–0.4	0.3	–0.3	0.5	–0.6	0.3	–0.8	–0.6	1.0	–0.2	0.1	0.2
1950–2003	0.4	0.0	–0.2	0.3	0.0	0.2	0.0	0.4	–0.3	0.1	1.0	0.3	0.1	0.3

Source: See table 2 and section 2 for details.

2.1 Specification

We use a VAR model of the Chilean economy that contains twelve equations corresponding to each of the variables described above. We use Choleski decomposition and impose block exogeneity restrictions consistent with the fact that the Chilean economy is a small open economy, meaning that domestically determined variables cannot affect the international block. Based on this approach—which let us reduce the overall number of parameters estimated for most equations—and our relatively large annual sample, we were able to estimate a VAR with such a large number of endogenous variables. Moreover, the dynamic structure of this model based on annual data is adequately handled by including only one lag.[14] The block exogeneity extension for small open economies was first used by Cushman and Zha (1997) for the Canadian economy. More recently, Dungey and Pagan (2000), Hoffmaister and Roldós (2001), and Buckle and others (2002) use a similar approach in applications for Australia, Brazil and Korea, and New Zealand, respectively.

The equations in our model are thus arranged in a way that takes into account the fact that a Choleski decomposition identification scheme depends theoretically on the order of the equations, with the lag structure of the model consistent with the small open economy case.[15] Table 4 summarizes the order of the equations and the lag structure of the model.

Most of the equations for variables pertaining to the international block precede the equations for variables pertaining to the domestic block. Thus, the first three international variables—external demand conditions, foreign interest rate, and uncertainty in international financial markets—are completely exogenous to the other variables included in the model, but they are interrelated with each other. That differs from the case of the terms of trade, which is affected (only) by the previous three variables but does not affect them.[16] The final variable

14. This is unlikely to be the case for a model based on data with quarterly frequency, which presumably may require four lags. The latter feature—together with the fact that quarterly data for most of the series that we use in this model are available only since 1986 and in some cases only since the early 1990s—prevents the estimation of a VAR with a large set of endogenous variables based on quarterly data for Chile.

15. We considered a number of different orderings and found no apparent changes in the results. This suggests that the structure of our lag restrictions considerably limits the ordering problem with respect to a nonrestricted (Choleski) VAR.

16. In the alternative specification in which terms of trade is replaced by both oil and copper prices, the oil price is allowed to affect external demand conditions, the foreign interest rate, and uncertainty in international financial markets, and vice versa.

Table 4. Order of Equations and Lag Structure of the Model

Dependent variable	*Independent variable*											
	External demand	*Foreign interest rate*	*Foreign equity*	*Terms of trade*	*Net capital flows*	*Openness*	*Output*	*Money*	*Fiscal revenue*	*Fiscal expend.*	*Real exchange rate*	*Domestic equity*
External demand	■	■	■									
Foreign interest rate	■	■	■									
Foreign equity	■	■	■									
Terms of trade	■	■	■	■								
Net capital flows	■	■	■	■	■	■	■	■	■	■	■	■
Openness						■						
Output	■	■	■	■	■	■	■	■	■	■	■	■
Money		■			■		■	■	■	■	■	
Fiscal revenue				■			■		■			
Fiscal expend.							■		■	■		
Real exchange rate	■	■	■	■	■	■	■	■	■	■	■	■
Domestic equity	■	■	■	■	■	■	■	■	■	■	■	■

of the international block, net capital inflows to the Chilean economy, features no lag restrictions, since it could potentially be affected by all the variables included in the model. We allow it to be contemporaneously affected by the four international variables that precede it in terms of the order of the equations. The lag structure of the equation associated with a measure of trade openness (a medium-term domestic policy decision) only depends on the lag for itself.[17]

The equation that accounts for monetary policy is assumed to depend on the lag of itself, the foreign real interest rate, capital inflows, the real exchange rate, and the two fiscal policy variables (namely, fiscal revenue and fiscal expenditure). Fiscal revenue is assumed to depend on the lag of itself, the terms of trade, and the output gap, while fiscal expenditure is assumed to depend on the lags of itself, output, and fiscal revenue. The other equations in the domestic block are those associated with the real exchange rate, domestic stock returns, and the business cycle. These equations feature no lag restrictions, the first two because they represent domestic asset prices and the third because we do not want to restrict the relationships of our main object of interest (that is, the business cycle).

This VAR specification satisfies the stability condition, as all the eigenvalues lie inside the unit circle, and the evidence presented in the following sections is robust to several changes. First, using different orderings to identify the orthogonal shocks does not qualitatively change the paper's results. The only evident difference resulted when we shifted output below domestic policy conditions: all impulse response functions looked relatively similar, but the contribution of monetary policy to business cycle fluctuations was significantly lower in this case, with almost all the effect captured by domestic equity. Second, the results are also robust to reducing or expanding the variables included in the model.[18] For example, we eliminated capital inflows, so as to leave the whole group of external variables completely block exogenous.[19] In this

17. Trade openness is presumably correlated with all the external variables, including net capital flows, contemporaneously.

18. All these estimates are available on request.

19. It was suggested to us that the two external financial variables already included in the model (namely, foreign interest rate and international capital market uncertainty) might be enough to capture changes in external financing conditions to the Chilean economy. The evidence, however, pointed toward an independent effect of capital inflows. To capture such an effect in a more exogenous way, net capital inflows to Argentina, Brazil, and Mexico as a percentage of their combined GDP were included instead of net capital inflows to the Chilean economy. This variable turned out to be statistically insignificant, suggesting that the common factor between capital inflows to the most important Latin American economies and capital inflows to Chile is not very relevant.

case, most of the effect was captured by a higher persistency of the output gap. We also tried expanding the model by replacing the terms of trade with two separate variables—namely, the real prices of oil and copper. Again, results were qualitatively similar regarding the relationship between the other variables and the business cycle. We also included a dummy variable to capture natural catastrophes (both earthquakes and climatic conditions), given Chile's geographical characteristics. Contrary to our expectations, domestic output did not display a statistically significant response to a positive innovation in this natural catastrophes dummy variable, and all the other variables maintained their impact and significance.[20]

3. Macroeconomic Responses and Sources of Fluctuations

This section presents the results of our VAR exercise, using impulse response functions and variance decomposition analysis to illustrate the effects and persistence of shocks on the different variables of the empirical model. We start by describing the economy's responses to the five external shocks identified above, including two foreign real shocks (external demand and terms of trade) and three foreign financial shocks (foreign interest rate, foreign equity, and net capital flows). We then address domestic shocks, covering five domestic policy shocks (monetary policy, two fiscal policy measures, real exchange rate, and openness) and a domestic equity shock. At the end of this section, we report our results regarding the sources of business cycle fluctuations.

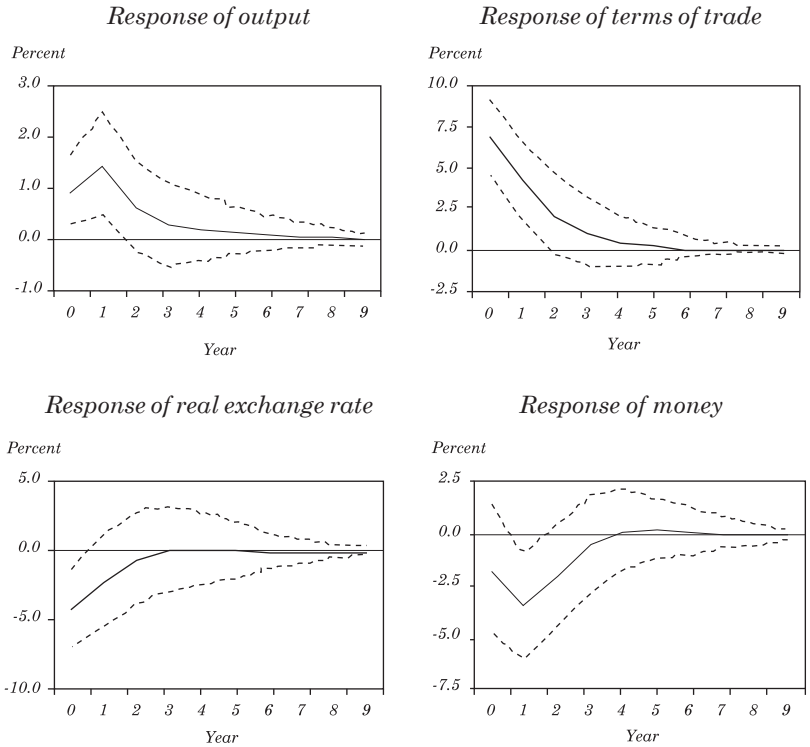
3.1 External Shocks

Figure 3 shows responses to a positive innovation to external demand. Chilean output expands on impact with a lasting effect of around two years. The peak response occurs in the first year. The

20. Earthquakes and sustained droughts were represented by a dummy variable. Droughts were considered if the cumulative shortfall from normal rainfall accumulated over the last four years exceeded 308 millimeters per year (which corresponds to the sample average rainfall minus 10 percent of the sample standard deviation). Following this definition, drought years are 1969, 1970, 1971, 1976, and 1996. Annual data on total rainfall was obtained from Dirección Metereológica de Chile (2003). Similarly, only earthquakes with a magnitude above 7.0 on the Richter scale that occurred less than 50 kilometers from the surface were considered as a natural disaster with macroeconomic relevance. Following this definition, earthquake years are 1960, 1971, 1975, 1985, and 1995 (Servicio Sismológico, 2003).

external demand shock is also transmitted immediately into the real exchange rate and the terms of trade, in different directions. In particular, the appreciation of the real exchange rate and its negative effects on output do not offset the positive effect that is generated with better terms of trade. Economic activity then begins to drop off in response to tighter monetary policy as the economy starts to expand.

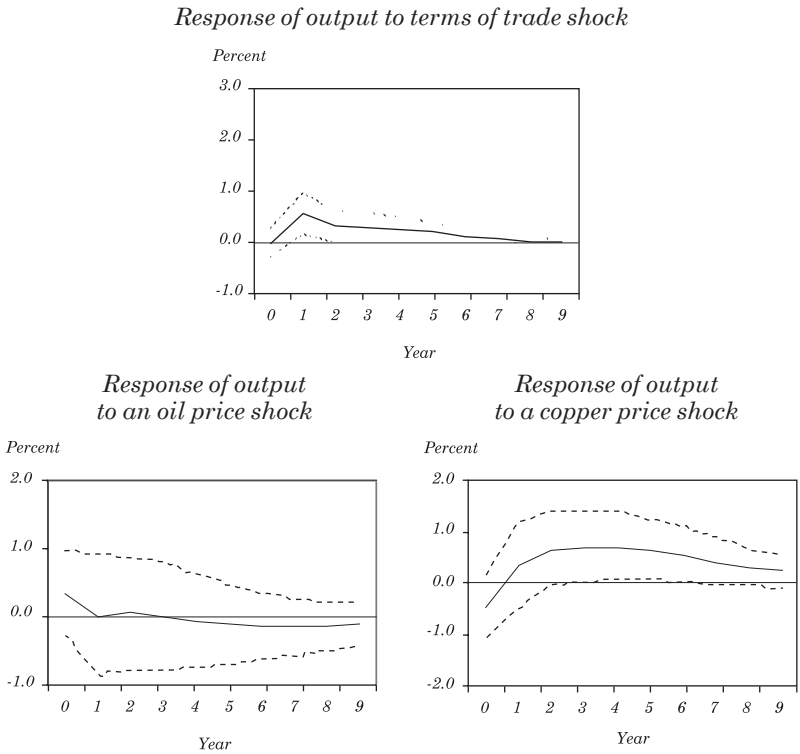
Figure 3. Response to an External Demand Shock



Responses to a rise in the terms of trade are consistent with conventional wisdom (see figure 4). In particular, an improvement in the terms of trade implies a positive impact on the business cycle. The effect on domestic output appears to be higher from the first year on, with a lasting effect of five years even when the persistence of the terms-of-trade shock is only two years. A terms-of-trade shock could stem from a rise in the price of exports or a fall in the price of imports.

Emphasis is usually placed on copper and oil prices in the case of Chile. An alternative VAR that includes these prices instead of the terms of trade shows that both shocks have the expected effects on the business cycle, but their respective impulse-response functions are not statistically significant. This suggests that the dominant source for explaining business cycle fluctuations is a composite of export and import prices, and not copper and oil prices alone. The public discussion of the significant impact of copper prices on the business cycle may thus be overstated.

Figure 4. Response to a Different Terms-of-Trade Indicator Shock



The responses to a rise in the foreign interest rate are illustrated in figure 5. This shock is transmitted into lower monetary aggregates in the first year. The corresponding increase in the domestic interest rate translates into a lower demand for domestic equities, reducing real

returns immediately. Consequently, domestic output eventually falls in response to monetary policy tightening and the reduction in equities.

Figure 5. Response to a Foreign Interest Rate Shock

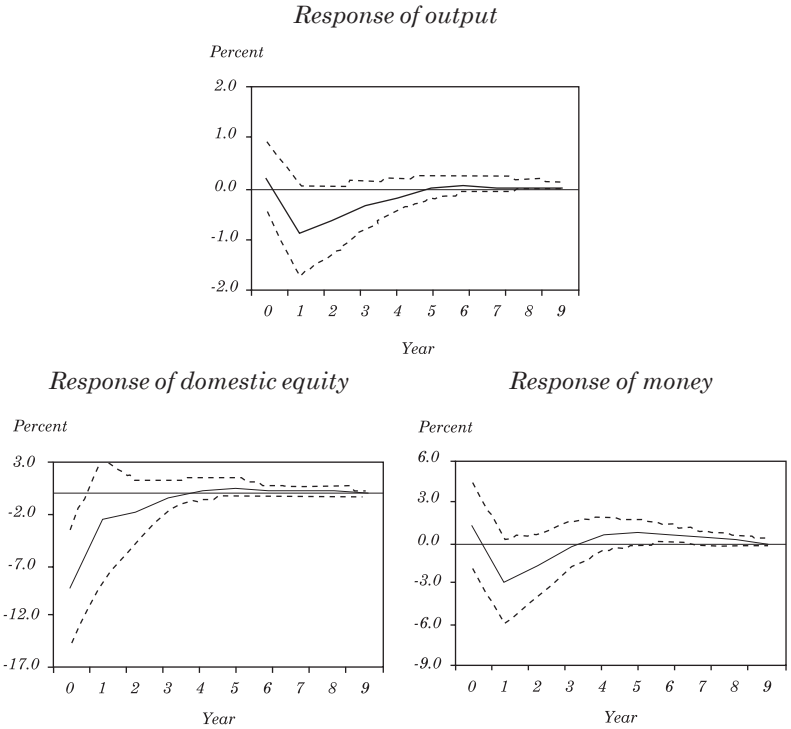
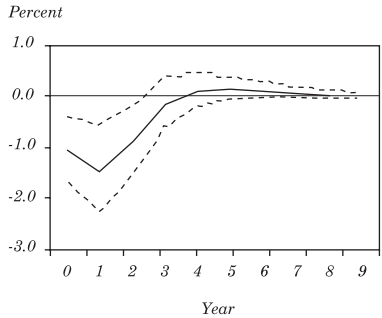


Figure 6 shows that an increase in the volatility of world equities causes a negative impact on the real return of Chilean equities and a decline in capital flows. This may reflect higher external financing costs that could have an impact on the risk premium associated with emerging markets. The combination of these negative forces has an immediate negative effect on the business cycle that lasts two to three years.

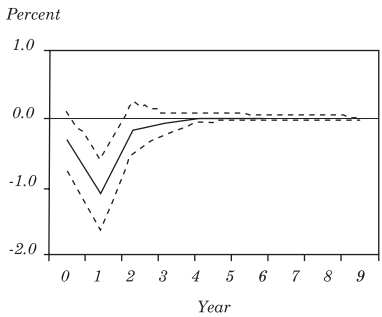
Finally, an increase in net capital flows leads, as expected, to an expansion of the business cycle on impact, which lasts one year (see figure 7). This reflects the financial restrictions faced by an emerging economy like Chile, in the sense that these restrictions imply that the ups and downs of net capital flows have a significant impact on the cyclical behavior of the economy.

Figure 6. Response to a Foreign Equity Shock

Response of output



Response of net capital flows



Response of domestic equity

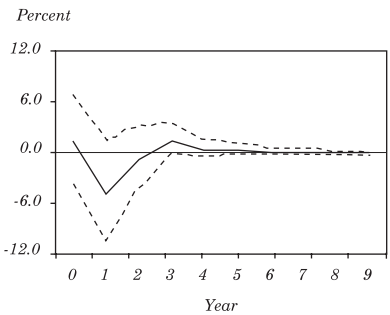
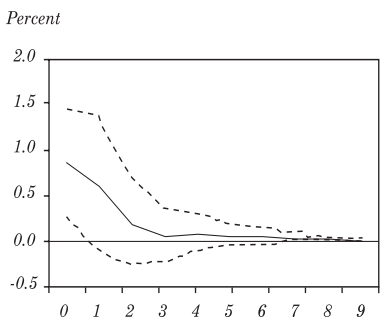
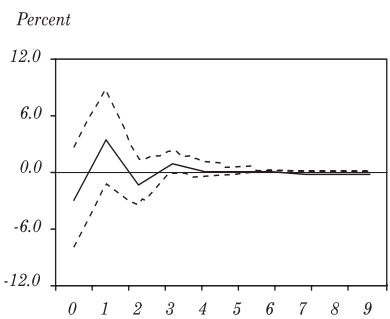


Figure 7. Response to a Net Capital Flow Shock

Response of output



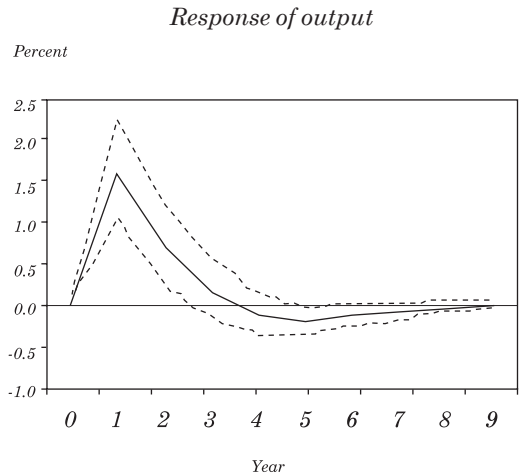
Response of domestic equity



3.2 Domestic Shocks

Figure 8 tracks the responses to a monetary policy shock. After an expansionary monetary policy shock, the impulse-response function for the business cycle displays a hump-shaped pattern, with the peak effect in the first year and a significant persistence of two years.

Figure 8. Response to a Monetary Policy Shock

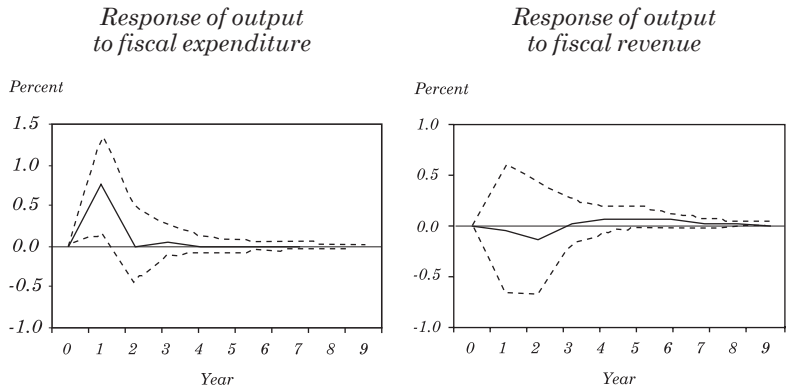


With regard to fiscal policy shocks, the first issue to be resolved in an empirical study is what indicator to use as a measure of policy stance. The usual candidate for this role is the fiscal deficit, but this measure has several well-known problems that make it a weak indicator of discretionary fiscal policy. The fiscal deficit captures both exogenous policy shifts and the automatic reaction of fiscal variables to the state of the economy. Even when changes in the deficit reflect purely discretionary policy decisions, the source of the change—whether a revenue adjustment or a change in government spending—is obviously important for the expected response of the private sector. Consequently, we consider the effects of expenditure and revenue separately. Fiscal expenditures have a high component of policy discretion, while fiscal revenues are explained not only by fluctuations in the tax regime, but also by endogenous reactions following changes in economic activity.

Figure 9 shows the responses to positive innovations to fiscal expenditure and revenue. The response of the business cycle is expansionary and statistically significant in the case of government

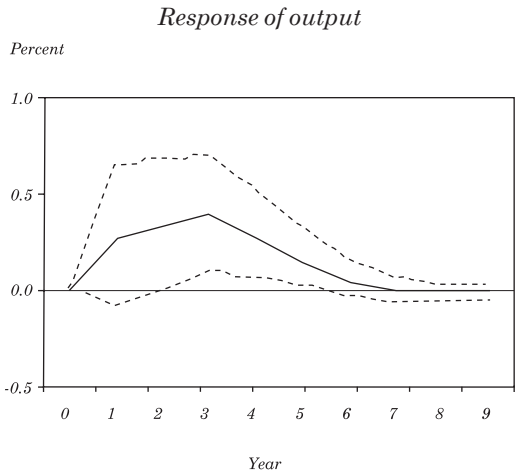
spending, but not in the case of fiscal revenue. This suggests that domestic demand is relatively unresponsive to changes in fiscal revenues.

Figure 9. Response to a Fiscal Policy Shock



A real exchange rate shock has a positive impact on the Chilean business cycle, as shown in figure 10. The impact on output takes two years to become significant, however, and it then lasts for another two years.[21]

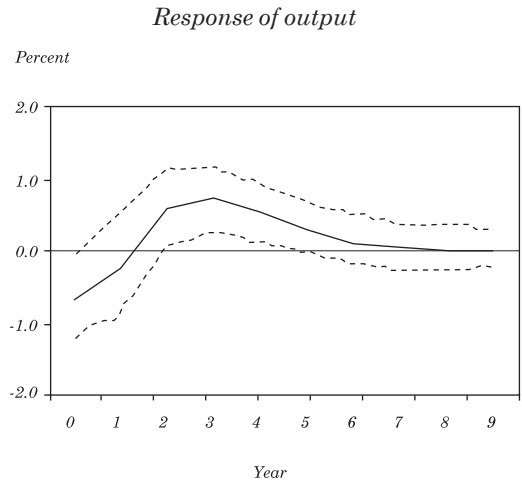
Figure 10. Response to a Real Exchange Rate Shock



21. An increase in the real exchange rate represents a real depreciation of the Chilean peso.

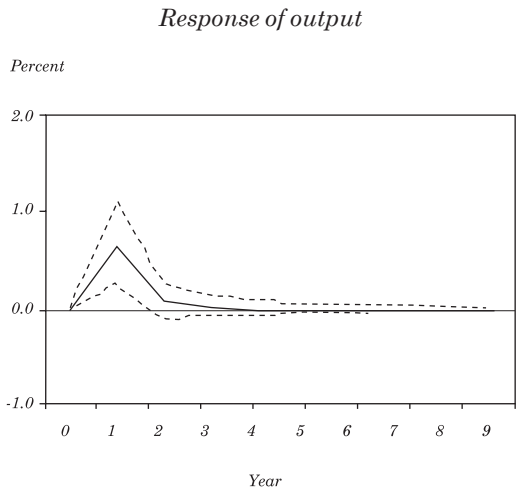
Figure 11 shows that the business cycle reacts positively—but with a lag of three years and a lasting effect of two years—to an increase in the openness of the economy. Since we use de facto openness, the variable reflects a combination of policy decisions and endogenous reactions. If we assume that the trajectory of the variable is influenced mostly by policy, greater openness appears to have helped moderate the impact of external shocks.

Figure 11. Response to an Openness Shock



Finally, figure 12 illustrates the responses to a positive innovation to domestic equity returns. This domestic financial shock has a positive impact in the business cycle in the first year, but the effect vanishes thereafter.

Figure 12. Response to a Domestic Equity Shock



3.3 Sources of Business Cycle Fluctuations

We carried out a variance decomposition analysis to determine what fraction of the variance of the Chilean business cycle is attributable to each shock (see table 5). The results can be summarized in three main findings. First, foreign shocks have a substantial effect on business cycle volatility, with external demand and foreign equity (volatility) shocks representing the dominant source of domestic output fluctuations.[22] Foreign shocks represent 28 percent of business cycle fluctuations in the first year, reaching 42 percent in the third year. Second, domestic equity shocks and fiscal policy shocks have relatively little impact on the business cycle, whereas trade openness and the terms of trade explain a much larger fraction of business cycle fluctuations. Finally, monetary policy shocks play an important role in explaining the forecasting error variance of the business cycle.

22. In one of the most recent assessments using a VAR model, Buckle and others (2002) reach a similar conclusion in which international variables—particularly world output, world equity prices, and world interest rates—are the key sources of volatility in New Zealand's real GDP. Similarly, Parrado (2003), in an empirical work that identifies the geographical sources of external shocks that have influenced the New Zealand business cycle, finds that volatility in Australian interest rates and U.S. equity prices are important sources of business cycle fluctuations.

Table 5. Chilean Business Cycle Variance Decomposition

Step	*Standard error*	*External demand*	*Foreign interest rate*	*Foreign equity*	*Terms of trade*	*Net capital flows*	*Openness*	*Output*	*Money*	*Fiscal revenues*	*Fiscal expenditures*	*Real exchange rate*	*Domestic equity*
0	0.029	9.29	0.51	10.88	0.05	7.44	4.43	67.40	0.00	0.00	0.00	0.00	0.00
1	0.044	13.65	3.57	14.21	5.74	4.86	2.16	39.57	11.46	0.02	2.50	0.33	1.95
2	0.047	13.57	4.68	15.43	6.47	4.38	3.33	35.69	11.78	0.10	2.18	0.68	1.71
3	0.048	13.26	4.96	14.77	7.41	4.18	4.96	34.09	11.32	0.10	2.09	1.23	1.63
4	0.049	13.07	4.89	14.42	8.23	4.10	5.83	33.18	11.08	0.10	2.03	1.49	1.59
5	0.049	13.00	4.82	14.30	8.65	4.06	6.08	32.77	11.07	0.11	2.01	1.55	1.57
6	0.049	12.99	4.81	14.27	8.80	4.05	6.12	32.63	11.10	0.11	2.00	1.55	1.56

Source: Authors' calculations.

4. Shock Resilience of the Chilean Economy

The variance decomposition analysis presented in the previous section confirms the common wisdom that fluctuations in the Chilean business cycle are largely explained by external shocks. The prominence of external shocks is due to the country's condition of being a small open economy—open to both trade and financial flows—with an export structure that is not sufficiently diversified and with limited access to international financing. Indeed, external shocks explain more than twice as much of the business cycle fluctuations as domestic shocks. In this section, we undertake a historical decomposition analysis to explore the volatility and resilience of the Chilean economy and its correlation and synchronization with international shocks.[23]

4.1 Historical Decomposition

In analyzing the effects of different combinations of shocks on output, including how the output response to those shocks has evolved over time, we divide business cycle fluctuations into different components: international conditions, policy conditions, other domestic shocks, and a remainder that includes the inertial or lagged effect and the error term (that is, other shocks that we do not control for). Then, we assess how the importance of these different components has evolved over time and whether domestic policies have contributed to moderating the effects of international shocks. The latter would suggest that the economy's resilience to external shocks has increased.[24]

23. We decompose the historical values of a set of time series into a basis projection and the accumulated effects of current and past innovations. This decomposition allows us to observe whether movements in the business cycle were likely the result of a combination of innovations or of a specific variable. The historical decomposition is based on the following partition of the moving average representation:

$$y_{t+j} = \sum_{s=0}^{j-1} \Psi_s u_{t+j-s} + \left(X_{t+j}\beta + \sum_{s=j}^{\infty} \Psi_s u_{t+j-s} \right),$$

where the first summation represents that part of y_{t+j} due to innovations in periods $t + 1$ to $t + j$ and where the second part is the forecast of y_{t+j} based on information available at time t. If u has n components, the historical decomposition of y_{t+j} has $n + 1$ parts: the forecast based on information at time t (the term in parentheses); and, for each of the n components of u, the part of the first term that is due to the time path of that component.

24. Data limitations prevent us from using a more straightforward approach to this issue—namely, the estimation of separate VARs within two subsamples, which would amount to looking for evidence of a structural break in the response of output to international conditions, policies, or other domestic shocks.

Figures 13 and 14 show the business cycle fluctuations divided by the different components described above. The international conditions component includes external shocks—both real (external demand and terms of trade) and financial (foreign interest rate, volatility of international financial markets, and net capital flows). The policy conditions component encompasses the effects of changes in monetary and fiscal policy (from both the revenue and expenditure sides) and the effects of changes in structural policies, captured by the degree of openness to international trade and the real exchange rate.[25] Finally, other domestic conditions refer to the effect of changes in domestic stock market prices that are beyond the medium-term average return.

Figure 13. GDP Cycle and Components

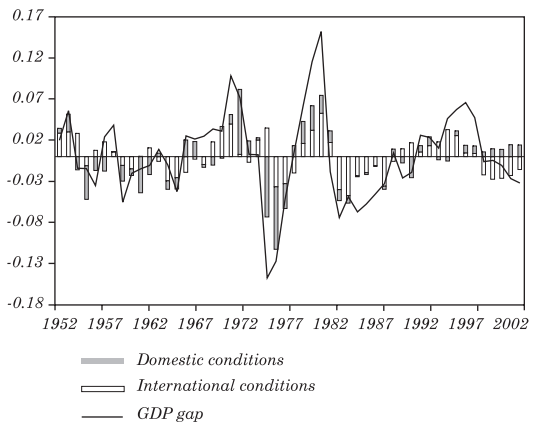


Figure 13 shows that cyclical output fluctuations are mainly explained by international and policy components, while the effect of other domestic shocks appear to be much smaller. The remainder component (lagged output and an error term) also plays an important role, primarily because of the autocorrelation of the output cycle.

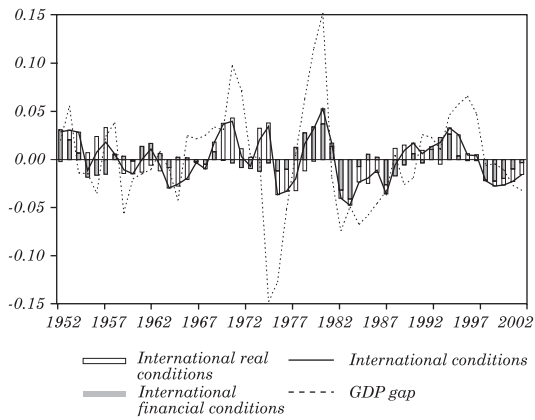
Real and financial international conditions appear to make similar contributions to the cyclical fluctuations of output (see figure 14). The total effect of international conditions on the output cycle does not show significant changes in terms of magnitude across the sample. This is

25. We consider this variable a structural policy because the fact that the Chilean economy was characterized by different exchange rate regimes over the sample period implies that the adjustment process followed by this relative price changed over time as a result of exchange rate policy decisions.

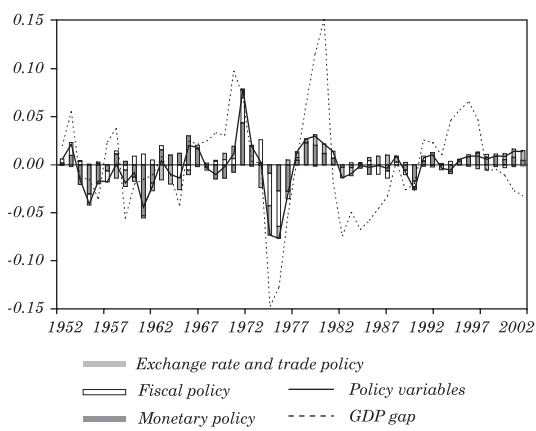
not the case of the policy component, which appears to have had broader effects on the cycle in the first two-thirds of the sample period than in the final period. With regard to policy components, monetary and fiscal policy have larger effects on cyclical output fluctuations than exchange rate and trade policies (structural component).

Figure 14. International Conditions and Policy Conditions

A. International conditions



B. Policy conditions

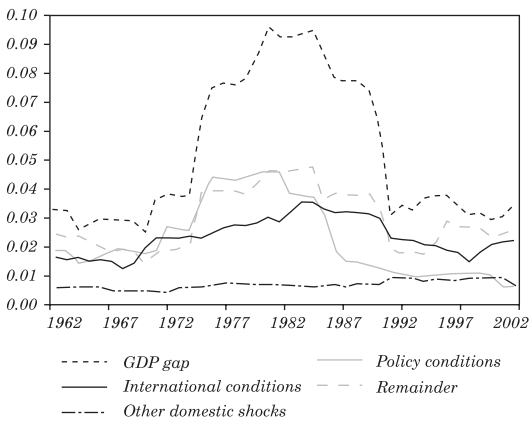


4.2 Volatility and Resilience

Output volatility, measured by the ten-year rolling standard deviation of the output gap, reached peaks in the late 1970s and early 1980s, as shown in figure 15. The differences are such that the gap volatility in peak years was up to three times the level of the calmer years of the 1960s and 1990s. The volatility of some of the components of the output gap also reached sustained peaks that extend from the mid-1970s to the early 1980s, as in the case of policy conditions and the remainder. In the case of international conditions, volatility peaked in the mid-1980s. Other domestic shocks present a relatively stable and low volatility throughout the sample period.

Figure 15. Volatility of GDP Gap and Components

Ten-year rolling standard deviation

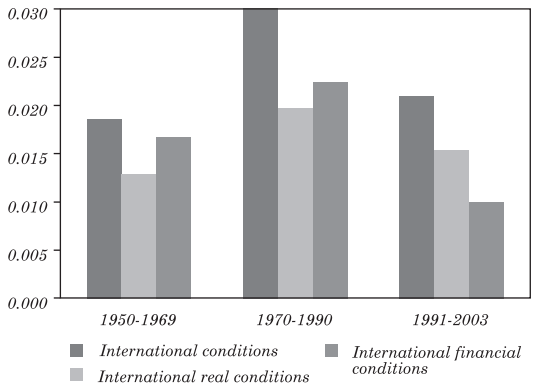


The peak in the GDP gap volatility cannot be associated with a single factor. While the volatility of international conditions increased steadily until the mid-1980s and then declined, the volatility of policy conditions and the remainder also contributed to the peak. Consequently, the increase and subsequent fall of output gap volatility was much more marked than that of any individual component considered on its own.

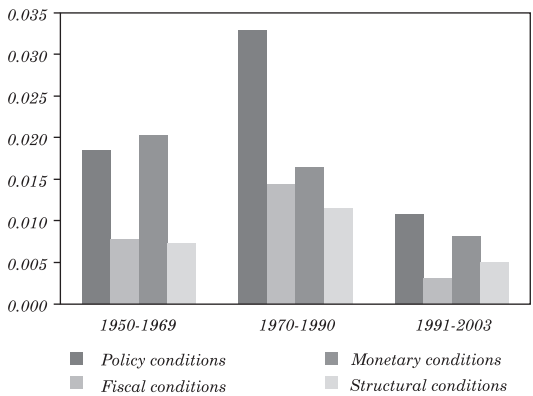
The volatility of international conditions, both as a whole and in its real and financial components, reached a maximum in 1970–90 and then fell sharply in the 1990s (see figure 16). However, the drop in the volatility of external conditions in the last decade of the sample period is not nearly as marked as that of the output gap or policy conditions.

Figure 16. Volatility of Gap Components: International Conditions and Policy Conditions

A. International conditions



B. Policy conditions



The policy conditions component registered the largest reduction in volatility, even larger than the output gap itself. This suggests that demand management and structural policies have made an economically significant contribution toward moderating business cycle fluctuations—in terms of both magnitude and amplitude. This outcome reflects the strengthening of the macroeconomic policy framework and an ongoing process of institutional building. On disaggregating this

trend, we find that the volatilities associated with structural and monetary policies fell to about half their previous values, while the volatility of fiscal policy fell much more markedly.

Resilience is commonly defined as the capacity to withstand shocks. It can thus be understood as the economy's capacity to limit the volatility of the output gap when confronting exogenous shocks. To measure resilience to external shocks—the most important type of exogenous shocks faced by the Chilean economy—we compute the ratio of the volatility of external shocks to the volatility of the output gap.[26] As presented in table 6, resilience to external shocks deteriorated markedly in the 1970s and 1980s and then improved sharply in the 1990s, to a slightly higher level than in the 1950s and 1960s. The deterioration in the resilience to external shocks in the 1970s and 1980s was to external shocks of both a financial and a real nature. However, the subsequent recovery of resilience in the 1990s was concentrated on external shocks of a financial nature.

Table 6. Resilience to External Shocks[a]

Period	*Total*	*Financial*	*Real*
1950–69	0.61	0.42	0.55
1970–90	0.40	0.26	0.29
1991–2003	0.63	0.46	0.30

a. Volatility ratios of external conditions against the output gap.

4.3 Correlation and Synchronization

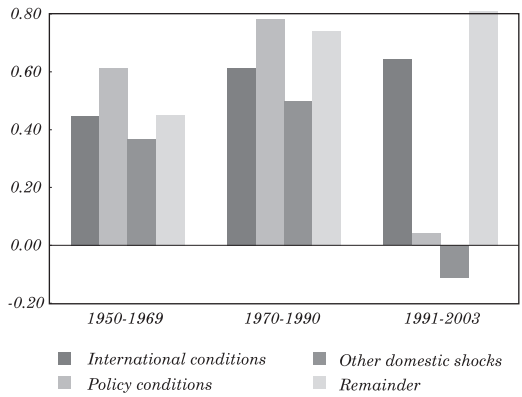
As the economy's integration with the rest of the world deepens, the synchronization of the domestic business cycle with external conditions is expected to increase. The evidence gathered in the previous section, however, suggests that the economy has become more resilient to external shocks. An interpretation that helps reconcile these facts is that policy actions can play a role as shock absorbers. Improved resilience to external shocks may result from policy actions that more effectively stabilize output, which would be manifested, for example, in a shift in the policy component from procyclical (positive correlation with the output gap) to countercyclical (negative correlation).

26. An alternative way to look at resilience is to analyze the contributions of the different components along the cyclical downturn. The results obtained through a preliminary analysis using this approach were qualitatively similar.

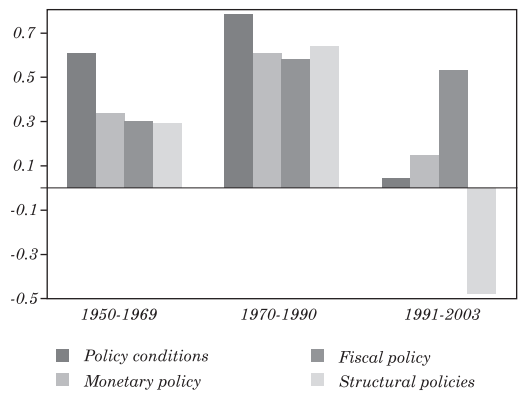
Over time, the Chilean business cycle has become increasingly associated with international conditions. The correlation coefficient increased from 0.45 in the first period (1950–69) to 0.60 in the second (1970–89) and almost 0.65 in the third (1990–2003). In other words, the domestic and external business cycles have indeed become more synchronized (see figure 17).

Figure 17. Correlations of GDP Gap with Main Components and Policy Conditions

A. Main components



B. Policy conditions



In sharp contrast with the pattern of increasing correlations described above, the correlation between policy conditions and the output gap increased only from the 1950s and 1960s to the 1970s and 1980s. It then dropped dramatically to almost zero in the 1990s. In other words, policy actions—which were highly procyclical in the past—played a cyclically neutral role after the early 1990s. A closer look at the correlations of the individual variables contained in the domestic policy component shows that the drop in correlation in the 1990s was widespread, but the shift from procyclicality to countercyclicality is fully captured by structural policies for the period as a whole.

Hence, the continuous trade opening (which allows the trade balance to adjust smoothly to negative external shocks) and the increasingly flexible exchange rate (which enhances the real exchange rate's role as shock absorber) were the main contributors to the increased resilience of the 1990s. Monetary policy also contributed to eliminating procyclical policy conditions in the 1990s. That is not the case, however, for fiscal policy, whose correlation with the business cycle remained stable relative to the 1980s.

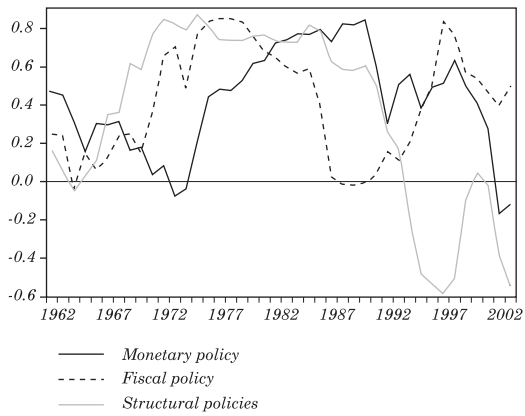
On the whole, the countercyclical role of economic policies became evident only in the 1990–2003 period, but a detailed examination of the timing of the fall in the correlation between domestic policies and the output gap shows a somewhat different pattern (see figure 18). The correlation with fiscal policy started falling in the early 1980s, but it increased again in the mid-1990s, while the correlations with monetary and structural policies started falling in the late 1980s and became negative in the last years in the sample. The process has not been continuous, however, with some reversals associated with significant episodes in policymaking.

The correlation of the output gap and structural policies fell sharply after the widening of the exchange rate band was initiated in 1991, reaching a negative value in the mid-1990s. The correlation increased around 1998, probably in response to the narrowing of the exchange rate band, and it fell again from 1999 onward, after the elimination of the band.

In the late 1980s the correlation between monetary policy and the GDP gap was positive and quite high (0.8). This correlation fell continuously, in the 1990s, as the independent Central Bank developed its inflation targeting framework and gained credibility, although a short interruption occurred in 1998 as a result of the narrowing of the exchange rate band and the hike in interest rates that paved the way to the short-lived recession of 1999. After that, the correlation continued

Figure 18. Correlation of GDP Cycle versus Policy Conditions Components

Ten-year rolling correlation coefficients



to fall, with monetary policy becoming countercyclical in 2002 and 2003. This result reflects the full-fledged inflation targeting framework currently in place and the associated reduction in interest rates over the last four years.[27]

Finally, the correlation of fiscal policy and the output gap fell markedly after the 1982 debt and banking crisis, even reaching negative values toward the latter part of the 1980s. In the second half of the 1980s, a strong economic recovery from the depressed post-crisis conditions took place within the framework of an IMF-supported program, which included an important fiscal consolidation effort. This accounts for the negative correlation between the output gap and the fiscal component. The correlation of fiscal policy and the GDP gap increased again in the 1990s, becoming positive in 1992 and reaching a maximum in 1997 as fiscal policy regained its procyclical characteristics. In this period, a policy of constant nominal fiscal surpluses was pursued. Fiscal expenditures therefore mirrored the cyclical pattern of fiscal revenue, which is largely determined in Chile by private spending given the high share of the VAT in total revenue.

27. The latter has contributed to the recovery from the prolonged economic slowdown that followed the downturn. According to most analysts, the negative output gap is expected to be closed in or around 2005.

At the end of the 1990s, the current administration of President Ricardo Lagos corrected the pro-cyclicality of fiscal policy by adopting a fiscal rule that allows automatic stabilizers to operate fully across the cycle. The operation of this fiscal rule should cause the correlation between the fiscal component and the business cycle to converge toward zero.

Overall, the strengthening of the policy framework in the last period of the sample (including the floating of the exchange rate, the adoption of the fiscal rule, and the refinement of the inflation targeting framework) seem to have played a significant role in the observed increase in the economy's resilience. This bodes well for these positive developments to be sustainable in the future.

5. Concluding Remarks

In this paper, we estimated a VAR model for a small open economy like Chile by introducing block exogeneity into the lag structure of the model. First, to take a relatively long view, we draw on an extended sample dating back to the 1950s. Second, to better capture the characteristics of the Chilean economy, we include an expanded set of variables that let us account for the impact of external shocks (both of real and financial), domestic shocks (including policy variables that capture both demand management and structural policies), and other domestic shocks. We use this toolkit to analyze the associated dynamic responses of the business cycle to several shocks (impulse responses), the sources of business cycle fluctuations (variance decomposition), and the shock resilience of the Chilean economy (historical decomposition).

Several interesting results emerge. First, in terms of the impulse response analysis, real external shocks (domestic demand and terms of trade) have significant effects on domestic economic activity. We provide evidence that the terms of trade, which reflect a composite of export and import prices, captures the dynamic response of the economy better than copper and oil prices alone. Furthermore, financial external shocks are transmitted to the domestic economy through several channels, and they have significant effects on domestic economic activity. The significant impact in the cyclical behavior of the economy following a shock in either the volatility of international financial markets or net capital flows reflects the financial restrictions faced by an emerging economy like Chile. Among domestic policy shocks, demand management policies (represented by monetary policy and government spending) and structural policies (represented by the real exchange rate and trade openness) significantly affect business cycle fluctuations, as

is also the case of other domestic shocks such as business confidence (represented by stock returns). In contrast, we did not find evidence to support the belief that natural catastrophes such as droughts and earthquakes have a significant impact on economic activity.

Second, our variance decomposition analysis indicates that foreign shocks have a substantial effect on business cycle volatility. In particular, external demand and foreign equity (volatility) shocks were the dominant source of domestic output fluctuations in the sample period. Other external shocks—in order of importance and at some distance—include the terms of trade, net capital flows, and international interest rates. Among policy variables, monetary policy is the most important source of business cycle fluctuations, with a contribution similar to that of the most important external shocks. Structural and fiscal policy policies explain a relatively low fraction of business cycle fluctuations.

Finally, our historical decomposition analysis provides ample evidence that the resilience of the Chilean economy increased in the 1990s. This positive development took place even as the deeper integration of the economy with the rest of the world resulted in increased synchronization of the domestic business cycle with international conditions. This pattern underscores the significant countercyclical role played by policies, particularly monetary and structural policies.

The most straightforward policy implications of the results presented in this paper are that good policies matter and that demand management policies are a necessary complement of structural policies. This is clearly demonstrated by the increase in the Chilean economy's resilience throughout the 1990s, a period in which domestic policies were rather complementary. The profound economic reforms of the 1970s and 1980s undoubtedly played an important role in Chile's outstanding growth performance between the mid-1980s and 1997—that is, before the prolonged slowdown period that resulted from the Asian and Russian crises and the unsupportive external environment that characterized the global economy until recently. The policies of the 1970s and 1980s were highly procyclical, however, and the economy was therefore vulnerable to external shocks. Indeed, the economy underwent two large recessions during that period. Hence, the incumbent and future Chilean economic authorities should continue on the path of strengthening the macroeconomic policy framework and managing it skillfully. If they do so, we would expect the Chilean economy to further improve its already high level of shock resilience. If they do otherwise, resilience could easily deteriorate, and given the uncertainties embedded in the global environment, the economy could return to more turbulent times.

With regard to future research, adding more structure to the small open economy VAR could yield further insights by allowing a more accurate identification of shocks. In particular, the changing policy framework of the last fifty years is an important barrier to successfully fitting a more particular structure to the contemporaneous matrices implicit in the VAR estimation. One way to tackle this issue is to pursue a similar study using quarterly data for the last decade. Preliminary exercises suggest that a structural VAR model fitted on a quarterly sample covering a shorter period could potentially be well equipped to capture the dynamics of the data. The number of variables included in the VAR may need to be streamlined, however, considering the typical autocorrelation pattern that characterizes data at this frequency. Also, in line with Parrado (2001), a direction in which to build on the model developed in this paper is to evaluate the impact of foreign shocks and monetary policy on both the business cycle and inflation variability and its tradeoff.

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