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CHILE

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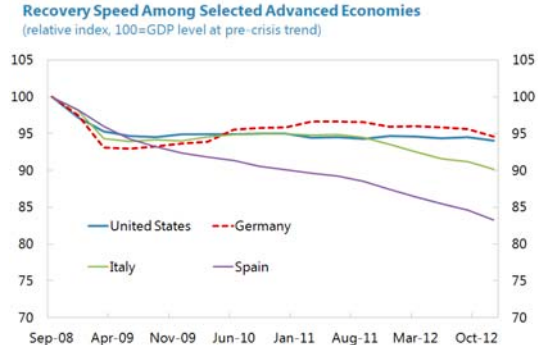
A TALE OF TWO RECOVERIES: THE POST-CRISIS EXPERIENCE OF BRAZIL AND CHILE[1]

The recovery from the 2008/2009 global crisis has been markedly different both among advanced and emerging economies. The goal of this chapter is to shed light on some key drivers of this different experience by comparing the cases of Brazil and Chile.

A. Introduction

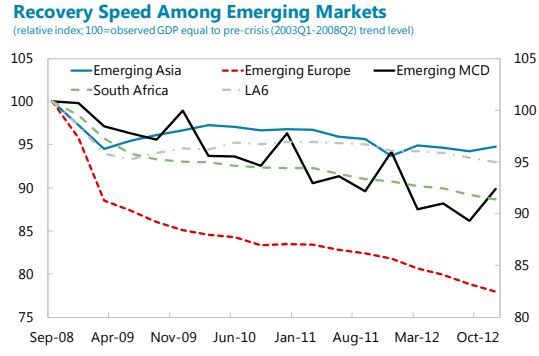
1. The degree to which countries have closed the gap between their GDP (level) and the one that would have resulted if the pre-crisis (2003-2008Q3) growth trend had prevailed, has varied greatly. [2] Regarding advanced economies, United States and Germany have reached GDP levels 5-6 percent below their pre-crisis trend. On the other hand, Italy and Spain not only remain well below such level, but also seem to be in a declining trend lately.



Sources: Haver Analytics and author's calculations

2. The recovery experience has also varied among emerging markets. For example, for LA6 (Brazil, Chile, Colombia, Mexico, Peru, Uruguay) average GDP is currently some 7 percent below its pre-crisis trend, while for emerging Europe it is 22 percent below trend.

3. This paper indentifies some key drivers of this different experience using as illustrative case the comparison of Brazil and Chile -which represent the extreme cases in the region in terms of recovery from the crisis. Brazil is currently some 11 percent below trend, while Chile is just 3½ percent below.



Sources: Haver Analytics and Fund staff estimates

4. The analysis relies on the Business Cycle Accounting (BCA) methodology and aims to identify key *distortions* or *wedges* behind the observed dynamics for GDP and other macroeconomic variables. Intuitively, this methodology asks: *by how much one would need to distort a standard growth model so that it is able to replicate*

[1] Prepared by J. Daniel Rodríguez-Delgado. Sofía Bauducco and other seminar participants at the Central Bank of Chile provided useful comments. Lucas Brito (IMF) helped with data collection.

[2] It is relevant to say at this juncture, that this comparison against the pre-crisis trend is for illustrative purposes only and does not affect the methodology or results of the paper. In particular, it does not intend to argue that absent the crisis, the previous trend would have continued.

the observed data? In this paper we allow for four different types of distortions, each one affecting a particular equilibrium condition of the growth model: efficiency (total factor productivity) wedge, labor wedge, capital wedge and bond wedge. Wedges are modeled as time-varying shocks and represent the combined effect of structural features such as market imperfections, institutional frameworks, and higher frequency events such as changes in global and local financial conditions, domestic policy decisions, etc.

5. In this paper we build-up on recent applications of the BCA methodology. This paper follows closely the paper by Lama (2011), which finds that in episodes of output drop in Latin America during 1990-2006, the labor and efficiency wedges played a dominant role. A similar finding is presented by Cho and Doblas-Madrid (forthcoming) using a larger sample of countries and considering 1980-2006. Further, they find that these two wedges are also key drivers during *recovery* periods. Simonovska and Soderling (2008) present similar results for Chile for the period 1999-2007. In this paper, we apply a similar methodology to the most recent crisis episode. Factors that make this last crisis interesting to analyze include the fact that many emerging markets, including Brazil and Chile, leveraged on the improvement in policy frameworks they achieved during the two decades prior to the crisis to support a strong initial recovery (IMF, 2010). At the same time, Brazil's recent weak economic performance has been highlighted as being partially driven by policy uncertainty (IMF, 2013). It is important to note at this time, that the analysis below will not pin-point the role of specific policy measures, but will provide an overall growth diagnostic framework which could help guide future, more detailed, analysis. This issue is further discussed in the concluding section.

6. The main findings are as follows. The model simulations suggest there have been both important similarities and also differences in the post-crisis behavior of Brazil and Chile. In both countries, the steady improvement in the labor wedge –distortions related to the consumption-leisure decision— helped support the recovery. In Chile, the growth generated by this improvement, was sufficient to overcome the relatively weak performance of efficiency (TFP); in Brazil, this growth contribution was not enough. This analysis suggests that to further understand the key factors including the effect of policies at play during the crisis and recovery, it would be important to look into mechanisms and models that would generate changes in TFP as well as in the wedge in the consumption-leisure decision.

B. Brief Description of Chile and Brazil Crisis and Recovery

7. While GDP evolution was relatively similar pre-crisis in Brazil and Chile[3], both the magnitude of the recession and the strength of the recovery differ significantly. GDP pre-crisis growth averaged about 1.2-1.3 percent (all numbers expressed as seasonally adjusted, q-o-q percentage change) in both countries; however, the crisis represented a recession more than twice

[3] The appendix includes a brief description of data sources and construction techniques.

as strong in Brazil. More importantly, Chile's after-crisis growth has exceeded its pre-crisis level. As mentioned, Chile and Brazil represent extreme cases among LA6 in terms of recovery from the crisis. Interestingly, Brazil had initially a strong recovery which then faltered, while Chile's recovery has been steadier.

Chile: Pre and Post Crisis

(average, q-o-q growth)

	GDP	Employment	Hours	Investment
2003Q1-2008Q3	1.3	0.7	-0.3	3.1
2008Q4-2009Q1	-1.2	-0.7	-0.8	-14.1
2009Q2-2012Q4	1.4	1.0	-0.2	3.9

Source: Haver Analytics, author's calculations

Brazil: Pre and Post Crisis

(average, q-o-q growth)

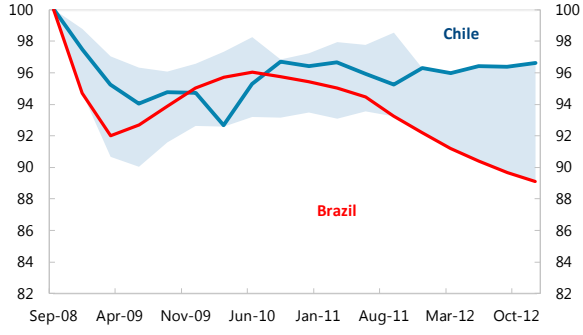
	GDP	Employment	Hours	Investment
2003Q1-2008Q3	1.2	0.6	0.0	2.5
2008Q4-2009Q1	-2.9	-0.3	-0.2	-15.3
2009Q2-2012Q4	1.0	0.7	0.0	2.0

Source: Haver Analytics, author's calculations

8. Investment growth is also an important difference. Chile's recovery has been characterized by strong investment growth, 0.8 percentage points (p.p.) higher than pre-crisis trend. Brazil's recovery, in contrast, has exhibited investment growth 0.5 p.p. weaker. Also notable is that in both countries employment (headcount) growth has increased after the crisis.

Downturn and Recovery among LA6

(relative index pre-crisis (2003-2008Q4) trend)



Sources: Author's calculations

9. This chapter aims to disentangle key distortions driving the observed behavior of not only GDP but also employment and investment. In particular, the BCA methodology offers the possibility to identify distortions which could have driven consumers/producers to optimally choose the observed level of employment and investment effort and consequently GDP level.

C. Business Cycle Accounting Methodology

10. The BCA methodology differs significantly from the standard growth accounting technique. Similar to traditional growth accounting, the BCA aims to determine the main drivers of the observed dynamics for output, investment, consumption, etc**.** In contrast with the traditional growth accounting, however, it focuses on indentifying which class of distortions induced economic agents to choose the dynamics observed in the data. These distortions are modeled as time-varying shocks.

11. The BCA essentially enriches a standard neoclassical growth model with distortions (wedges); in this chapter: efficiency wedge, labor wedge, capital wedge and bond wedge. It identifies the stochastic process of the wedges most likely to have generated the data. It also infers the exact value of the wedges that drove the data and computes the quantitative importance of each wedge. This section follows Lama (2011) who extends Chari et al. (2007)'s methodology to identify frictions that are relevant for explaining economic fluctuations. This is a two-step procedure:

1) measure the wedges or deviations between the standard neoclassical growth model and the data; 2) evaluate the quantitative relevance of each individual wedge to account for the observed evolution of GDP.

12. While both the growth accounting and the BCA techniques aim to decompose observed dynamics into its subcomponents, there are important differences in how they disentangle the role of "fundamentals". In short, the BCA aims to incorporate the role of economic agents' decisions, while the growth accounting technique offers a more algebraic decomposition that abstracts from the fact that agents would have chosen different consumption, investment and labor decisions if the fundamentals were different.

13. The decomposition of the role of TFP illustrates this point. Part of the process of the BCA is to solve the model in terms of the (reduced-form) shocks, including TFP shocks. For example, investment and labor decisions would become functions of the shocks $K_t=K(A,z)$, $L_t=L(A,z)$ where A, describes TFP shock realization and Z captures the realization of all other shocks besides TFP. Intuitively, the growth accounting technique measures what would have been the evolution of GDP, if capital and labor were not affected by TFP, in equation 1. In contrast, in the BCA technique, the object of interest is what would have been the level of GDP *optimally chosen* by economic agents, if all other shocks were constant, as in equation 2. The BCA technique, therefore, captures not only the direct effect of TFP on output, but also its indirect effect via the investment and labor decisions.

$$Y_t = A_t K^{\alpha} L^{1-\alpha} \quad (1)$$

$$Y_t = A_t K(A_t, Z)^{\alpha} L(A_t, Z)^{1-\alpha} \quad (2)$$

A prototype small open economy version of the neoclassical growth model

14. As in Lama (2011), the prototype model includes a standard representative consumer and firm. In this setup wedges are introduced as taxes; tax revenue is returned back to the consumer as a lump-sum transfers (T).

- Stand-in consumers. Consumers maximize expected utility (equation 3) which depends on per capita consumption and per capita labor, subject to the budget constraint, and the law of motion for capital. As it is standard in this type of model, adjustment costs are assumed both for capital (K_t) and debt ($-b_t$) accumulation as in equations 5 and 6 below.

$$\boldsymbol{max}_{\boldsymbol{c_t, l_t i_t}} E_0 \sum_{t=0}^{\infty} N_t \beta^t U(C_t, l_t) \quad (3)$$

$$(1+n)b_{t+1} + C_t + i_t \leq (1-\tau_{lt})w_t l_t + (1-\tau_{kt})r_t k_t + (1+\tau_{bt})(1+r_t^*)b_t + T_t. \quad (4)$$

$$(1+n)K_{t+1} = (1-\delta)K_t + i_t - \emptyset\phi(i_t/K_t)K_t. \quad (5)$$

$$(\mathbf{1}+\boldsymbol{r_t^*}) = (\mathbf{1}+\boldsymbol{r^*})\left(\frac{\boldsymbol{b_t}}{\boldsymbol{b^*}}\right)^{\boldsymbol{v}} \quad (6)$$

- Firms have access to constant returns to scale technology with labor augmenting technological progress and choose capital and labor to maximize profits (equation 7) each period. In this

specification, (1+γ) is the rate of labor augmenting technical progress – assumed to be constant over time. At is the efficiency wedge.

$$\pi = A_t F(K_t, (1+\gamma)^t l_t) - w_t l_t - r_t k_t \quad (7)$$

15. The key equilibrium conditions determining the wedges can be summarized by the following equations:

- Investment wedge: distortions to the inter-temporal allocation of consumption and investment. Models in which the availability of financing to capital investors depend on their net worth (e.g. models with default in which a higher net worth would make default less likely) are relevant candidates to generate this type of friction.

$$U_{ct} = \beta E[U_{ct+1}\{(1-\tau_{kt+1})A_{t+1}F_{kt+1} + (1-\delta)\}] \quad (8)$$

- Labor wedge: distortions to the intra-temporal allocation of leisure and consumption. In the literature there a few mechanisms which have been shown to generate this type of distortions including those related to wage markups created by sticky wages or strong labor unions (Chari, et al., 2007). Neumeyer and Perri (2005) put forward an alternative mechanism based on working capital requirements. Under this mechanism, the firms total labor costs would also include a financial component so that more restrictive access to credit would represent a worsening of the labor wedge (Lama, 2011).

$$-\frac{U_{lt}}{U_{ct}} = (1-\tau_{lt})A_t F_{lt} \quad (9)$$

- Efficiency wedge (TFP): gap between GDP and the combination of capital and labor. This represents the standard exogenous TFP shock commonly used in the literature. However, it is relevant to consider models that would generate this wedge endogenously. For example, trade frictions could limit firms' exposure to foreign technology and knowledge. Matching/pairing frictions in the labor market could also result in a suboptimal allocation of skills resulting in lower observed TFP. At this moment, it is useful to note that the previous example represents one in which, a labor market-related distortion would manifest itself beyond what in this chapter is labeled as *labor wedge*.

$$A_t = \frac{Y_t}{F_t} \quad (10)$$

- Bond wedge**:** distortions to the debt accumulation decision. For example, this wedge could reflect risk premium, or the presence of enforcement-related borrowing constraints.

$$U_{ct} = \beta E[U_{ct+1}\{(1+\tau_{bt+1})(1+r^*_{t+1})\}] \quad (11)$$

16. Although it is useful to think of them as taxes, these wedges could also represent additional factors. That is, wedges are not primitive shocks but rather reduced form representations.

Calibration and estimation of the model

17. The calibration and estimation of the model are as follows:

- We assume a Cobb-Douglas production function and a utility function of the form:

$$U(c,l) = \log c + \psi \log(1-l) \quad (12)$$

- The capital adjustment cost is defined by

$$\phi\left(\frac{i}{k}\right) = \frac{a}{2}\left(\frac{i}{k} - \delta - \mathrm{Y} - \eta - y\eta\right)^2 \quad (13)$$

- The stochastic processes is modeled as a VAR (1):

$$Z_t = \left[\log\left(\frac{A_t}{A}\right), \log\left(\frac{1-\tau_{lt}}{1-\tau_{it}}\right), \log\left(\frac{1-\tau_{kt}}{1-\tau_k}\right), \log\left(\frac{1+\tau_{bt}}{1+\tau_b}\right)\right] \quad (14)$$

$$Z_t = AZ_{t-1} + \varepsilon_t \quad (15)$$

- The shocks are iid and have a standard normal distribution. From this point forward, all variables are expressed in detrended per capita (in fact, per working age population) terms, with the exception of labor/employment.

18. The general identification strategy is to calibrate the parameters of the model related to technology, preferences, and population growth, and estimate the parameters of the stochastic processes with maximum likelihood. Some of the parameters are calibrated to match the main features of Chile's and Brazil's quarterly data; otherwise we use values used in the literature. Ψ is calibrated based on the employment to working age population ratio and hours. The discount factor β is calibrated from the Euler equation (8) at steady state. Capital shares are inferred from Loayza, et al, 2005 (c.f. Sosa, et al, forthcoming). The rate of technological progress (γ) and population growth are calculated from each country's data. We use a standard annual depreciation rate of 5 percent and calibrate the capital adjustment cost as in Lama (2011). The model is log-linearized around the steady state.

Parameters		
	Brazil	Chile
Capital share (α)	0.47	0.40
Tech. progress (γ)	0.005	0.006
Depreciation (δ)	0.012	0.012
Leisure weight (ψ)	2.63	3.25
WAP growth rate (n)	0.004	0.004
Discount factor (β)	0.9604	0.9737
Capital adjustment cost (a)	11.89	9.34
Wedges Stochastic Process		
Efficiency wedge		
autocorrelation	0.9856	0.9313
st.dev	0.0123	0.0107
Labor wedge		
autocorrelation	0.9987	0.9779
st.dev	0.0110	0.0167
Capital wedge		
autocorrelation	0.6393	0.5888
st.dev	0.1302	0.2489
Bond wedge		
autocorrelation	0.9997	0.9598
st.dev	0.0001	0.0004

Source: See text

D. Results

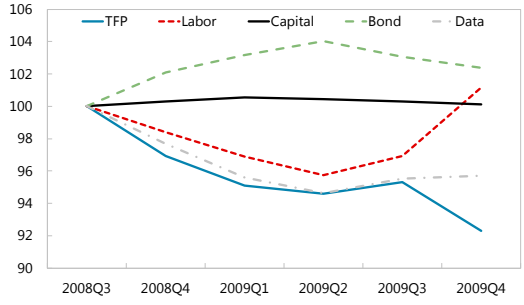
19. In his section we apply the calibrated and estimated parameters to recover values for the various wedges consistent with the data. We then infer the relative importance of the various wedges to output, employment and investment fluctuations.

20. *The simulations depict the counterfactual level* of GDP (investment or employment) in the case that only the specified wedge is as estimated, and all others wedges are constant at their steady state level. As explained before, wedges represent reduced-form representations of distortions in the intra and inter-temporal allocation of resources. A model with null-wedges would generate constant series in which each variable (GDP, investment, labor, and consumption) would be equal to its steady state level.

GDP decline and recovery

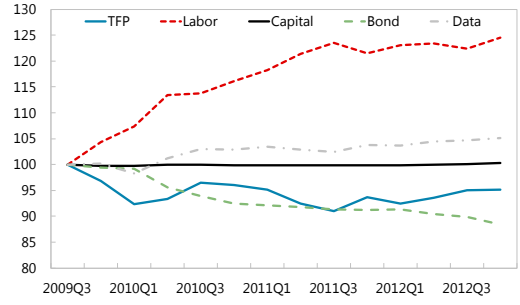
21. Labor and efficiency wedge were the two key drivers in the post-crisis GDP dynamics, however there are some important differences. In Chile the initial output drop was underpinned by a worsening in both the efficiency and labor wedge, while in Brazil only the efficiency wedge played a significant role. On the other hand, the recovery has been a balancing act between a relatively weak efficiency wedge, and steady improvement in the labor wedge. In Chile such balance resulted in steady GDP growth, while in Brazil the worsening of efficiency managed to cancel other gains. Another common characteristic is the relatively limited quantitative importance of the capital wedge.

Chile: Accounting for GDP Decline
(index, 2008Q3=100)



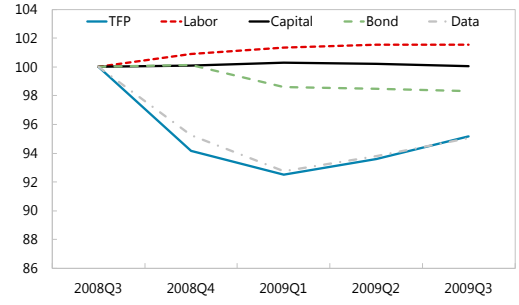
Sources: Author's calculations

Chile: Accounting for GDP Recovery
(index 2009Q3=100)



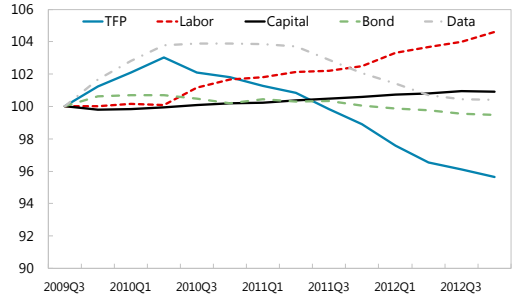
Sources: Author's calculations

Brazil: Accounting for GDP Decline
(index 2008Q3=100)



Sources: Author's calculations

Brazil: Accounting for GDP Recovery
(index 2009Q3=100)

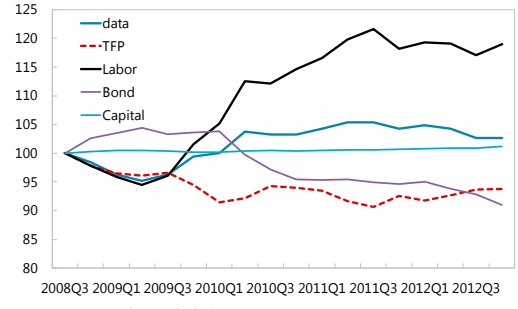


Sources: Author's estimation

Employment

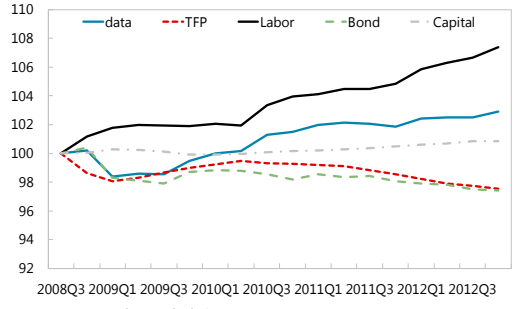
22. The results suggest that the observed strength in employment growth post-crisis was heavily driven by the improvement in the labor wedge. In Chile, if all other distortions were absent, the improvement in the labor wedge would have expanded employment by some 20 percent compared to its pre-crisis level. Such increase in Brazil would have been around 8 percent. However, the observed employment growth was weaker in both countries due in part to a relatively weak growth in TFP.

Chile: Employment and Wedges
(index 2008Q3=100)



Sources: Author's calculations

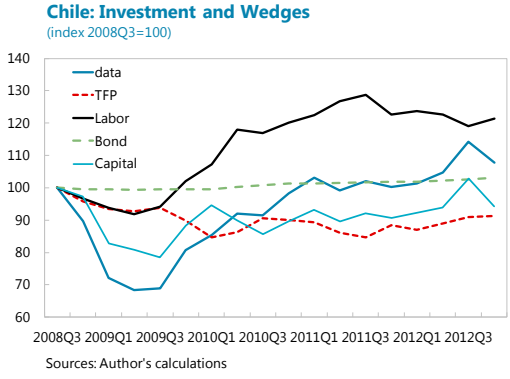
Brazil: Employment and Wedges
(index 2008Q3=100)

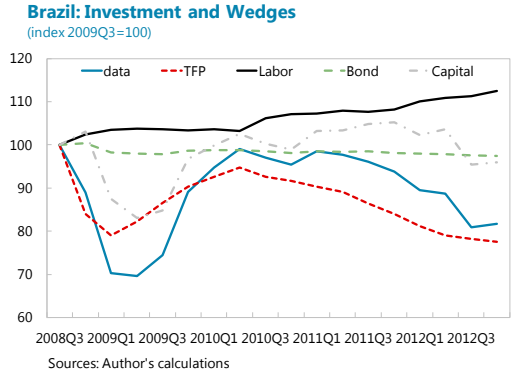


Sources: Author's calculations

Investment

23. The evolution of investment follows relatively closely the capital wedge. Naturally the evolution of investment would be affected by distortions in the inter-temporal allocation of resources. The simulations also suggest that the relatively weak performance of efficiency affected the investment decision. On the other hand, the labor wedge by itself would have generated an investment boom stronger than in the data.





E. Concluding Remarks

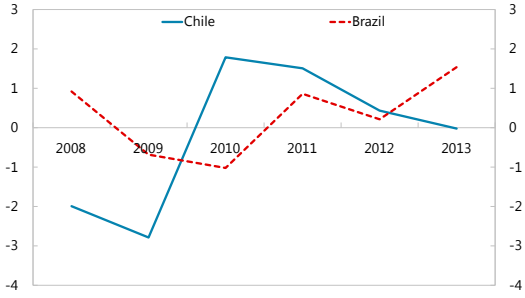
24. The analysis in this chapter confirmed the dominant role of labor and efficiency wedges, also found by recent papers. It also illustrated significant similarities and differences in the post-crisis dynamics in Brazil and Chile. This analysis suggests that to further understand the key factors including the effect of policies at play during the crisis and recovery, it would be important to look into mechanisms and models that would generate changes in TFP as well as in the wedge in the consumption-leisure decision

25. The steady improvement in the labor wedge clearly deserves more analysis and looks as a promising growth complement in the current context of global capital (liquidity) abundance and the onset of population ageing in the region. At the same time, the worsening in labor wedge at the time of the crisis in Chile is another attention-deserving feature as it could relate to the fact that some frictions might only be visible at times of downward stress. Further, the interdependence among wedges would also be an interesting topic for future research.

26. Studying the direct impact of policies would also be an important extension. A framework in which fiscal and/or monetary policy are allowed to interact with the basic dynamics presented here would allow identification of how much of the changes in the wedges can be mapped to agents reacting to different policies. Measured by the structural balance, the fiscal response was stronger and more front-loaded in Chile. In both countries the stimulus was withdrawn relatively quickly. Regarding related literature, Simonovska and Soderling (2008) and Chari, et al (2007) find no significant role for a government consumption wedge in a simple model. However, the role of fiscal policy merits further analysis in a richer setting (e.g. financially constrained agents; complementarities of public and private investment, etc). Also, prudent rule-

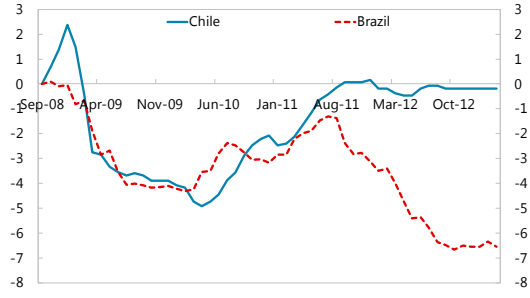
based fiscal behavior, as in Brazil and Chile, could be an important determinant of inter-temporal decisions such as investment which could be otherwise being measured in the investment wedge. Regarding monetary policy in Chile, it was first tightened–in the context of relatively high inflation- during September 08-January 09 and later on aggressively loosened; while Brazil had a smoother sequence of rate cuts. Also striking is the strong policy easing since late-2011 in Brazil, while in Chile the rate has been reverted to its pre-crisis level. Financial conditions could be affecting not only the investment wedge but also the labor wedge as explained.

Brazil and Chile: Fiscal Policy Respose
(change in structural balance, -=expansionary; in percent of GDP)



Sources: World Economic Outlook and Fund staff estimates

Brazil and Chile: Monetary Policy Response
(real policy rates; p.p. deviation from September 08)



Sources: Haver Analytics and Fund staff estimates

27. The wedges specification can also be enriched. In the framework presented in this chapter, the stochastic process governing the wedges is assumed constant throughout the sample period. However, it would be interesting to explore the role of higher uncertainty or other structural breaks during or after the crisis. Changes in expectations could be an important factor for what is here being measured in this chapter as efficiency and/or investment wedge.