A Solution to Fiscal Procyclicality: The Structural Budget Institutions Pioneered by Chile

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In June 2008, the President of Chile, Michelle Bachelet, had a low approval rating, for management of the economy in particular. There were undoubtedly multiple reasons for this, but a major reason was popular resentment that the government had resisted intense pressure to spend soaring receipts from copper exports. Copper is Chile's biggest export, and Chile is the world's biggest copper exporter. The world price of copper was at $800 per metric ton in 2008, a historical high in nominal terms and more than quadruple the level of 2001. Yet the government insisted on saving most of the proceeds.

One year later, in mid-2009, Bachelet attained the highest approval rating of any president since democracy had been reinstated in Chile, and she kept it through the remainder of her term (see figure 1).[1] Her finance minister, Andrés Velasco, also had the highest approval rating of any finance minister since the restoration of democracy. Why the change? It was certainly not an improvement in overall economic circumstances, given that the global recession had hit, causing copper prices to fall, growth to decline, and unemployment to rise. Rather, the government had

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1. The figure shows the approval ratings for four Chilean presidents from 1991 to 2009. For a chart that also includes the finance ministers, see Frankel (2011a, figure 2; also included in the NBER version).

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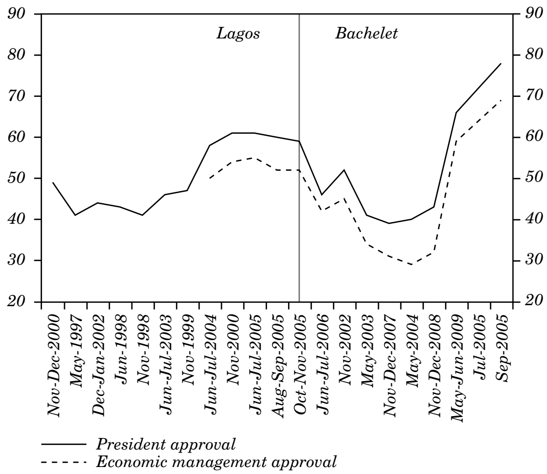
increased spending sharply, using the assets that it had acquired during the copper boom, and had thereby moderated the downturn. Saving for a rainy day made the officials heroes, now that the rainy day had come.

Figure 1: Approval of president and economic management under two Chilean adminstrations[a]



Source: Centro de Estudios Públicos, National Survey of Public opinion, october of 2009, www.cepchile.cl
a. Statistical significative difference between measurements of Aug-2009 and Oct-2009.

Thus, Chile has over the last decade achieved what few commodity-producing developing countries had managed previously: a truly countercyclical fiscal policy. It is not the only country to have made progress in this direction in recent years[2], Chile is a particularly striking case, however. It has beaten the curse of procyclicality via the innovation of a set of fiscal institutions that are designed to have a good chance of working even in a world where politicians and voters are fallible human beings rather than angels.

The proposition that institutions make a big difference, that a country is less likely to establish good policies in the absence of

2. Frankel, Végh, and Vuletin (2011) show that during the decade 2000–09, roughly one-third of developing countries escaped from the pattern of fiscal procyclicality.

good institutions, has popped up everywhere in economics of late.[3] What is sometimes missing, however, is examples of very specific institutions that countries might wisely adopt. These should be institutions that are neither so loose that their constraints do not bind nor so rigid that they have to be abandoned subsequently in light of circumstances.

Although specifics differ from country to country, there is no reason why a version of Chile's institutions cannot be emulated by other commodity-producing developing countries.[4] Even advanced countries and noncommodity producers, for that matter, could take a page from the Chilean book. Proper budget discipline is never easy, and commodity cycles are but one kind of cyclicality that such institutions could address.

1. Chile's Fiscal Institutions

Looking at the budget balance in structural or cyclically adjusted terms is an old idea.[5] Chile's structural budget regime is somewhat more complex. Chile's fiscal policy is governed by a set of rules. The first rule is that the government must set a budget target. The target was originally set at a surplus of 1 percent of GDP, for three reasons: to recapitalize the central bank, which inherited a negative net worth from bailing out the private banking system in the 1980s and sterilizing inflows in the 1990s; to fund some pension-related and other liabilities; and to service net external dollar debt.[6] The target was subsequently lowered to 0.5 percent of GDP in 2007 and again to 0 percent in 2009, as it was determined that the debt had

3. In the case of fiscal policy, the importance of institutions is emphasized by Buchanan (1967), von Hagen and Harden (1995), Alesina and Perotti (1995, 1996), Poterba (1997), Poterba and von Hagen (1999), Persson and Tabellini (2004), Wyplosz (2005), Calderón and Schmidt-Hebbel (2008), and Calderón, Duncan, and Schmidt-Hebbel (2010). For commodity producers more specifically, see Davis and others (2001, 2003) and Ossowski and others (2008), among others. For Latin America, see Alesina and others (1999), Stein, Talvi, and Grisanti (1999), and Perry (2003), among others.

4. The structural budget regime is one of many innovative reforms that Chile has adopted over the last few decades, many of which have been successful and are potentially worthy of emulation. See Corbo and Fischer (1994), Edwards and Cox-Edwards (1991, 2000), Ffrench-Davis (2010), and Velasco (1994) for details.

5. The swing in Chile's budget from surplus in the boom year of 1989 to deficit in the recession year of 1999, for example, was determined to be all cyclical rather than structural (Marcel and others, 2001, p. 18).

6. Rodríguez, Tokman, and Vega (2007, p.5, 21).

been essentially paid off and that a structurally balanced budget was economically appropriate.[7]

A budget target of zero may sound like the budget deficit ceilings that supposedly constrain members of the euro area (which agreed to deficits of 3 percent of GDP under the Stability and Growth Pact, or SGP) or like U.S. proposals for a balanced budget amendment (zero deficit). But those attempts have failed, in part because they are too rigid to allow for deficits in recessions, counterbalanced by surpluses in good times.

Tougher constraints on fiscal policy do not always increase effective budget discipline. Countries often violate their constraints. In an extreme setup, a rule that is too rigid—so rigid that official claims that it will be sustained are not credible—might even lead to looser fiscal outcomes than if a more moderate and flexible rule had been specified at the outset.[8]

Euro countries large and small have repeatedly violated the fiscal rules of the SGP, which was originally envisioned as a simple ceiling on the budget deficit of 3 percent of GDP. The main idea for enforcing the SGP is that a government that is unable to reduce its budget deficit to the target has to pay a substantial fine. This, of course, just adds to the budget deficit. Thus, the enforcement mechanism does not much help the credibility of the rule.[9]

Credibility can be a problem for budget institutions either with or without uncertainty regarding the future path of the economy. Consider first the nonstochastic case. Even if the future unfolds as expected when the rule was formulated, the target may be up against predictably irresistible political pressures. Common examples are provisions for special fiscal institutions that may have been formulated to please the World Bank or the International Monetary Institute (IMF), but without local elites "taking ownership" of the reforms, let alone winning public support for them. Such institutions,

7. A team of three economists appointed by Velasco in 2007 recommended reducing the structural budget target: Engel, Marcel, and Meller (2007). See Velasco and others (2007), Velasco and others (2010), and Eduardo Olivares C., "Las opciones que Hacienda tuvo para flexibilizar la regla," El Mercurio, 24 May 2007.

8. Neut and Velasco (2003).

9. An analogous example outside the realm of macroeconomic policy is the idea that the Kyoto Protocol on Global Climate Change would be enforced by a provision requiring countries that exceeded their allocation of greenhouse gas emissions in one period to cut emissions even further below target in the subsequent period—a penalty with interest. One might as well tell people on a diet plan that if they fail to lose five pounds in the first week, then they have to lose ten pounds in the second week.

which include fiscal rules and fiscal responsibility legislation, are often abandoned before long.[10]

The case of rules that are too onerous to last arises particularly in the stochastic context. A target that might have been reasonable ex ante, such as an unconditionally balanced budget, becomes unreasonable after an unexpected shock, such as a severe fall in export prices or national output. Common examples are rigid balanced budget rules that do not allow the possibility of fiscal deficits in bad times.

A sensible alternative is to specify rules that mandate changes in response to changed circumstances. In particular, instead of targeting an actual budget balance of zero or some other numerical surplus, the rule can target a number for the structural budget.

This alternative may not work, however, if the political process determines whether a deficit is or is not structural. Politicians can always attribute a budget deficit to unexpectedly and temporarily poor economic growth. Since there is no way of proving what an unbiased forecast of growth is, there is no way of disproving the politicians' claim that the shortfall is not their responsibility.

Copper accounts for approximately 16 percent of Chile's fiscal income: about 10 percent from the revenues of CODELCO, which is owned by the government, and the rest in tax revenue from private mining companies.[11] That the figure is only 16 percent illustrates that Chile's use of copper exports has not prevented it from achieving a diversified economy. Nevertheless, the number understates the sensitivity of the budget to copper prices. Copper profits are highly volatile, much more volatile even than copper prices. Furthermore, the mining industry tends to have a multiplier effect on the rest of GDP. Madrid-Aris and Villena (2005) argue that copper prices drive the Chilean economy.[12] Other mineral and agricultural commodities

10. In their econometric analysis of these special financial institutions for oil-producers, Ossowski and others (2008, pp. 19, 23, 24, 38–43) find no statistically significant effect on the actual fiscal stance. This may be partly due to econometric limitations, but it is evidently also due to governments that, after having adopted these institutions, subsequently find them too rigid in practice and so weaken or abandon them. Recent examples include Ecuador, Equatorial Guinea, and Venezuela (Ossowski and others, 2008, pp. 12–13, 19, 24). See also Villafuerte, López-Murphy, and Ossowski (in this volume).

11. Rodríguez, Tokman, and Vega (2007, p. 8).

12. Their econometrics consists in cointegration tests, and their theory is essentially classic Dutch disease: an increase in copper prices is transmitted to the nontradables sector via appreciation of the currency.

are also important, but their prices on world markets are to some extent correlated with copper.[13]

The central rule that makes up Chile's structural balance regime is that the government can run a deficit larger than the target to the extent that output falls short of its long-run trend, in a recession, or that the price of copper is below its medium-term (ten-year) equilibrium. The key institutional innovation is that there are two panels of experts whose job it is each mid-year to make the judgments, respectively, on what is the medium-term trend of output and what is the medium-term equilibrium price of copper. The experts on the copper panel are drawn from mining companies, the financial sector, research centers, and local universities. The government then follows a set of procedures that translates these numbers, combined with any given set of tax and spending parameters, into the estimated structural budget balance. If the resulting estimated structural budget balance differs from the target, then the government adjusts spending plans until the desired balance is achieved.

The structural budget policy showed clear benefits by 2006. Between 2000 and 2005, public savings rose from 2.5 to 7.9 percent of GDP (allowing national saving to rise from 20.6 to 23.6 percent).[14] As a result, central government debt fell sharply as a share of GDP, and the sovereign spread gradually declined.[15] By December 2006, Chile had achieved a sovereign debt rating of A, several notches ahead of Mexico, Brazil, and other Latin American peers.[16] Chile had become a net creditor by 2007. By June 2010, its sovereign rating had climbed to A+, ahead of some advanced countries, such as Israel and Korea (A), Iceland (BBB–), and Greece (BB+).

The announcement of the structural surplus rule in itself appears to have improved Chile's creditworthiness in 2000, even before it had had time to operate.[17] Even this early, better access

13. Nitrates were the important export before World War I. Fruit and wine have gained importance in recent years. Larraín, Sachs, and Warner (2000) discuss the reasons for Chile's heavy structural dependence on commodity exports, which they view as negative for long-term growth. The reasons include not just natural endowments, but also a small internal market and geographic remoteness, which necessitate exports that have a high ratio of value added to transport cost.

14. Rodríguez, Tokman, and Vega (2007, p. 27).

15. Rodríguez, Tokman, and Vega (2007, p. 29–30).

16. Standard and Poor's ratings, obtained from Bloomberg.

17. Lefort (2006) empirically substantiates that the structural balance rule made a significant contribution in reducing the country risk margin beyond the effect of lower public indebtedness. Rodríguez, Tokman, and Vega (2007, p. 30) report a turnaround in Chile's sovereign spread from the date of the announcement in early 2000. Perry (2003, pp. 13–14) also sees an immediate credibility effect.

to foreign capital may have helped the country to weather the 2001–02 crisis more easily than the crisis of 1982–83.[18] Public spending fluctuated much less than in past decades and less than income, helping to stabilize the business cycle.[19] According to one estimate, the structural balance policy allowed a reduction in GDP volatility of one-third in 2001–05.[20] Another study goes so far as to claim that the policy can all but eliminate the effects of copper price fluctuations on the real economy.[21]

The real test of the policy came during the latter years of the copper boom of 2003–08 when, as usual, there was political pressure to declare the increase in the copper price permanent and to thereby justify spending on a par with export earnings. The expert panel ruled that most of the price increase was temporary, so that most of the earnings had to be saved. This turned out to be right, as the 2008 spike was partly reversed the next year. As a result, the fiscal surplus reached almost 9 percent when copper prices were high. The country paid down its debt to a mere 4 percent of GDP, and it saved about 12 percent of GDP in the sovereign wealth fund. This allowed a substantial fiscal easing in the recession of 2008–09, when the stimulus was most sorely needed.

Part of the credit for Chile's structural budget rule should go to the government of President Ricardo Lagos (2000–06) and Finance Minister Nicolás Eyzaguirre, who initiated the structural budget criterion and the panels of experts.[22] In this first phase, however, the budget rule was a policy initiated and followed voluntarily by the government, rather than a matter of legal or other constraint.[23] The structural budget rule became a true institution under the Bachelet government (2006–10), which enshrined the general framework in law. It introduced a Fiscal Responsibility Bill in 2006, which gave

18. Rodríguez, Tokman, and Vega (2007, p. 32) shows that the external shocks in 1982 were a recession in advanced countries and the international debt crisis. The external shocks in 2001 were another (admittedly milder) U.S. recession and a debt crisis next door in Argentina.

19. Rodríguez, Tokman, and Vega (2007, pp. 33–34).

20. Larraín and Parro (2008).

21. Medina and Soto (2007) find in a dynamic stochastic general equilibrium (DSGE) model that the fiscal regime is capable of reducing the effect on Chile's GDP of a 10 percent exogenous increase in the copper price from 0.70 percent to 0.05 percent.

22. IMF (2005, p. 11). Some credit should also go to earlier governments for establishing the Copper Stabilization Fund in the 1980s, which stipulated that copper revenue above a certain price was to be saved, and for sticking with the rule when the price rose later.

23. Aninat and others (2006, pp. 8, 54); Rodríguez, Tokman, and Vega (2007, p. 5).

legal force to the role of the structural budget.[24] Moreover, it abided by the law—and in fact took extra steps to make sure the copper bonanza was saved—when it was most difficult to do so politically. The public approbation received by the Bachelet government in the polls by the end of its term in office was in this sense well-earned.

The advice to save in a boom is standard, and there are other examples of governments that have had the courage to take away the fiscal punch bowl. What makes Chile's institutions particularly worthy of study is that they may constitute a template that other countries can adopt, a model that can help even in times and places where the political forces to follow procyclical fiscal policy would otherwise be too strong to resist.

Section 2 highlights economic volatility among countries that are dependent on exports of mineral and agricultural products. Section 3 focuses on procyclical fiscal policy among commodity producers. I then turn to the role played by systematic bias in official budget forecasts in other countries and how Chile has avoided it.

2. Volatility Among Commodity Exporters

Developing economies generally tend to be more volatile than advanced economies. The volatility arises, in part, from foreign shocks, such as fluctuations in the prices of exports on world markets. The mineral and agricultural commodities produced by Latin American countries tend to be characterized by particularly large price fluctuations, as shown in table 1.[25] Volatility also arises from domestic macroeconomic and political instability.[26] Although most developing countries brought their chronic runaway budget deficits, money creation, and inflation under control in the 1990s, a majority are still subject to monetary and fiscal policy that is procyclical rather than countercyclical: they tend to be expansionary

24. The bill, Law No. 20,128, was proposed by the government in September 2005 and approved by Congress to enter into effect in August 2006. Among other things, it also created a Pension Reserve Fund and a Economic and Social Stabilization Fund, the latter a replacement for the existing Copper Stabilization Funds that dated from 1981, and specified norms for how the funds should be invested.

25. Some authors suggest that the volatility of natural resource prices is, in itself, bad for economic growth, that it is the source of the so-called natural resource curse. See Blattman, Hwang, and Williamson (2007), Hausmann and Rigobon (2003), and Poelhekke and van der Ploeg (2007).

26. Perry (2009) decomposes the extra growth volatility of commodity producers.

in booms and contractionary in recessions, thereby exacerbating the magnitudes of the swings. The aim should be to moderate the cyclical fluctuations—that is, to achieve the countercyclical pattern that the models and textbooks of the decades following the Great Depression originally hoped discretionary policy would take.

Table 1. Price Volatility of Leading Commodity Exports in Latin American and Caribbean Countries, 1970–2008

Country	*Leading commodity export*[a]	*Std. dev. of log of dollar price*
Argentina	Soybeans	0.2781
Bolivia	Natural Gas	1.8163
Brazil	Steel	0.5900
Chile	Copper	0.4077
Colombia	Oil	0.7594
Costa Rica	Bananas	0.4416
Ecuador	Oil	0.7594
El Salvador	Coffee	0.4792
Guatemala	Coffee	0.4792
Guyana	Sugar	0.4749
Honduras	Coffee	0.4792
Jamaica	Aluminum	0.4176
Mexico	Oil	0.7594
Nicaragua	Coffee	0.4792
Panama	Bananas	0.4416
Peru	Copper	0.4077
Paraguay	Beef	0.2298
Trinidad and Tobago	Natural Gas	1.8163
Uruguay	Beef	0.2298
Venezuela	Oil	0.7594

Source: Global Financial Data.
a. According to World Bank analysis, as of 2007.

That developing countries tend to experience larger cyclical fluctuations than industrialized countries is only partly attributable to commodities. It is also due to the role of factors that should moderate the cycle, but in practice seldom operate that way: procyclical capital flows, procyclical monetary and fiscal policy, and the related Dutch disease. If anything, these factors tend to exacerbate booms and busts instead of moderating them. The hope that improved policies or institutions might reduce this procyclicality makes this one of the most potentially fruitful avenues of research in emerging market macroeconomics.

2.1 The Procyclicality of Capital Flows to Developing Countries

According to the theory of intertemporal optimization, countries should borrow during temporary downturns to sustain consumption and investment, and they should repay that debt or accumulate net foreign assets during temporary upturns. In practice, it does not always work this way. Capital flows are more often procyclical than countercyclical.[27] Most theories to explain this involve imperfections in capital markets, such as asymmetric information or the need for collateral. In the commodity and emerging market boom of 2003–08, net capital flows typically went to countries with trade surpluses, especially Asian economies and commodity producers in the Middle East and Latin America, where they showed up in record accumulation of foreign exchange reserves. This was in contrast to the two previous cycles, 1975–81 and 1990–97, when the capital flows to developing countries largely went to finance current account deficits.

One interpretation of procyclical capital flows is that they result from procyclical fiscal policy: when governments increase spending during booms, some of the deficit is financed by borrowing from abroad; when they are forced to cut spending in downturns, it is to repay some of the excessive debt that they incurred during the upturn. Another interpretation of procyclical capital flows to developing countries is that they pertain especially to exporters of agricultural and mineral commodities, particularly oil. The next subsection consider procyclical fiscal policy.

2.2 The Procyclicality of Fiscal Policy

Many authors document the tendency for fiscal policy to be procyclical in developing countries, especially in comparison with

27. Kaminsky, Reinhart, and Végh (2005); Reinhart and Reinhart (2009); Gavin and others (1996); and Mendoza and Terrones (2008). Caballero (2002) and Gallego, Hernández, and Schmidt-Hebbel (2002) examine procyclical capital flows in Chile, in particular.

industrialized countries.[28] Most studies look at the procyclicality of government spending. An important reason for procyclical spending is precisely that government receipts from taxes or royalties rise in booms, and the government cannot resist the temptation or political pressure to increase spending proportionately or more than proportionately.

Procyclicality is especially pronounced in countries that possess natural resources and where income from those resources tends to dominate the business cycle. Among those focusing on the correlation between commodity booms and spending booms is Cuddington (1989). Sinnott (2009) finds that Latin American countries are sufficiently commodity dependent that government revenue responds significantly to commodity prices. Arezki and Brückner (2010a) find that commodity price booms lead to increased government spending, external debt, and default risk in autocracies, but do not have those effects in democracies.[29]

Two large budget items that account for much of the increased spending from commodity booms are investment projects and the government wage bill. Regarding the first budget item, investment in infrastructure can have a large long-term payoff if it is well designed; too often in practice, however, it takes the form of white elephant projects, which are stranded without funds for completion or maintenance when the commodity price goes back down (Gelb, 1986). Regarding the second budget item, Medas and Zakharova (2009) point out that oil windfalls have often been spent on higher public sector wages. The revenue can also go to increasing the number of workers employed by the government. Either way, it raises the total public sector wage bill, which is hard to reverse when oil prices go back down.[30]

Cross-country evidence is harder to come by on the tax side than on the spending side, because tax receipts are particularly endogenous with respect to the business cycle. But one can find a procylical pattern there, as well, by focusing on tax rates rather than revenues.[31]

28. For example, Cuddington (1989), Tornell and Lane (1999), Kaminsky, Reinhart, and Végh (2005), Talvi and Végh (2005), Alesina, Campante and Tabellini (2008), Mendoza and Oviedo (2006), Ilzetzki and Végh (2008), and Medas and Zakharova (2009). For Latin America in particular, see Gavin and Perotti (1997), Calderón and Schmidt-Hebbel (2003), and Perry (2003).

29. Arezki and Brückner (2010b) find that the dichotomy extends to the effects on sovereign bond spreads paid by autocratic versus democratic commodity producers.

30. Arezki and Ismail (2010) find that current government spending increases in boom times, but is downward sticky.

31. Végh and Vuletin (2011) find evidence that tax rate policy has been mostly procyclical in developing countries, and acyclical in industrialized countries.

3. The Problem of Procyclical Fiscal Policy among Mineral Exporters

The Hartwick rule says that rents from a depletable resource should be saved, on average, against the day when deposits run out.[32] At the same time, traditional textbook macroeconomics says that government budgets should be countercyclical, running surpluses in booms and spending in recessions. Mineral producers tend to fail in both these principles: they save too little on average and all the more so in booms. Thus one of the most important ways to cope with the commodity cycle is to create institutions to ensure that export earnings are put aside in a commodity saving fund during the boom time, perhaps with the aid of rules governing the cyclically adjusted budget surplus.[33]

In general, one would expect that the commitment to fiscal constraints would produce more transparent and disciplined budgets. Alesina and others (1999), Stein, Talvi, and Grisanti (1999), and Marcel and others (2001) find that Latin American countries attained better fiscal discipline in the 1980s and early 1990s if their institutions were more hierarchical and transparent, judged by the existence of constraints and voting rules.

3.1 Mineral Cycles and the Budget

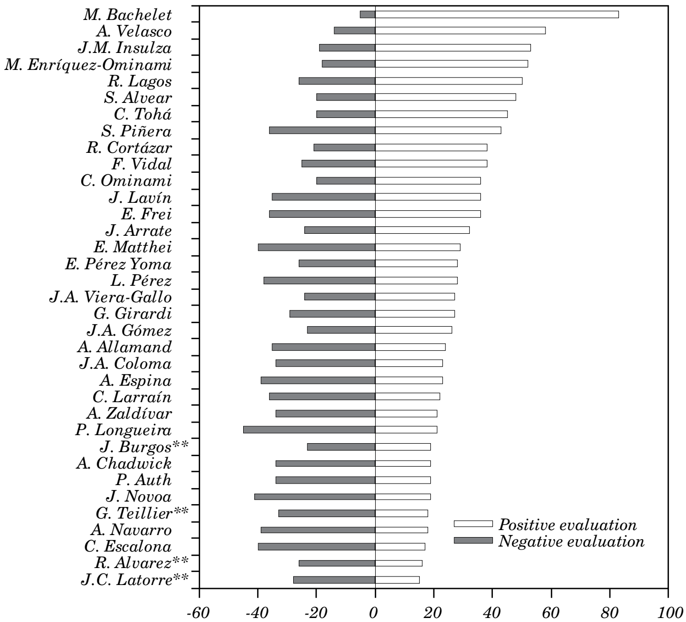
The tendency to undersave mineral wealth is particularly pronounced during booms.[34] The temptation to spend the windfall from high world prices is sometimes irresistible. When the price of the mineral eventually goes back down, countries are often left with high debt, a swollen government sector and nontradable goods sector, and a hollowed out nonmineral tradable goods sector. They may then be forced to cut back on government spending, completing the perverse cycle of countercyclical saving. This may occur if the political process overrides sober judgments, so that spending responds to booms more than intertemporal optimization would dictate. It could also reflect an error in perceptions: forecasters extrapolate a high world price

32. More precisely, the Hartwick rule says that all rents from exhaustible natural resources should be invested in reproducible capital, so that future generations do not suffer a diminution in total wealth (natural resource plus reproducible capital) and therefore in the flow of consumption (Hartwick, 1977; Solow, 1986).

33. Davis and others (2001, 2003).

34. They may also undersave on average, of course. Few countries follow the Hartwick rule, in practice.

Figure 2. Evaluation of Political Figures in 2009, including the President of Republic and his Cabinet



Source: Centro de Estudios Públicos, National Survey of Public opinion, october of 2009, www.cepchile.cl
Note. To surveyed people is readed a closed list of individuals to be evaluated. A positive or negative evaluation is measured for those who have an opinion ('not answered' or 'unknown individual' categories are eliminated).

today, during the boom, far into the future, whereas in reality the real price will eventually return to some long-run equilibrium.

The example of copper prices in Chile illustrates how important commodity price movements can be to the task of forecasting the budget. There are several ways to measure the benchmark relative to which the ex post spot price of copper is observed. One is the forward or futures price of copper observed the preceding year. Figure 2 plots the official budget forecast error (one year ahead) against the copper price relative to the previous August's forward price. There is clearly a strong relationship.[35] Table 2 reports the corresponding regression.

35. An appendix in Frankel (2011a) explains the data sources. Figure 7a in that paper uses the ten-year average of the spot price of copper, rather than the future rate used in figure 5 in this work, as the benchmark for measuring short-term movements. The data then go back to 1977. Again, copper price movements are correlated with fluctuations in the budget balance.

The copper price is statistically significant and dominates movement in the budget to such an extent that GDP is not significant alongside it. Presumably this reflects not just the important role of copper royalties in Chile's budget revenues, but also the big influence of copper prices on the rest of the economy.

The bottom line is that anyone who wishes to make unbiased forecasts of next year's budget in Chile needs to be able to make unbiased forecasts of next year's copper price. The next sections therefore addresses the question of the copper price's time series behavior.

Table 2. Short-Term Determinants of Chile's Budget Deficit[a]

Explanatory variable	*(1)*	*(2)*
Copper price movement	0.060**	0.056**
	(0.021)	(0.021)
GDP movement	0.239	
	(0.187)	
Constant	0.023	0.163
	(0.754)	(0.683)
Summary statistic		
No. observations	20	20
R^2	0.299	0.251
Root mean square error	2.655	2.666

Source: Author's calculations.
** Statistically significant at the 5 percent level.
a. The dependent variable is the budget balance (ex post budget relative to forecast); the explanatory variables are also ex post relative to forecast. The copper price movement is here measured as 100 [log(average of end of month price, Jan.–Dec., of the next year) – log(August 15 – month forward price)]. The sample period is 1990–2009. Robust standard errors are in parentheses.

3.2 Reasons for Overshooting in Mineral Prices

Conceptually, there are three different reasons why mineral prices may follow a cyclical or mean-reverting process. They are based, respectively, in mineral microeconomics, in monetary economics, and in speculative bubbles. The relative importance of the three makes no difference for the purposes of this paper.

First, it is not hard for a microeconomist to understand why the market price of minerals overshoots in the short run or even the medium run. Because elasticities of supply and demand with respect to price are low, relatively small fluctuations in demand (due, for example, to weather) or in supply (due, for example, to disruptions) require a large change in price to re-equilibrate supply and demand. Demand elasticities are low in the short run largely because the capital stock at any point in time is designed physically to operate with a particular ratio of mineral inputs to output, with little scope for substitution. Supply elasticities are also often low in the short run because it takes time to open new mines or otherwise adjust output. Inventories can cushion the short run impact of fluctuations, but they are limited in size. Scope to substitute across materials is also limited. As time passes, elasticities become far higher on both the demand side and the supply side, so prices come back down in the aftermath of a spike. In the medium term, mineral prices may be subject to a cobweb cycle, due to the lags in response: the initial market equilibrium is a high price; the high price cuts demand after some years, which in turn leads to a new low price, which raises demand with a lag, and so on.

The second possible explanation for a cycle in mineral prices is monetary overshooting.[36] The Hotelling (1931) theory of nonrenewable resources says that the decision of whether to leave deposits in the ground or to extract and sell them at today's price should be governed by an arbitrage condition between the interest rate, on the one hand, and the expected future rate of increase in the mineral price, on the other. The expected future rate of price increase, in turn, should be related to any perceptions that today's price is below its long-run equilibrium price. A similar arbitrage condition holds with respect to the decision of whether to hold inventories or sell them, but storage costs are added to the interest rate on the carrying-cost side of the ledger, while convenience yield is added to expected future appreciation on the benefits side. The key implication is an inverse relationship between real interest rates and real commodity prices. If the real interest rate is high, it undercuts the incentive to hold minerals underground or in inventories. The result is a fall in demand or rise in supply, which drives down the spot price of the mineral. The market is in short-run equilibrium when the mineral is sufficiently undervalued (relative to its long-run equilibrium) that a general perception of future price increases is sufficient to offset the higher real interest rate, thereby restoring the arbitrage condition.

36. Frankel (1986, 2008b).

That much is Hotelling. Monetary cycles can be inserted into the process. A currently high real interest rate can be the result of transitorily tight monetary policy. In the medium run, the real interest rate tends to return to its medium-run equilibrium; as a result, the real commodity price also returns to its equilibrium. According to this view, low real interest rates in the 1970s and 2000s led to high global real prices for oil and minerals, while high real interest rates in the 1980s and 1990s led to low real prices for oil and minerals.

The third possible explanation for mean reversion is speculative bubbles, defined as a self-confirming or bandwagon process that carries the commodity price away from its fundamentals. Speculators know that the bubble might pop and the price return to its fundamental value. But they weigh the probability, in each given month that the bubble will end (so that they will have lost money if they stay in the market) against the probability that it will continue another month (so that they will have lost money if they got out of the market). Theory does not have much to say about when or under what conditions bubbles get started or stop, but they usually start on the back of a trend that originated in fundamentals, whether microeconomic (as in the first theory above) or monetary (as in the second).

3.3 Evidence of Reversion to Long-Run Equilibrium in Real Copper Prices

Is a high mineral price statistically likely to be followed eventually by a reversion to the long-run mean? Cuddington and Jerrett (2008) find three “super cycles” in the prices of copper and four other metals over the 150 years from 1850 to 2000, followed by the beginnings of a fourth super cycle. The tendency for commodity prices to revert from historic highs back to their long-run equilibrium is too weak to show up statistically in a few decades of data. This is true even though the tendency to revert may be strong enough to wreck national economies, implausible as that juxtaposition may sound. Statistically, one needs a lot of data to reject a random walk (or to establish a permanent trend). There is not enough power in tests on time series of prices that are only a few decades long.

This proposition can be illustrated with either empirical evidence or a priori theory. Assume an AR(1) process. Table 3 regresses the change in the real copper price against its lagged value, both with and without a trend. In a deliberate attempt to mimic many other studies, the data in table 3 cover only 30 years, starting in 1980. The real price of copper

Table 3. Test for Mean Reversion in the Copper Price, 1980–2009[a]

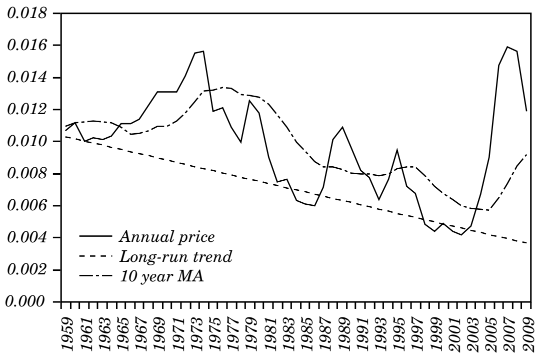
A. With trend	*Test statistic*	*1% C.V.*	*5% C.V.*	*10% C.V.*
$Z(t)$	−1.512	−4.334	−3.580	−3.228
MacKinnon approximate p value for $Z(t) = 0.017$				
Change in log of real copper price	*Coefficient*	*Std. error*	*t statistic*	$p > \|t\|$
Lagged real copper price	−0.1484	0.0981	−1.51	0.142
Trend	0.0058	0.0042	1.38	0.179
Constant	−0.8077	0.4790	−1.69	0.103

B. Without trend	*Test statistic*	*1% C.V.*	*5% C.V.*	*10% C.V.*
$Z(t)$	−1.576	−3.716	−2.986	−2.624
MacKinnon approximate p value for $Z(t) = 0.287$				
Change in log of real copper price	*Coefficient*	*Std. error*	*t statistic*	$p > \|t\|$
Lagged log of real copper price	−0.1569	0.0995	−1.58	0.126
Constant	−0.7651	0.4857	−1.58	0.126

Source: Author’s calculations.
a. All the regressions in this table are based on 30 observations.

for this period is illustrated in figure 3. The estimated trend is positive, but not significant, when the sample ends in 2009.[37] More importantly for present purposes, the coefficient on the lagged real price of copper is negative but not significant. (Dickey-Fuller critical levels require a test statistic of 3.6 to give significance at the 5 percent level, or about 3.0 to give significance at the 10 percent level.) Putting the significance question aside momentarily, the point estimate is about –0.1 when the process is estimated without a trend, suggesting that about 10 percent of the gap between the real price of copper and its long-run average is closed each year in the absence of new disturbances.

Figure 3. Real Copper Price
(M US$ per metric ton)



Sources: , Historical Statistics of the United States, US Bureau of Labor Statistics y Bloomberg.

Why is the reversion parameter not significant? Economists often observe such a failure to reject the null hypothesis of a random walk and then jump to language implying that the variable in question actually follows a random walk. The two propositions are different, however, as any introductory statistics student is taught.

37. Some authors find a small upward trend in mineral prices, some a small downward trend. The answer seems to depend, more than anything else, on the date for the end of the sample. Studies written after the commodity price increases of the 1970s find an upward trend, but those written after the 1980s find a downward trend, even when both kinds of studies went back to the early twentieth century. No doubt, when studies using data through 2008 are completed, some will again find a positive long-run trend. References include Cuddington (1992), Cuddington, Ludema, and Jayasuriya (2007), Cuddington and Urzúa (1989), Grilli and Yang (1988), Pindyck (1999), Hadass and Williamson (2003), Reinhart and Wickham (1994), Kellard and Wohar (2005), Balagtas and Holt (2009), and Harvey and others (2010).

Imagine that the true speed of adjustment is indeed 0.1. In other words, the autoregressive coefficient for the real copper price is 0.9. A simple calculation can illustrate why one would not expect 30 or 40 years of data to give enough statistical power to reject a unit root (random walk) even if none were there. The asymptotic standard error of an estimate of an autoregressive coefficient ρ is approximately the square root of $(1-\rho^2)/N$. So the t statistic to test the null hypothesis that $\rho = 1$ is

$$t = \frac{1-\rho}{\left(\frac{1-\rho^2}{N}\right)^{\frac{1}{2}}}.$$

If the true speed of adjustment is on the order of 10 per cent per year ($\rho = 0.9$), the number of years of data needed to have enough power to reject the null hypothesis ($t > 3$) can be computed as

$$t = \frac{1-\rho}{\left(\frac{1-\rho^2}{N}\right)^{\frac{1}{2}}} > 3;$$

$$N > \left(\frac{3}{1-0.9}\right)^2 (1-0.9^2) = 171.$$

In other words, one should expect to require something like 171 years of data in order to be able to reject the null hypothesis of a unit root.[38] If one only has 30 years of data, it would be surprising if one succeeded in rejecting $\rho = 1$. It would be analogous to Gregor Mendel's famous experiments with peas, where the results matched the theoretical predictions of gene theory so perfectly that Fisher (1936) later argued on probabilistic grounds that he must have cheated.

38. Because the formula for the standard error is asymptotic, one should perhaps not take this calculation too literally. However, the implication that one needs something like 200 years of data to reject a random walk can be further supported in several ways, including more elaborate a priori calculations, trying the test out on varying time samples of actual data, and Monte Carlo studies. These points regarding random walk test power were made some years ago in the context of real exchange rates.

Table 4. Test for Mean Reversion in Copper Price, 1784–2009[a]

A. With trend	*Test statistic*	*1% C.V.*	*5% C.V.*	*10% C.V.*
$Z(t)$	–3.799	–4.001	–3.434	–3.134
MacKinnon approximate *p value* for $Z(t)$ = 0.017.				
Change in log of real copper price	*Coefficient*	*Std. error*	*t statistic*	$p > \|t\|$
Lagged real copper price	–0.1284	0.0338	–3.80	0.000
Trend	–0.0010	0.0003	–3.20	0.002
Constant	–0.4228	0.1117	–3.78	0.000
B. Without trend	*Test statistic*	*1% C.V.*	*5% C.V.*	*10% C.V.*
$Z(t)$	–2.000	–3.471	–2.882	–2.572
MacKinnon approximate *p* value for $Z(t)$ = 0.287.				
Change in log of real copper price	*Coefficient*	*Std. error*	*t statistic*	$p > \|t\|$
Lagged log of real copper price	–0.0357	0.0178	–2.00	0.047
Constant	–0.1523	0.0748	–2.04	0.043

Source: Author's calculations.
a. All the regressions in this table are based on 217 observations.

Fortunately, for a commodity such as copper, it is easy to get data going back two centuries and more. Table 4 repeats the same statistical tests with over 200 years of data, starting in 1784.[39] The coefficient on the lagged real copper price is now statistically significant, showing an estimated tendency to revert to equilibrium at a speed of 0.13 per year. The autoregressive coefficient is less than one, not just at the 10 percent level of statistical significance, but also at the 5 percent level. Just as the a priori calculation suggested, mean reversion is there, but one needs two centuries of data to see it.

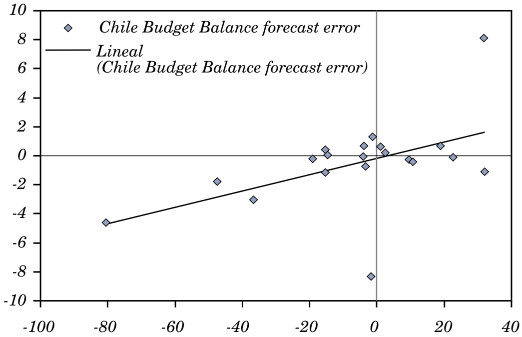
3.4 Private Forecasts of Copper Prices

Do copper price forecasters internalize the long-term data, which imply that a large increase in the current spot price of copper is likely to be partially reversed in the future? Or do they subscribe to the random walk hypothesis, consistent with shorter time samples? I use the futures markets to measure private forecasts, although there is only a decade of data. As illustrated in figure 4, when the spot price of copper rises, the forward price rises less than proportionately, implying a forecast of a possible future reversal. The graph also shows the official Chilean estimate of the long-run copper price produced by the expert panel. It rose even less than the forward price during the spike of 2006–08, behaving much like the ten-year moving average, as it is supposed to do. The panel, like the private markets, does appear to internalize the tendency of the price to revert toward its long-run trend.

Table 5 formally tests the hypothesis that private forecasters—to the extent that their monthly expectations are reflected in the forward market—believe in mean reversion in the real price of copper. The dependent variable is the expected future rate of change in the real copper price, with expectations measured by the forward rate at a monthly frequency. At all three horizons (15 months, 27 months, and 63 months) the results strongly support the hypothesis.

39. The time series constructed from *Historical Statistics of the United States* obtains the price of copper from different locations in different periods: Philadelphia: 1784–1824; Sheathing: 1825–59; Copper Lake: 1860–1906; New York: 1907–26; Connecticut: 1927–77; U.S. Bureau of Labor Statistics: 1978–98. The real price is the current dollar price divided by the BLS-based consumer price index. The 225-year history of the real price of copper is graphed in Frankel (2011a, appendix, figure 2). The trend is statistically significant, but negative.

Figure 4. Chile Budget Balance Forecast Error



Source: Bloomberg.

Table 5. Private Market Recognition of Mean Reversion in Copper Prices[a]

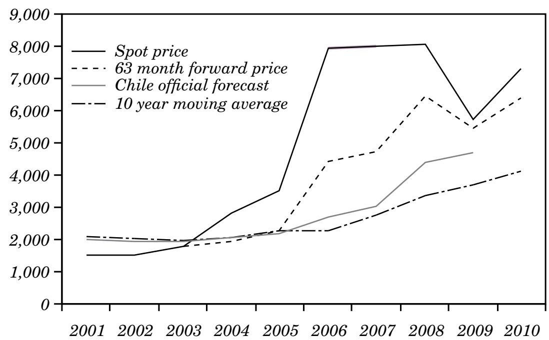
	Horizon		
	15 months	*27 months*	*63 months*
Explanatory variable	*(1)*	*(2)*	*(3)*
Spot price real	−0.0016***	−0.0029***	−0.0047***
	(0.0002)	(0.0003)	(0.0009)
Constant	0.0232***	0.0405***	−0.0119
	(0.0070)	(0.0116)	(0.0466)
Summary statistic			
No. observations	258	204	93
R^2	0.147	0.232	0.186
Root mean square error	0.0631	0.0980	0.201

Source: Author's calculations.
*** Statistically significant at the 1 percent level.
a. The dependent variable is log(real forward price / real spot price). Robust standard errors are in parentheses.

Even though real copper prices have a tendency to revert to a long-run trend and the forward market seems to internalize this tendency, the temptation to believe that changes in the price are permanent is very strong, particularly with big increases. The temptation would be especially understandable if uncertainty were genuinely higher after big increases in the price; it would be harder for naysayers to object.

The next hypothesis to be tested is that uncertainty is indeed higher at the top of the cycle. Uncertainty is here measured by the volatility that is implicit in options prices. The middle of the cycle is estimated as the long-run trend value of the real price, over the entire sample period 1784–2009. Unfortunately, options data are only available from 2004 to 2009, and the copper price during all of this period was above the measure of the long-run trend price. Thus, the only hypothesis that can be tested is that uncertainty becomes unusually high as the price moves toward the upper range of the price cycle; the symmetric hypothesis that uncertainty is also unusually high toward the lower part of the cycle cannot be tested with these data. Table 6 confirms the hypothesis, at high significance levels for options prices of five of the six horizons tested. Evidently, uncertainty does indeed rise as the copper price moves far above its long-run trend value. Figure 5 graphs the positive relationship between option-implied volatility and the level of the spot price. This finding is consistent with the hypothesis that forecasting is especially difficult in a boom.

Figure 5. Copper Price - Spot, Forward and Forecasted
(US$ per metric ton)



Sources: International Financial Statistics (IMF) and Bloomberg.

Table 6. Uncertainty When the Copper Price Is above Its Long-Run Trend?[a]

	Horizon					
	12 months	*15 months*	*24 months*	*27 months*	*39 months*	*63 months*
Explanatory variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Real copper price	7.339**	8.377***	9.903***	10.040***	9.506***	–2.143
(diff. vs. long-run trend)	(3.190)	(3.017)	(2.822)	(2.775)	(2.677)	(1.522)
Constant	29.19***	27.74***	24.88***	24.32***	23.42***	31.95***
	(2.624)	(2.489)	(2.381)	(2.353)	(2.276)	(1.228)
Summary statistic						
No. observations	60	60	60	60	59	47
R^2	0.109	0.150	0.226	0.238	0.242	0.027
Root mean square error	7.108	6.750	6.206	6.082	5.675	3.688

Source: Author's calculations.
** Statistically significant at the 5 percent level.
*** Statistically significant at the 1 percent level.
a. The table reports the regression of option-implied copper price volatility on log(real spot price) – linear trend [log(real spot price)], using data for 230 years. Robust standard errors are in parentheses.

4. Statistical Evidence of Overoptimism in Government Forecasts

Of the various ways that governments can fail to save enough, especially in boom times, the one of central interest in this paper is the possibility that official forecasts of revenue are overly optimistic. If the official forecast is optimistic, there is no reason to take painful steps such as cutting spending or raising taxes. The syndrome is not confined to commodity producers. A prominent example is the overly optimistic U.S. budget forecasts made by the White House in 2001 and subsequent years. Its unrealistic forecasts were a major reason for the striking failure of the United States to take advantage of the opportunity of the 2002–07 expansion to save.[40] However, the pattern, and the hope for an institutional solution, comes into sharper focus in the case of commodity producers.

4.1 Are Official Budget Forecasts Overly Optimistic on Average?

There is some evidence that government budget forecasts are overly optimistic on average, often because official estimates of economic growth are overly optimistic. Studies of growth forecasts by U.S. government agencies in the 1960s and 1970s used to find them generally unbiased and as accurate as private sector forecasts. Subsequent analyses, however, found biases. For example, McNees (1995) updated the time sample to 1994 and found an optimistic bias in some official forecasts of long-term growth. Auerbach (1994) found overly optimistic forecasts in the decade preceding 1993. In a later work, Auerbach (1999) again found that the semi-annual forecast of the U.S. Office of Management and Budget (OMB) tended to overestimate revenues during the period 1986–93, but tended to *underestimate* revenues in 1993–99 (during the Clinton Administration). McNab, Rider, and Wall (2007) find that the OMB's one-year-ahead forecasts of U.S. tax receipts were biased over the period 1963–2003. They

40. The White House claim that budget surpluses over the subsequent ten years would approach $5 trillion was a major factor in the new administration's ability to persuade the Congress to approve long-term tax cuts and spending increases. The result was that the ten-year fiscal outlook soon swung to roughly a cumulative $5 trillion *deficit*. (For details and further references, see Frankel, 2003, 2008a.)

suggest that the slant may be strategic on the part of various administrations seeking to achieve particular goals, such as overstating budget balance when the administration is seeking to increase spending or cut taxes. Frendreis and Tatalovich (2000) find that U.S. administrations (through the OMB) are less accurate in estimating growth, inflation, and unemployment than are the Congressional Budget Office and the Federal Reserve Board. They find partisan bias, which they interpret as Republican administrations overforecasting inflation and Democratic administrations overforecasting unemployment.

Forni and Momigliano (2004) find optimism bias among member countries of the Organization for Economic Cooperation and Development (OECD) more generally. Ashiya (2007) finds that official Japanese growth forecasts at a 16-month horizon are skewed upward by 0.7 percentage points, and they are significantly less accurate than private sector forecasts. Canada evidently underestimated its budget deficits in the late 1980s and early 1990s, but subsequently overestimated them (1994–2004), perhaps to reduce the risk of missing its target of a balanced budget under its strengthened institutional framework (O'Neill, 2005; Mühleisen and others, 2005).

Jonung and Larch (2006) find a clear tendency for E.U. governments to overestimate the economic growth rate when making budget plans. Several European countries display a statistically significant optimistic bias, including France, Italy, and Portugal over the period 1991–2002 (Hallerberg, Strauch, and von Hagen, 2009) and Germany, Italy, Greece, Luxembourg, and Portugal when the data set is updated to 2004 (Schuknecht, von Hagen, and Walswijk, 2009). The United Kingdom, Finland, and Sweden, on the other hand, tend to overestimate their deficits. Brück and Stephan (2006) explicitly conclude that euro area governments have manipulated deficit forecasts before elections since the introduction of the Stability and Growth Pact (SGP). Most of these authors argue that the systematic overoptimism in ex ante forecasts translates directly into larger ex post deficits, in particular deficits larger than targeted under the SGP.

Similarly, Beetsma, Guiliodori, and Wierts (2009) find that ex post budget balances among SGP countries systematically fall short of official ex ante plans. Marinheiro (2010) adds another complete business cycle to the data under the SGP and again finds that the forecasts of European fiscal authorities are overly optimistic, on average. This evidence is not consistently strong across the set of 15 E.U. countries, but the error is again systematically high for France, Italy, and Portugal at all forecast horizons.[41]

There is far less research into the forecasting records of fiscal authorities in low-income or medium-income countries than in advanced countries.[42] One reason is the very limited availability of data. However, some major emerging market countries became more transparent about their budgets after the crises of the 1990s. Mexico, for example, now makes available data on its ex ante planned budget balance, which can be compared with the ex post realized budget balance. If the numbers are interpreted as a forecasting exercise, then the accuracy during the period 1995–2009 is impressively high. At the same time, there is evidence of a small bias in the direction of overoptimism: the budget deficit as a share of GDP is underforecast by an average of one-tenth of a percent of GDP. The mean is greater than zero and statistically significant, but only at the 10 percent level.[43]

Table A1 in the appendix reports the mean errors made by government forecasts of the budget balance for 33 countries.[44] A majority of the countries are European (25, of which 16 are euro members, not counting Estonia which was approved for membership in 2010). European countries are heavily represented in the sample because they report official budget forecast data as a side effect of the Stability and Growth Pact, whereas most countries do not. The European data allow testing for the effect on forecast bias of the political forces from a budget rule such as the SGP, as shown below. Of the additional eight countries, three are advanced commodity-exporting countries (Australia, Canada, and New Zealand), two are major advanced countries that are not primarily associated with their commodity exports (the United States and the United Kingdom), and three are middle-sized emerging market countries that export commodities (Chile, Mexico, and South Africa). The last category is perhaps the most important for this study, but national sources must be consulted one by one, and for most countries the answer is that such data are not available.

41. He proposes delegating the macroeconomic forecasting to supranational authorities, such as the E.U. Commission or the IMF.

42. Chang, Franses, and McAleer (2010) analyze official forecast errors for Taiwan, a newly industrialized economy, but without clear findings.

43. Frankel (2011a, table 5 and figure 6) reports the results.

44. An appendix in Frankel (2011a) identifies the data sources for the 33 countries.

The third column of the table reports the official ex ante forecast minus actual ex post outcome one year ahead: mean forecast error, minimum, and maximum. Some countries report forecasts two or three years ahead; these forecast errors are shown in the fourth and fifth columns, respectively. The general pattern, as suspected, is overoptimism. In most cases, the positive bias emerges more strongly at the three-year horizon than at the two-year horizon and more sharply at the two-year horizon than at the one-year horizon. The average across all countries is an upward bias of 0.2 percent of GDP at the one-year horizon, 0.8 percent two years ahead, and a hefty 1.5 percent three years ahead. The absolute magnitude of forecast errors increases with the length of the horizon. This would be true even if forecasts were optimal. The upward trend in the bias suggests, however, that the longer the horizon and the greater the genuine uncertainty, the more the scope for wishful thinking.

The bias is not greater for commodity producers or developing countries than it is for other economies, though the sample is far too small to allow a reliable test of the difference. The U.S. and U.K. forecasts have substantial positive biases around 3 percent of GDP at the three-year horizon. This is approximately equal to their actual deficit, on average; in other words, they repeatedly forecast a disappearance of their deficits that never materialized. The forecast biases in the European countries have already been noted from the literature. Official budget forecasts in South Africa were overly *pessimistic*, on average, as were those for Canada and New Zealand. Chile had no optimism bias (the hypothesis of this study is that this was the result of its institutions), and Mexico has already been discussed. Neither offers forecasts beyond the one-year horizon.

4.2 Are Official Growth Forecasts Overly Optimistic on Average?

One likely reason for upward bias in official budget forecasts, in advanced and developing countries alike, is upward bias in economic assumptions such as economic growth and commodity prices. This is the hypothesis of central interest in this paper. There are other possible reasons, as well, why official budget forecasts could be overly optimistic on average. The official forecast may represent the desired target in the plan of the executive, but there could be slippage by the time the final expenditures are made, due to the usual political pressures.[45] Those who write the initial budget plan may even be fully aware of this tendency toward slippage and may place a lower priority on statistically unbiased forecasts than on setting an ambitious goal so as to achieve as strong a final outcome as possible.

Table A2 in the appendix reports the mean errors made by government forecasts of the GDP growth rate, for 33 countries. Again the overall pattern is an upward bias, on average, which rises with the length of the horizon: 0.4 percent when looking one year ahead, 1.1 percent at the two-year horizon, and 1.8 percent at three years. The bias appears in the United States and many other advanced countries, but it is not generally among the commodity producers in this sample.[46] Chile on average underforecast its growth rate, by 0.8 per cent at the one-year horizon. South Africa was just slightly too optimistic, on average (0.2 per cent at the one-year horizon), and Mexico more so (1.7 per cent).

I next turn to cyclical patterns in the forecast errors. Fewer authors have looked for cyclical patterns in the systematic forecast errors made by national authorities than unconditional average errors.

4.3 The Influence of Macroeconomic Fluctuations on Budget Balances

As previously illustrated in table 2, the price of copper is key to the ex post determination of the budget in Chile. Before any attempt to detect systematic ex ante determinants of errors made in officials forecast of budget deficits in the full sample of 33 countries, it would be useful to confirm that a few macroeconomic variables such as the real growth rate are, in fact, key to the ex post determination of the actual budget balance. This would then indicate that overoptimism in forecasts of these macroeconomic variables is a possible source of any observed overoptimism in the budget forecasts.

Table 7 regresses the ex post budget outcome (expressed relative to the ex ante attempt to predict it) against the ex post real growth rate (again expressed relative to the forecast), for the full set of

45. Cárdenas, Mejía, and Olivera (2009) show how this process works for Colombia. There may also be slippage that is not captured in the final budget numbers, because it takes place in off-budget agencies or categories.

46. The commodity exporters in this data set almost certainly represent some sample selection bias, in that only governments that are transparent enough to publish their budget forecasts are included, for obvious reasons. I therefore do not emphasize tests of whether official forecasts behave differently for commodity exporters than for other countries. Such tests appear to show that the special commodity exporters in the sample are actually less optimistic than others.

countries. At all three horizons, the growth rate is highly significant at determining the budget balance. For every 1 percent of growth, relative to what was forecast a year previously, the budget improves by about half that amount, relative to what was forecast a year previously. The same is true at the two-year and three-year horizons. Thus, overoptimism in forecasting the budget is likely to coincide with overoptimism in predicting real growth.

In some countries, inflation pushes taxpayers into a higher tax bracket.[47] Accordingly, table 8 adds the inflation rate as another possible determinant of the budget balance. (Both are again expressed relative to the official ex ante forecasts.) The finding is that inflation does indeed translate into a strong budget surplus, to a statistically significant degree at the two- and three-year horizon.[48]

Table 7. GDP as a Determinant of Budget Balance as a Percent of GDP[a]

Explanatory variable	*One year ahead (1)*	*Two years ahead (2)*	*Three years ahead (3)*
GDP forecast error	0.479***	0.525***	0.489***
	(0.060)	(0.068)	(0.077)
Constant	0.155	0.198	0.556*
	(0.174)	(0.249)	(0.314)
Summary statistic			
No. observations	367	277	175
No. countries	33	31	28
R^2	0.280	0.369	0.322
Root mean square error	1.695	2.053	2.327

Source: Author's calculations.
*** Statistically significant at the 1 percent level.
a. The dependent variable is the ex post budget outcome (expressed relative to the ex ante attempt to predict it). The estimations include random effects by country. Robust standard errors are in parentheses.

47. The Tanzi effect can go the other direction at high levels of inflation: due to lags in tax collection, inflation erodes the real value of tax receipts and can worsen the budget deficit.

48. These tables allow random effects by country (which facilitates comparison across the three columns even though the sample of countries diminishes). Results without random effects are reported in Frankel (2011a). There, the effect of inflation was a bit stronger statistically.

Table 8. GDP and Inflation as Determinants of Budget Balance as a Percent of GDP[a]

Explanatory variable	*One year ahead (1)*	*Two years ahead (2)*	*Three years ahead (3)*
GDP forecast error	0.498***	0.466***	0.460***
	(0.055)	(0.064	(0.075)
Inflation forecast error	0.158	0.196*	0.254***
	(0.109)	(0.116)	(0.093)
Constant	0.331	0.593*	0.913**
	(0.212)	(0.306)	(0.356)
Summary statistic			
No. observations	214	185	159
No. countries	28	27	27
R^2	0.351	0.402	0.351
Root mean square error	1.634	2.127	2.313

Source: Author's calculations.
* Statistically significant at the 10 percent level.
** Statistically significant at the 5 percent level.
*** Statistically significant at the 1 percent level.
a. The dependent variable is the ex post budget outcome (expressed relative to the ex ante attempt to predict it). The estimations include random effects by country. All variables are lagged so that they line up with the year in which the forecast was made, not the year being forecast. Robust standard errors are in parentheses.

4.4 Are Budget Forecasts More Prone to Overoptimism in Booms?

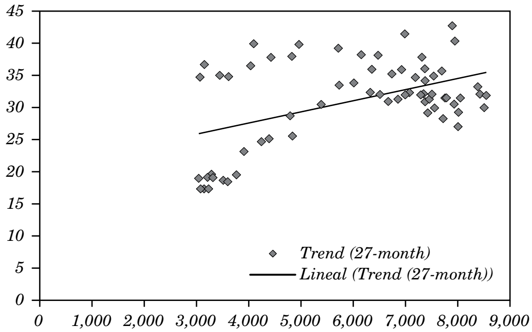
I now return to the examination of bias in government forecasts. Table 9 goes beyond testing for unconditional overoptimism in official budget forecasts to see if the bias is greater in a boom, here measured as the deviation of output from a quadratic trend. The cyclical term is indeed positive and highly significant: overoptimism tends to be greater in booms. Its estimated magnitude rises as the horizon moves from one year to two years and then again to three years. This makes sense: there is more scope for wishful thinking at longer horizons because the uncertainty is genuinely higher. Nevertheless, there is still also evidence of a bias toward optimism even when GDP is at its trend value.

Table 9. Budget Balance Forecast Error as a Percent of GDP: Full Sample[a]

Explanatory variable	*One year ahead (1)*	*Two years ahead (2)*	*Three years ahead (3)*
GDP deviation from trend	0.093***	0.258***	0.289***
	(0.019)	(0.040)	(0.063)
Constant	0.201	0.649***	1.364***
	(0.197)	(0.231)	(0.348)
Summary statistic			
No. observations	398	300	179
R^2	0.033	0.113	0.092
Root mean square error	2.248	2.732	3.095

Source: Author's calculations.
*** Statistically significant at the 1 percent level.
a. The dependent variable is lagged so that it lines up with the year in which the forecast was made and not the year being forecast. The regressions include random effects by country. The GDP deviation is the deviation from the quadratic trend. Robust standard errors are in parentheses, clustered by country.

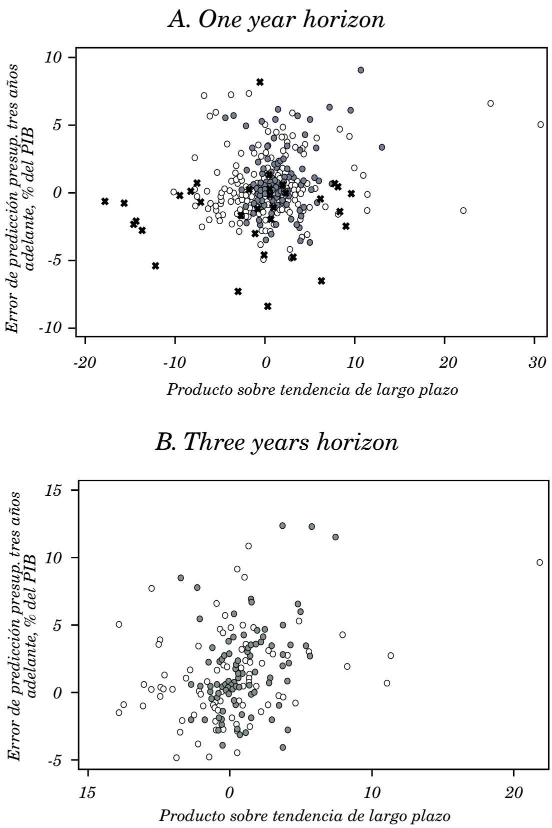
Figure 6. Trend (27-month)



Source: Bloomberg.

The findings are visible in figures 6 and 7. First, budget forecasts in most countries are biased upward (that is, most points appear above the zero level of budget prediction error). Second, Chile is an exception, in that the *x* values in figure 6 mostly lie below the zero level. Third, a comparison of the two figures reveals that the bias is greater at longer horizons. Fourth, the bias is greater in booms (that is, a regression line slopes upward.) [49]

Figure 7. Budget Balance Forecast Error and Business Cycle State



Source: World Development Indicators (World Bank).
Lighter colors corresponds to APEC countries. Crosses indicates Chile.

49. The country with the longest sample period at the one-year horizon is Chile (1977–2009); see figure 6. At the two-year horizon, the United States has the longest sample period (1987–2009), as shown in Frankel (2011a, figure 7B). At the three-year horizon, numerous European countries have a sample period of 2001–2009: see figure 7. For the individual country sample periods, see Frankel (2011a, table A1).

4.5 Are Official Budget Forecasts More Prone to Overoptimism When the Country is Subject to a Budget Rule?

The E.U. countries that had to work the hardest to meet the Maastricht fiscal criteria—such as Italy—are also the ones found by several studies to have had the greatest bias in their forecasts. The fact that the United Kingdom does not show significant overoptimism (Jonung and Larch, 2006) is consistent with the possibility that the bias is related to the common currency, given that the country has not sought entrance into the euro area. Thus the literature supports the hypothesis that formal adoption of a budget deficit ceiling may, by itself, induce a tendency toward overoptimism in official forecasts, but that overoptimism can be counteracted by the right sort of fiscal regime or institution.

To test this hypothesis, I performed a regression of my own tests of the "planning to cheat" hypothesis, on a bigger data set than the earlier studies. The examples of rule-bound countries are the euro members, as in the literature.[50] Rather than comparing them only to other European countries, however, I also include economies from other regions, including a number of commodity producers. The data confirm the finding that the European countries, in general, and the SGP countries, in particular, are prone to overly optimistic budget forecasts in the data set. The bias is stronger at longer forecast horizons. I also tested for a cyclical pattern in the overoptimism by including a term for the interaction of the dummy for countries subject to the SGP and their GDP expressed as a deviation from its long-run trend.[51] The coefficient is statistically significant. The positive sign confirms the extrapolative nature of the forecasters' optimism: when the business cycle is at its peak, the government forecasters are more prone to give free reign to wishful thinking. The results are very similar regardless of whether the data set includes just western European countries, all European countries, or the complete set of countries.

50. New Zealand and Switzerland are other examples of countries with rules that put ceilings on the deficit and debt (Marcel and others, 2001).

51. Frankel (2011a, tables 9A, 9B, and 9C) or Frankel (2011b, table 3). The coefficient's estimated magnitude and statistical significance rise with the horizon of the forecast.

4.6 Is Overoptimism in Growth Forecasts Worse in Booms?

As discussed above, for most countries, the evolution of the actual budget deficit at a one-year horizon is heavily influenced by the evolution of the economy, particularly GDP. In this section, I test whether the cyclical component to errors in budget forecasting derives from an analogous cyclical component to errors in economic forecasting. Table 10 tests if growth forecasts tend to be more overly optimistic when the economy is at a cyclical peak, here measured as the deviation of GDP from a quadratic trend. The answer is a resounding yes, especially as the horizon of the forecast lengthens, just as with forecasts of the budget deficit.

Table 10. GDP Growth Rate Forecast Error[a]

Explanatory variable	*One year ahead* (1)	*Two years ahead* (2)	*Three years ahead* (3)
GDP deviation from trend	0.204***	0.497***	0.668***
	(0.033)	(0.078)	(0.159)
Constant	0.265***	0.799***	1.600***
	(0.091)	(0.130)	(0.247)
Summary statistic			
No. observations	368	282	175
No. countries	33	31	28
R^2	0.138	0.298	0.303
Root mean square error	2.234	2.945	3.306

Source: Author's calculations.
*** Statistically significant at the 1 percent level.
a. The dependent variable is lagged so that it lines up with the year the forecast was made in and not the year being forecast. The regressions include random effects by country. The GDP deviation is the deviation from the quadratic trend. Robust standard errors are in parentheses, clustered by country.

The next step is to see if the pattern is worse among rule-bound countries. In every case, the term that interacts the SGP dummy with GDP has a significantly positive effect on the error made in forecasting output, very much like the positive effect in forecasting the budget.[52] In other words, when the economy is at a cyclical high

52. Frankel (2011a, tables 11A, 11B, and 11C) or Frankel (2011b, table 5).

in rule-bound countries, forecasters tend to extrapolate, as if the boom would last forever.

4.7 Are Official Forecasts Overly Optimistic at Cyclical Lows as Well as Highs?

I have noted some evidence consistent with the idea that overoptimism thrives when genuine uncertainty is high—namely, it increases with the horizon of the forecast. Uncertainty is probably greater at cyclical highs and lows, because it is difficult to tell whether the recent movement is temporary or permanent. These considerations suggest a further hypothesis worth testing: that forecasts are overly optimistic not just at the top of the business cycle, but at the bottom as well. The simplest way to test this hypothesis is to transform the cyclical independent variable, which has been expressed as the deviation of GDP from trend, to the absolute value of that deviation. The exercise offers strong support for the hypothesis, as a characterization of both bias in official forecasts of the budget balance and bias in official forecasts of economic growth.[53] Evidently, official forecasters are overly optimistic both in booms and busts, more so than when GDP is at its long-run trend. They overestimate the permanence of the booms and the transitoriness of the busts.[54]

5. Summary of Statistical Findings

This section restates the paper's 15 econometric results.

—The real price of copper tends to revert toward its long-run trend, but the tendency can only be statistically detected when the time series history runs for as long as a century or two. For studies that only encompass a few decades of data, statistical power is lacking. In such cases, a departure of the price of copper from its long–run trend, as in the 2003–08 boom, can easily but erroneously appear to be permanent.

—Further illustrating the difficulty of forecasting in the midst of a boom, the option-implied volatility is higher when the real price of copper lies far above its long-run trend value.

53. Reported in Frankel (2011a, tables 12A and 13A) or Frankel (2011b, tables 6a and 7a).

54. The patterns are worse for European forecasters than for others (Frankel, 2011a, tables 12B and 13B) or Frankel (2011b, tables 6b and 7b).

—Official forecasts of future budgets in a sample of 33 countries are, on average, overly optimistic.

—The bias toward overoptimism in budget forecasts is stronger the longer the horizon (from one to two to three years). At the three-year horizon, the average is an upward bias of 1.5 percent of GDP.

—Official forecasts of the budget in the United States and Europe are overly optimistic, on average.

—Chile's official forecasts are not overly optimistic, on average.

—The same patterns show up in official forecasts of real GDP growth rates among 33 countries: overly optimistic on average, especially at longer horizons (1.8 percent at the three-year horizon), but not overly optimistic for Chile.

—Forecasting GDP is a major component of forecasting the budget: prediction errors in the former are highly significant determinants of prediction errors in the latter.

—In Chile, errors in predicting the price of copper are highly significant determinants of errors in predicting the budget; indeed, GDP is not a statistically significant determinant of the budget when controlling for the copper price.

—The bias in official budget forecasts among 33 countries is statistically correlated with the business cycle: overoptimism is higher in booms.

—The tendency for overoptimism in government budget forecasts and growth forecasts to rise in booms is particularly strong in European countries that are formally subject to the Stability and Growth Pact, especially at the two- and three-year horizons.

—There is also statistical evidence for the proposition that budget forecast bias is related to the absolute value of the deviation of GDP from its long-run trend. In other words, overoptimism occurs at the bottom of the business cycle as well as at the top, although the R^2 is not as high as in the earlier formulation.

—The same pattern holds for bias in GDP forecasts: there is some support for the hypothesis that overoptimism increases at both ends of the cycle, but the fit is not quite as good as for the hypothesis that it increases at the top of the cycle.

—There is no consistent relationship between budget forecast errors and the copper price in Chile, suggesting that the country has avoided the problem common in other countries.

—Taken together, these results tell a coherent story. Among many countries, there is a tendency toward wishful thinking in official forecasts of growth and the budget. Governments unrealistically extrapolate booms three years into the future. The bias is worse among the European countries that are supposedly subject to the budget rules of the SGP, presumably because those in the government who make the forecasts feel pressured to be able to announce that they are on track to meet the budget targets even if they are not. Chile has a budget rule, but is not subject to the same bias toward overoptimism in forecasts of the budget, growth, or the all-important copper price. This evidence is consistent with the idea that the key innovation that has allowed Chile to achieve countercyclical fiscal policy and to run surpluses in booms is not just a structural budget rule in itself, but rather the regime that entrusts to two panels of independent experts the responsibility for estimating the extent to which contemporaneous copper prices and GDP have departed from their long-run averages.

6. Countercyclical Fiscal Institutions Generalized for Other Countries

Any country could usefully apply variants of the Chilean fiscal device. This is especially true for oil and mineral producers.[55] Countries that do not rely on commodities could also usefully adopt versions tailored to their own circumstances. Much like mineral producers, countries prone to natural disasters should put aside savings in good years. In both cases, independent expert panels could estimate the relevant parameters. Even large diversified industrialized countries could set up independent institutions charged by law with estimating the output gap and other budget-relevant macroeconomic variables, such as the inflation rate and the fractions of GDP going to wage versus nonwage income.

Given that many countries, especially in the developing world, are prone to weak institutions, a useful reinforcement of the Chilean idea would be to formalize the details of the procedure into law and give the panels legal independence. There could be a law protecting panel members from being fired, as there for governors of independent central banks. The principle of a separation of decisionmaking powers should be retained: the rules as interpreted by the panels

55. Ecuador at one point had institutions designed to increase national saving during an oil boom, and Colombia had institutions for both coffee and oil. But such countries often miss their targets or change their rules (Perry, 2003, pp. 18–19; Villafuerte, López-Murphy, and Ossowski, in this volume).

help determine the total amount of spending and budget deficits, while the elected political leaders determine how that spending is allocated and how tax revenue is raised.

Two technical questions remain: of the extent to which the structural budget calculations are to be delegated to the independent panels of experts and whether the budget rules are interpreted as ex ante or ex post. With regard to the former, the computation of the structural balance in Chile involves a number of calculations that are made inside the Ministry of Finance, rather than by the panels of experts. These calculation apparently include the estimation of trend GDP from an aggregate production function (the macroeconomic panel provides the estimates of trend levels of inputs), the estimation of the long-term price of molybdenum,[56] the estimation of mining and nonmining tax revenues, and so on.[57] If the locus of these calculations were to be moved from the Ministry to the independent panels, it might require establishing a standing bureaucracy, in the manner of the U.S. Congressional Budget Office (CBO). The CBO has managed to maintain its independence and integrity, despite the politicization of most of the rest of Washington.[58] If the new independent agency were given more comprehensive control over fiscal policy, it would then draw closer to symmetry with the delegation of monetary policy to independent central banks.[59] At the opposite end of the spectrum, the panels might be charged with nothing more than computing the ten-year moving-average trend of the copper price and real GDP.

The second, related, question is whether the targeting is to be ex ante or ex post. An ex post rule for the budget deficits would have to be phrased as a target range or as an upper bound, because unanticipated economic developments make it impossible for anyone to hit a budget

56. As of 2005, the government can run a larger deficit to the extent that the price of molybdenum is below its medium-term average, so it is now targeting more than just the price of copper.

57. Marcel and others (2001, pp. 6–17); Rodríguez, Tokman, and Vega (2007, pp. 10–21).

58. Chile's congress established a version of the CBO in 2003, with a staff of three analysts (Santiso, 2005, p. 29). The legislative branch in Chile does not have the power to determine fiscal policy as it does in the United States.

59. Wyplosz (2005) and Jonung and Larch (2006) propose setting up an independent fiscal policy committee that would reproduce what independent monetary policy committees do. Others also note the analogy with monetary policy (for example, Alesina and Perotti, 1996), but the analogy has its limits. Few reformers suggest that the details of tax and spending policy could or should be delegated to an agency that is not directly accountable in a democratic way, even though the details of interest rate setting and asset purchases are delegated to independent central banks.

target precisely. The alternative is for an ex ante rule: tax rates, spending parameters, and so forth are set so as to produce the desired target if all goes precisely as expected, while recognizing that there will be unanticipated deviations during the course of the year.

The analogous issue is familiar in the context of monetary policy. If the target variable is the money supply or inflation rate, the authorities cannot be expected to hit it exactly, as opposed to a target of the gold price or the exchange rate. The usual approach is that the monetary authorities announce a target range for M1 or the inflation rate. Conceptually, a sincere central bank will set the range so it they can achieve an outcome within the specified range, say 95 percent of the time. The public can then monitor the ability of the central bank to deliver on its commitment. An alternative proposal is that the monetary authorities set the parameters so as to hit a desired ex ante inflation target. If the one true model of how the economy operates were known to the central bank, which in turn announced it to the public, the two procedures would be equivalent. In reality, however, the model is highly uncertain, everyone knows that it is uncertain, and different elements among the staff and different members of the monetary policy committee vary as to their preferred models. Thus, it is less practical to announce an ex ante target. The members of the monetary policy committee would have to negotiate with each other over an ever-changing common model and set of forecasts, a cumbersome way to go about negotiating a decision on monetary policy.

In the case of the fiscal expert panels, however, setting an ex ante target may be more feasible. More precisely, the panel could be charged with evaluating whether the government's budget proposal would hit the desired structural budget target, not only if output were at potential and the copper price were at its long-run equilibrium, which they already have to do under the Chilean system, but also, more comprehensively, if growth and other economic variables were at the levels *expected over the coming year.*

Another important modification to consider is to recast the fiscal policy rule as more aggressively countercyclical. The Bachelet government appears to have steps to make the budget even more countercyclical than required by the rule, saving more in 2007–08 and spending more in 2009–10. One could argue that this degree of countercyclicality should now be formalized into the rule. A further possibility would be an escape clause for earthquakes as severe as the one that hit central Chile in February 2010. The design of rules is always subject to a tradeoff between the advantages of simplicity and the disadvantages of leaving to much to the discretion of uncommitted politicians.

7. Concluding Thoughts

Although Chile's fiscal institutions have been well studied inside Chile, they have not yet received the attention from the wider world that they merit. They should and could provide a useful model worthy of emulation by other countries.

Chile's fiscal institutions are a relatively pure example of several much broader trends. The first is the increased emphasis on institutions in development economics and other branches of economics over the past decade or two. It is recognized that it is not enough to recommend good fiscal policy to a country—or for the IMF to make loans to a country conditional on good fiscal policy—if the deeper political support and institutions are not there to sustain the policy. Sometimes, however, economists are not specific enough about what they mean by good institutions. Exhortations on the importance of rule of law need to be backed up by concrete recommendations.[60]

The second trend is the increased importance over the last decade of primary commodities: namely, fossil fuels, minerals, and agricultural products. After two decades of lower real prices, almost all minerals and other commodities experienced a major boom in 2003–08. With the commodity boom, issues of how to manage volatility, Dutch disease, and the natural resource curse returned. The need, then, is for institutions to help manage the commodity cycle, in line with trend number one. It is good news that there are now examples of regimes that are designed to guard against the human nature to overspend when commodity prices go up.

The third trend is a historic reversal of roles between some countries traditionally classified as advanced or industrialized and some countries traditionally classified as emerging or developing. The

60. No set of rules or institutions is foolproof against determined efforts to circumvent them. In the United States, for example, politicians who wish to appear fiscally responsible have found legislative tricks for manipulating CBO estimates so that future budget deficits falsely appear to diminish and disappear. The Bush Administration routinely left the cost of foreign wars off the budget, treating their continuation as a surprise every year. It also pretended for legal purposes that its extensive tax cuts would expire in the future even though its policy was to renew them when the time came.

latter group, especially in Latin America, has been characterized by unfortunately procyclical fiscal policy and poor creditworthiness. In the post-2000 boom, however, many developing countries achieved stronger budget balances, national saving rates, current account balances, and foreign exchange reserve holdings than in past cycles. Consequently, some have been able to reap the rewards of better creditworthiness, as reflected in credit ratings and sovereign spreads, and they were better able to respond to the global financial crisis and recession of 2008–09 by easing rather than tightening. Some of these countries have now achieved a fiscal policy that is not only less procyclical than the pattern of their own past histories, but also more countercyclical than that of the advanced countries.

The fiscal regime that has been explored in this paper is among the most well-focused examples that lie at the intersection of these three trends. For the many countries that need to make their budgets stronger and less procyclical, Chile's fiscal institutions may offer a useful model.

Appendix
Data Sources and Supplemental Tables

The countries classified as commodity exporters are Australia, Canada, Chile, Mexico, New Zealand, and South Africa.

The countries classified as European are Austria, Belgium, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, the Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, and the United Kingdom.

The countries classified as western European are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, the Netherlands, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

The countries included in the Stability and Growth Pact convergence program are Austria, Belgium, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Greece, Hungary, Ireland, Latvia, Lithuania, Luxemburg, Malta, Poland, Portugal, Slovakia, Slovenia, and Spain. (These countries are all in the SGP, but were not in the Mühleisen and others, 2005, data set.) All forecast data are from the European Union SGP convergence programs. The years 1999–2007 are from the convergence programs as reported in Beetsma, Giuliodori, and Wierta (2009). The data for 2008–10 were updated directly from the convergence programs. Through 2006, the realized values for these countries are from the European Commission AMECO database (via Beetsma, Giuliodori, and Wierta, 2009). The data for 2007–09 were updated using the realizations reported in the SGP convergence programs. European Union SGP convergence programs are available online at ec.europa.eu/economy_finance/sgp/convergence/programmes/index_en.htm.

Table A1. Errors in Forecasting Budget Surplus: Official Budget Forecast Minus Actual Fiscal Balance
(Percent of GDP)

Country, sample period, and statistic	*Actual fiscal balance*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
Australia: 1985–2009				
Mean	–0.2	–0.2	–0.2	1.2
Minimum	–2.7	–1.6	–1.4	–0.9
Maximum	1.7	4.0	3.3	3.2
No. observations	26	25	14	2
Austria: 1999–2009				
Mean	–1.8	0.3	0.7	0.9
Minimum	–3.9	–0.6	–1.3	–1.3
Maximum	–0.2	3.2	3.3	4.1
No. observations	13	11	10	9
Belgium: 1999–2009				
Mean	–1.0	0.2	1.0	1.3
Minimum	–5.9	–1.1	–1.1	–1.0
Maximum	0.3	2.4	6.2	6.6
No. observations	13	11	10	9
Canada: 1985–2008				
Mean	–2.1	–0.9	–0.7	n.a.
Minimum	–8.6	–2.6	–2.5	n.a.
Maximum	1.3	0.5	1.7	n.a.
No. observations	26	23	20	0

Table A1. (continued)

Country, sample period, and statistic	*Actual fiscal balance*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
Chile: 1977–2009				
Mean	2.2	–1.4	n.a.	n.a.
Minimum	–5.5	–8.3	n.a.	n.a.
Maximum	8.9	8.1	n.a.	n.a.
No. observations	33	33	0	0
Cyprus: 2005–2009				
Mean	–2.8	–0.2	–0.4	–0.4
Minimum	–6.5	–4.9	–5.1	–4.8
Maximum	3.3	5.3	6.6	5.7
No. observations	12	5	4	3
Czech Republic: 2005–2009				
Mean	–4.2	–0.1	–0.3	0.4
Minimum	–6.8	–2.4	–1.9	–1.7
Maximum	–1.6	5.0	3.6	3.6
No. observations	13	5	4	3
Denmark: 1999–2008				
Mean	1.6	0.1	0.2	0.1
Minimum	–3.0	–2.8	–3.1	–2.8
Maximum	4.8	3.0	5.0	4.8
No. observations	13	11	10	9

Table A1. (continued)

Country, sample period, and statistic	*Actual fiscal balance*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
Estonia: 2005–2009				
Mean	0.3	–0.3	0.4	1.4
Minimum	–3.5	–3.3	–3.4	–2.8
Maximum	3.4	4.1	4.1	4.2
No. observations	13	5	4	3
Finland: 1999–2009				
Mean	2.8	–0.5	–0.8	–0.3
Minimum	–2.2	–2.5	–4.7	–3.1
Maximum	6.9	4.3	5.8	4.9
No. observations	13	11	10	9
France: 1996–2009				
Mean	–3.5	0.6	1.5	2.2
Minimum	–7.9	–0.5	–0.4	0.1
Maximum	–1.5	4.0	6.2	7.0
No. observations	16	14	10	9
Germany: 1991–2009				
Mean	–3.0	1.0	1.4	1.3
Minimum	–4.8	–1.7	–2.5	–2.0
Maximum	0.0	3.5	3.4	3.8
No. observations	19	19	18	9

Table A1. (continued)

Country, sample period, and statistic	*Actual fiscal balance*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
Greece: 2000–2009				
Mean	–5.5	4.3	5.4	6.0
Minimum	–12.7	0.3	0.1	0.9
Maximum	–2.9	9.0	11.9	11.5
No. observations	13	10	9	8
Hungary: 2005–2009				
Mean	–6.1	1.7	2.2	1.9
Minimum	–9.3	–1.3	–0.5	0.7
Maximum	–3.0	4.6	6.2	3.1
No. observations	13	5	4	3
Ireland: 1999–2009				
Mean	0.0	0.4	1.0	1.9
Minimum	–11.7	–3.6	–3.6	–4.1
Maximum	4.7	6.3	10.6	12.3
No. observations	13	11	10	9
Italy: 1990–2009				
Mean	–7.9	1.1	1.6	2.6
Minimum	–18.1	–3.8	–3.5	0.5
Maximum	–1.8	5.8	5.2	4.2
No. observations	25	20	19	9

Table A1. (continued)

Country, sample period, and statistic	*Actual fiscal balance*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
Latvia: 2005–2009				
Mean	–2.1	1.5	2.9	3.7
Minimum	–10.0	–1.3	–1.4	–1.4
Maximum	1.4	6.5	11.0	9.6
No. observations	13	5	4	3
Lithuania: 2005–2009				
Mean	–3.4	1.4	2.7	3.7
Minimum	–11.9	–2.0	–1.3	–0.3
Maximum	–0.5	7.0	9.3	9.1
No. observations	13	5	4	3
Luxembourg: 1999–2009				
Mean	2.3	–1.7	–1.4	–0.7
Minimum	–1.2	–4.8	–4.8	–4.8
Maximum	6.1	2.2	2.6	4.6
No. observations	13	11	10	9
Malta: 2005–2009				
Mean	–5.7	0.9	1.8	2.6
Minimum	–9.9	–0.7	–0.5	0.4
Maximum	–1.8	3.5	3.8	3.9
No. observations	13	5	4	3

Table A1. (continued)

Country, sample period, and statistic	*Actual fiscal balance*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
Mexico: 1995–2009				
Mean	–0.6	0.1	n.a.	n.a.
Minimum	–2.3	–0.1	n.a.	n.a.
Maximum	0.1	0.6	n.a.	n.a.
No. observations	15	15	0	0
Netherlands: 1995–2009				
Mean	–2.7	0.6	0.4	0.7
Minimum	–11.0	–2.3	–2.6	–2.3
Maximum	1.3	7.1	5.5	5.8
No. observations	17	15	10	9
New Zealand: 1995–2008				
Mean	1.9	–0.1	–0.4	–0.8
Minimum	–0.9	–4.2	–3.9	–0.8
Maximum	7.3	2.9	3.9	–0.8
No. observations	18	13	12	1
Poland: 2005–2009				
Mean	–4.4	1.6	2.1	2.7
Minimum	–7.2	0.4	–0.2	–0.2
Maximum	–2.0	4.7	5.2	6.6
No. observations	13	5	4	3

Table A1. (continued)

Country, sample period, and statistic	*Actual fiscal balance*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
Portugal: 1999–2009				
Mean	−3.9	1.4	2.3	3.1
Minimum	−9.3	−1.0	−1.0	0.1
Maximum	−2.7	5.4	7.8	7.8
No. observations	13	11	10	9
Slovakia: 2005–2009				
Mean	−5.2	0.5	1.4	1.9
Minimum	−12.2	−0.7	−0.1	0.3
Maximum	−2.2	3.3	4.5	4.4
No. observations	13	5	4	3
Slovenia: 2005–2009				
Mean	−2.6	−0.2	0.9	1.5
Minimum	−5.7	−1.4	−1.3	−1.0
Maximum	−0.1	0.9	5.1	4.7
No. observations	13	5	4	3
South Africa: 1998–2008				
Mean	−1.6	−0.3	−1.3	−1.5
Minimum	−5.2	−2.8	−4.0	−4.4
Maximum	1.7	5.6	0.9	0.2
No. observations	13	11	10	9

Table A1. (continued)

Country, sample period, and statistic	*Actual fiscal balance*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
Spain: 1999–2009				
Mean	−1.6	0.9	1.5	1.6
Minimum	−11.4	−1.2	−1.6	−1.8
Maximum	2.2	5.6	12.6	12.3
No. observations	13	11	10	9
Sweden: 1998–2009				
Mean	0.8	0.4	0.7	1.4
Minimum	−2.2	−1.7	−2.3	−2.5
Maximum	3.8	3.5	5.3	5.3
No. observations	14	12	11	9
Switzerland: 1990–2003				
Mean	−0.4	−0.2	−0.2	n.a.
Minimum	−2.2	−2.9	−2.3	n.a.
Maximum	0.8	1.4	1.0	n.a.
No. observations	16	14	13	0
United Kingdom: 1997–2009				
Mean	−3.0	0.8	1.8	2.8
Minimum	−12.6	−1.4	−1.9	−0.7
Maximum	2.7	4.5	10.2	10.9
No. observations	25	13	11	9

Table A1. (continued)

Country, sample period, and statistic	*Actual fiscal balance*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
United States: 1986–2009				
Mean	–2.7	0.4	1.0	3.1
Minimum	–9.9	–2.2	–3.1	–0.6
Maximum	2.6	7.2	8.7	8.5
No. observations	26	24	23	3
Total				
Mean	–1.9	0.2	0.8	1.5
Minimum	–18.1	–8.3	–5.1	–4.8
Maximum	8.9	9.0	12.6	12.3
No. observations	535	399	300	179

Source: See Frankel (2011a, data appendix).
a. Years are those for which there are data for the one-year-ahead budget forecast error.

Table A2. Errors in Forecasting Growth: Official GDP Forecast Minus Actual GDP

Country, sample period, and statistic	*Actual GDP growth rate*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
Australia: 1987–2009				
Mean	3.1	0.2	0.8	n.a.
Minimum	–0.8	–2.0	0.4	n.a.
Maximum	4.6	2.8	1.1	n.a.
No. observations	24	23	2	0
Austria: 1999–2009				
Mean	1.9	0.1	0.9	1.0
Minimum	–3.4	–1.5	–1.0	–1.2
Maximum	3.6	2.0	5.9	5.9
No. observations	13	11	10	9
Belgium: 1999–2009				
Mean	1.8	0.0	0.9	1.1
Minimum	–3.1	–1.2	–1.4	–0.6
Maximum	3.7	1.7	5.1	5.3
No. observations	13	11	10	9
Canada: 1985–2003				
Mean	2.9	–0.3	0.4	n.a.
Minimum	–1.7	–3.3	–2.6	n.a.
Maximum	5.1	2.0	4.7	n.a.
No. observations	21	18	17	0

Table A2. (continued)

Country, sample period, and statistic	*Actual GDP growth rate*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
Chile: 1981, 1985–2008				
Mean	4.9	–0.8	n.a.	n.a.
Minimum	–10.3	–7.3	n.a.	n.a.
Maximum	12.3	4.6	n.a.	n.a.
No. observations	28	25	0	0
Cyprus: 2005–2009				
Mean	3.3	0.7	1.6	2.3
Minimum	–1.7	–0.5	0.1	0.4
Maximum	5.9	3.8	5.7	5.8
No. observations	13	5	4	3
Czech Republic: 2005–2009				
Mean	2.6	0.8	1.7	2.6
Minimum	–4.0	–2.8	–2.5	–2.7
Maximum	6.5	7.7	9.0	8.8
No. observations	13	5	4	3
Denmark: 1999–2009				
Mean	1.4	0.5	0.6	1.0
Minimum	–4.3	–1.9	–2.6	–2.0
Maximum	3.9	4.1	5.4	5.0
No. observations	13	11	10	9

Table A2. (continued)

Country, sample period, and statistic	*Actual GDP growth rate*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
Estonia: 2005–2009				
Mean	5.2	2.4	6.5	10.3
Minimum	–14.5	–4.6	–5.2	–1.1
Maximum	11.2	11.0	20.6	22.1
No. observations	13	5	4	3
Finland: 1999–2009				
Mean	2.7	0.7	0.7	0.9
Minimum	–7.6	–1.7	–2.5	–2.5
Maximum	6.1	8.2	10.6	10.2
No. observations	13	11	10	9
France: 1998–2009				
Mean	1.7	0.6	1.0	1.3
Minimum	–2.3	–0.9	–1.4	0.0
Maximum	3.9	2.7	4.8	4.6
No. observations	14	12	10	9
Germany: 1992–2009				
Mean	1.4	0.9	1.2	1.7
Minimum	–5.0	–1.5	–1.5	–0.7
Maximum	3.9	5.2	6.5	6.8
No. observations	20	18	18	9

Table A2. (continued)

Country, sample period, and statistic	*Actual GDP growth rate*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
Greece: 2000–2009				
Mean	3.5	0.2	0.7	0.9
Minimum	–1.2	–1.2	–1.0	–0.6
Maximum	5.0	2.3	5.2	5.3
No. observations	13	10	9	8
Hungary: 2005–2009				
Mean	3.0	1.8	4.0	5.8
Minimum	–6.7	–0.1	0.3	3.0
Maximum	5.2	5.8	10.7	10.9
No. observations	13	5	4	3
Ireland: 1999–2009				
Mean	5.4	0.0	1.2	1.7
Minimum	–7.5	–3.7	–2.9	–1.0
Maximum	11.4	6.7	11.0	11.5
No. observations	13	11	10	9
Italy: 1991–2009				
Mean	1.7	0.7	1.3	2.3
Minimum	–4.8	–1.4	–0.9	0.7
Maximum	4.8	2.8	6.4	6.4
No. observations	25	18	17	9

Table A2. (continued)

Country, sample period, and statistic	*Actual GDP growth rate*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
Latvia: 2005–2009				
Mean	4.9	3.2	6.9	11.2
Minimum	−18.0	−5.4	−6.4	−3.6
Maximum	12.9	13.0	25.0	25.5
No. observations	13	5	4	3
Lithuania: 2005–2009				
Mean	4.8	1.5	4.3	7.0
Minimum	−15.0	−2.3	−3.3	−2.6
Maximum	10.4	10.2	19.5	19.5
No. observations	13	5	4	3
Luxemburg: 1999–2009				
Mean	4.3	−0.1	0.9	1.6
Minimum	−3.9	−5.2	−4.7	−2.3
Maximum	8.6	6.9	8.9	7.9
No. observations	13	11	10	9
Malta: 2005–2009				
Mean	2.5	−0.3	−0.1	0.8
Minimum	−2.5	−3.8	−3.5	−2.5
Maximum	8.1	4.2	5.2	5.1
No. observations	13	5	4	3

Table A2. (continued)

Country, sample period, and statistic	*Actual GDP growth rate*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
Mexico: 2003–2009				
Mean	1.5	1.7	n.a.	n.a.
Minimum	–6.5	–1.2	n.a.	n.a.
Maximum	4.8	9.5	n.a.	n.a.
No. observations	8	7	0	0
Netherlands: 1995–2009				
Mean	2.1	0.2	0.8	1.1
Minimum	–4.0	–2.5	–1.8	–1.0
Maximum	4.7	5.3	5.8	5.8
No. observations	17	15	10	9
New Zealand: 1998–2008				
Mean	2.8	–0.3	0.3	0.4
Minimum	0.0	–1.7	–1.1	0.4
Maximum	4.6	2.7	4.2	0.4
No. observations	13	11	10	1
Poland: 2005–2009				
Mean	4.3	0.1	0.0	1.0
Minimum	1.2	–1.9	–1.9	–0.9
Maximum	7.1	2.0	3.3	3.9
No. observations	13	5	4	3

Table A2. (continued)

Country, sample period, and statistic	*Actual GDP growth rate*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
Portugal: 1999–2009				
Mean	1.7	0.7	1.9	2.5
Minimum	–2.7	–0.6	–0.7	0.9
Maximum	4.8	2.2	5.5	5.7
No. observations	13	11	10	9
Slovakia: 2005–2009				
Mean	4.2	0.0	0.7	1.7
Minimum	–5.7	–3.3	–4.3	–5.0
Maximum	10.4	8.1	11.5	10.8
No. observations	13	5	4	3
Slovenia: 2005–2009				
Mean	3.4	0.1	2.1	3.2
Minimum	–7.3	–1.8	–2.1	–2.1
Maximum	6.1	3.3	11.4	11.4
No. observations	13	5	4	3
South Africa: 1998–2008				
Mean	3.2	0.2	0.1	0.1
Minimum	0.4	–1.5	–1.7	–1.6
Maximum	5.6	2.6	2.7	2.8
No. observations	13	11	10	8

Table A2. (continued)

Country, sample period, and statistic	*Actual GDP growth rate*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
Spain: 1999–2009				
Mean	3.0	0.0	0.5	0.8
Minimum	–3.6	–1.4	–1.8	–0.9
Maximum	5.1	2.2	6.6	6.9
No. observations	13	11	10	9
Sweden: 1998–2009				
Mean	2.2	0.4	0.4	0.7
Minimum	–5.2	–2.4	–2.2	–1.8
Maximum	4.6	6.5	7.7	7.9
No. observations	14	12	11	9
Switzerland: 1990–2003				
Mean	1.1	0.9	1.1	n.a.
Minimum	–0.7	–1.6	–1.4	n.a.
Maximum	3.4	2.7	2.7	n.a.
No. observations	16	14	13	0
United Kingdom: 1998–2009				
Mean	2.1	0.0	0.7	0.9
Minimum	–4.8	–2.0	–1.5	–1.0
Maximum	3.8	3.8	7.6	7.3
No. observations	13	12	11	9

Table A2. (continued)

Country, sample period, and statistic	*Actual GDP growth rate*	*One-year-ahead forecast error*	*Two-year-ahead forecast error*	*Three-year-ahead forecast error*
United States: 1985–2009				
Mean	2.7	0.5	0.6	3.8
Minimum	–2.5	–3.1	–3.1	1.9
Maximum	7.0	5.5	5.6	5.6
No. observations	27	25	24	2
Total				
Mean	2.9	0.4	1.1	1.8
Minimum	–18.0	–7.3	–6.4	–5.0
Maximum	12.9	13.0	25.0	25.5
No. observations	500	369	282	175

Source: See Frankel (2011a, data appendix).
a. Years are those for which there are data for the one-year-ahead GDP growth forecast error.

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