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CHILE

Selected Issues

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Content   Page

Figures

Tables

Appendixes

I. STRENGTHENING CHILE'S RULE-BASED FISCAL FRAMEWORK[1]

A. Introduction

1.   **The cornerstone of Chile's impressive fiscal performance has been its structural balance rule.** By insulating public spending from short-term copper price fluctuations and the business cycle, the rule has helped preserve fiscal discipline. However, the implementation of the rule in recent years has revealed certain challenges, and in May 2010, the government established a high-level commission to recommend reforms that could make the rule even more effective. This paper assesses the scope for improving the design and implementation of the structural balance rule in light of best practices and OECD country experience with fiscal rules. This assessment suggests several possible options to strengthen Chile's fiscal rule, including by simplifying the calculation of the structural balance; enhancing the rule's flexibility, transparency and accountability; and complementing it with a medium-term fiscal framework.

2.   **The structure of the paper is as follows.** Section B provides an overview of how the structural balance rule has helped Chile to address its main fiscal challenges and risks. Section C assesses Chile's structural balance rule, from three complementary angles, including the rule's *de jure* design, the rule's *de facto* operational implementation, and a comparison with OECD practices. Section D outlines options to strengthen Chile's structural balance rule. Section E concludes.

B. Background: Chile's Main Fiscal Challenges and Risks

3.   **Chile's economy remains highly vulnerable to external shocks, but especially to volatility in copper prices.** Shocks include sharp exchange rate changes, natural disasters, as well as terms of trade fluctuations, among others. But one of Chile's most important fiscal challenges, by far, is managing the volatility of copper tax revenues, especially given the large and increasing amount of revenues that the government derives from the copper sector (see Appendix 1). While during 2000–04 copper revenues accounted for only 5 percent of total revenues (around 1 percent of GDP), in the last five years copper revenues have increased significantly and accounted for 24 percent of total government revenues (or almost 6 percent of GDP). If fully spent in real time, copper revenues would have put pressure on absorptive capacity and triggered pressures for a sizable real appreciation of the currency.

4.   **To address these challenges, since 2001, the authorities have put in place the structural balance rule.** The rule built on the copper stabilization fund adopted in the late 1980s, which allowed government spending to evolve in line with sustainable copper revenues, valued at the long-term copper price. In 2001, the government added an adjustment for the business cycle and defined the structural balance as the central government balance evaluated at

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[1] Prepared by Teresa Dabán.

potential output and the long-term copper price. In 2002, committees of experts were designated to provide independent, technical estimates of potential output and the long-term copper price. The government then set a target for the structural balance in line with a goal for accumulation of net financial assets. The rule allowed the central government to fend off spending pressures and run large surpluses as copper prices surged. At the end of 2008, the central government's financial assets equaled 20 percent of GDP,

Figure 1. Central Government's Assets and Liabilities
(In percent of GDP)

Source: DIPRES

while financial liabilities accounted for only 6 percent of GDP, with a total net financial position equivalent to 26 percent of GDP (see Figure 1).
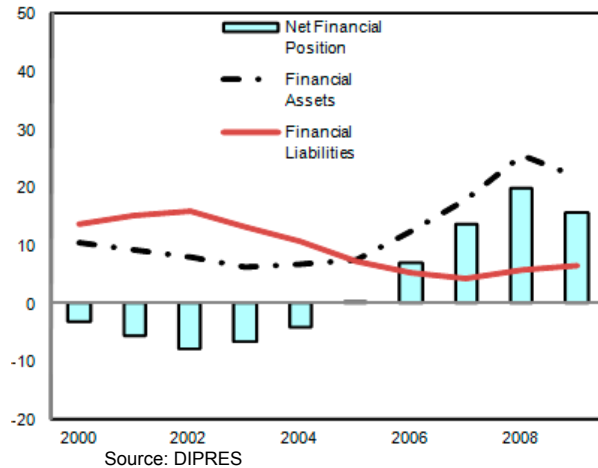
5.   **The structural balance rule was also aimed at providing long-term savings to cover Chile's contingent liabilities, which at present still remain sizeable.**[2] The main contingent liabilities include the (i) the recognition bonds introduced in the 1980s after the privatization of the pension system; (ii) the minimum pension guarantee introduced in 2008; (iii) government guarantees of borrowing by state-owned enterprises; (iv) minimum revenue and exchange rate guarantees under public-private partnership arrangements; (v) banking deposit guarantees; (vi) judicial lawsuits; and (vii) a miscellaneous of programs that provide guarantees to loans and mortgages issued by commercial banks to students, small business, and other collectives. The estimated costs of these contingent liabilities, when adjusted by expected associated risks, amounted to 13 percent of GDP in 2009. However, this estimation could be higher if the liabilities associated to the negative capital of the central bank and commitments under the fuel price stabilization funds are included. The contingent liabilities' expected costs would also increase if estimations are conducted at the maximum risk level and the contingent liabilities related to the minimum pension guarantee are computed by using the net present value of the expected future flows (see Table 1).

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[2] Since 2003 Chile has included information on contingent liabilities in its fiscal accounts. Since November 2007—following the requirement of its 2006 Fiscal Responsibility Law—it has also issued a stand-alone annual report on contingent liabilities that provides information on the amount, expected maturity, type of guarantee and beneficiaries of the government's explicit contingent liabilities, i.e., those that are defined by law or contract. However, the report does not provide an estimation of the government's implicit guarantees, i.e., those guarantees that derive from a moral or expected obligation, based on public expectations or pressures. The government's main implicit contingent liabilities derived from the expectation that (i) the government would maintain fuel prices at a stable level (e.g., the government has intervened in recent years with sizeable capital injections in its two fuel price stabilization funds, the FEPCO and FEPP, see DIPRES (2009)) and (ii) the Ministry of Finance would address the recapitalization of the central bank.

Table 1: Chile: Contingent Liabilities in 2009

	Maxium Risk Level	Methodology	Adjusted Risk Level 2/	Methodology 2/	Probability
	(In percent of GDP)				
Recognition Bonds	7.7	NPV	7.7	NPV	High
Minimun Pension Guarantee	17.5	NPV	0.9	Annual Flow	High
PPP Guarantee	4.2	NPV at max. risk	0.2	NPV adjt. Risk	Moderate
Banking Deposit Gurantee	2.8	NPV at max. risk	1.8	NPV adjt. Risk	Low
SOE debt guarantee	1.6	NPV face value	1.6	NPV face value	High
Others 1/	0.6	Annual Flow	0.6	Annual Flow	Low/Moderate
Undercapitalization central bank	2.5	BCCh's negative capital	…	…	Moderate
Petroleum Prices Stabilization Funds	0.2	Average Contribution	…	…	Moderate
Total	37.1		12.8		

1/ Includes sevaral programs to support housing, employment creation, small and medium enterprises, student loans, and judicial lawsuits.
2/ This columns corresponds to the authorities' methodology as published in DIPRES (2009)
Source: DIPRES and IMF staff estimations

C. An Assessment of Chile's Fiscal Rule

6. **This paper assesses Chile's *structural balance* rule from three different but complementary angles:** (i) from the optic of best practices on the design of fiscal rules; (ii) the practical implementation of the rule; and (iii) vis-à-vis the most common practices and approaches used by OECD countries.

Best practices on the design of fiscal rules

7. **According to best practices, rule-based fiscal frameworks are characterized by a set of distinct features.** A fiscal rule is defined as "a mechanism placing some durable constraints on fiscal discretion through numerical limits on budgetary aggregates (expenditure, revenue, budget balance and/or public debt)" (see Kumar and Ter-Minassian (2007)). However, there is no one-size-fits-all fiscal policy rule that is always and everywhere ideal. The design of a fiscal rule depends on the constellation of shocks prevalent in an economy, the nature and magnitude of the fiscal policy bias under discretion, and the main fiscal challenges ahead.

8. **The abundant literature on fiscal rules identifies a core set of critical components of a well-designed fiscal rule (IMF, 2009 and Kopits and Symansky, 1998).** These include**:**

(i) ***Clear, and as simple as possible, set of operating fiscal variables***, including a *numerical target* or *ceiling* (or a combination thereof) defined in terms of a specific fiscal indicator (or a combination thereof); a clear definition of the *fiscal objectives or challenges* the rule aims at addressing, which should be consistent with other macroeconomic policies; and an *unambiguous and stable link* between the numerical targets or ceilings and the ultimate fiscal objectives.

(ii) ***Sufficient flexibility to respond to shocks,*** which are beyond the authorities' control, so that the rule should not exacerbate the adverse macroeconomic impact of shocks (permanent or transitory). The rule should provide ex-ante sufficient room for a

stabilizing fiscal response and a gradual adjustment to the fiscal targets, while avoiding procyclicality and preserving credibility. The flexibility provisions would include, "exceptional circumstances clauses" that allow for temporary deviations in the face of major shocks; well-defined mechanisms to deal with ex-post deviations; and provisions to undertake periodic and rolling adjustments of the numerical targets.

(iii)   ***Clear and well-designed institutional arrangements,*** which should include a *clear statutory basis;* effective management and *monitoring mechanisms*, to prevent and assess deviations from the numerical targets or ceilings; *transparency and accountability provisions*, to make it explicit the cost incurred by policymakers if they deviate from the rule; and *enforcement procedures,* to ensure policymakers incur costs when deviations occur.

How does the "de jure" design of Chile's structural balance rule compare with best practices?

9.   **Chile's fiscal rule is supported by a solid and highly hierarchical institutional arrangement.** Since 2006, the implementation of Chile's structural balance rule is supported by legislation, the Fiscal Responsibility Law (FRL).[3] This gave a more solid legal foundation for the rule adopted in 2001, which had been based on a high-profile political commitment.[4] The FRL mandates that the President must adopt, within the 90 days of taking office, "a decree defining the fiscal fundamentals of his/her administration and the expected impact on the structural balance." This reflects Chile's institutional arrangement, according to which, compared with other Latin American and OECD countries, most fiscal powers are vested in the President and the executive branch (IMF, 2003, 2005). According to the constitution, the President alone may take fiscal initiatives, which congress can only approves or rejects. The constitution prohibits congress from increasing or lowering the revenue estimates in the draft budget; it may only reduce draft expenditures—as long these are not allocated by a permanent law. If congress does not approve the annual budget law within 60 days after submission by the President, the draft budget automatically comes into force.[5] Under this hierarchical system, fiscal discipline depends excessively on the commitment of a relatively small group of actors (see Blondal and Curristine (2004) and Marcel, et al. (2001)).

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[3] Law 20128 of Fiscal Responsibility, approved in September 2006.

[4] The decision to implement the structural balance rule in 2001 was taken after the overall central government balance for 1999 showed a 2 percent of GDP deficit for the first time in 10 years (see Fiess, 2001). It was perceived as highly credible, even though the rule was not mandated by law.

[5] According to Blondal and Curristine (2004), "in Chile congress enjoys very limited powers in the budget process. It simply appears to be accepted across the political spectrum that congress would act irresponsibly in the budget area if it were given any substantive power."

10.   **The FRL defines clearly the nature and coverage of the *structural balance,* but provides no guidance on the practical implementation of the rule.** The *target* of Chile's fiscal rule, i.e., the *structural balance,* is defined as "the balance that the central government would have achieved if the economy was operating at potential, i.e. excluding the effect that the cyclical fluctuations in economic activity, the copper price, and other factors of similar nature, may have on the government revenues and expenditures" (Article 16 FRL, 2)). The structural balance is the measure of the central government's *discretionary fiscal policy.* The definition of the structural balance excludes the central bank and public enterprises but includes the central government's interest payment and interest receipts.

11.   **The FRL does not define the objectives of the rule.** Instead, the FRL focuses on the use of fiscal surpluses, if generated by the implementation of the rule. Moreover, it authorizes the Ministry of Finance to allocate 0.5 percent of GDP per year, during 2006–11, for the recapitalization of the central bank provided the central government runs an overall surplus. It also creates two sovereign funds: (i) the Pension Reserve Fund (PRF), aimed at covering future (after 2016) commitments on minimum pensions; the PRF is funded with a minimum annual contribution of 0.2 percent of GDP (to be made even in the case of overall deficit), which can be increased to 0.5 percent of GDP; and (ii) the Economic and Social Stabilization Fund (ESSF), which replaced the Copper Stabilization Fund, and was designed to compensate for drops in revenue in periods of slower growth and/or lower copper prices, and to finance any future deficits as an alternative to borrowing. The ESSF's resources will come from any central government overall surpluses (after the contributions to the PRF and the transfers for the recapitalization of the central bank have been done). Resources from the ESSF can be used to fund the contributions to the PRF when the overall central government balance is negative.

12.   **The FRL does not include an explicit provision to respond to major shocks nor envisage any provision to handle temporary ex-post small deviations.** In principle, Chile's rule is very flexible because it allows the government to modify the structural balance target at any time. Indeed, the target has been changed on two occasions, in 2008 and in 2009, when circumstances required a change. However, the FRL does not specify the circumstances under which the structural balance target could be changed, the procedures that need to be followed to introduce these changes or the process to return the fiscal accounts to normal. In fact, once a target value for the structural balance is specified, the rule becomes extremely rigid, with no ex-ante and transparent "escape clauses." Moreover, the FRL does not specify whether the compliance of the rule should apply to ex-ante estimates or ex-post outcomes or envisage any mechanism to correct small ex-post deviations. These small deviations may take place because of forecast errors in the estimation of structural revenues, which usually are very sensitive to most recent data and revisions to historical data.

13.   **The FRL includes important provisions on the monitoring and transparency of the rule, but leaves out any formal verification process.** The most salient aspects of the FRL are (i) requiring the Budget Directorate to compute the structural balance each year;[6] (ii) allowing the government to rely on independent experts for non-binding judgments on the long-term copper price and the key inputs for potential output;[7] and, (iii) requiring the Budget Directorate to issue an annual report on the government's contingent liabilities. Moreover, the FRL does not provide for the monitoring and reporting of the actual structural balance or for independent third party verification of the compliance with the rule.

Implementation of Chile's structural balance

14.   **In practice, the nature, rationale and even the methodology of the structural balance rule are usually laid out in policy papers of the Budget Directorate.** A 2001 policy paper of the Budget Directorate (see Marcel et al. (2001)) outlined for the first time Chile's *structural balance* rule. The paper noted that the structural surplus targeted with the rule (1 percent of total GDP at the time) was to be used to recapitalize the central bank, pre-finance contingent liabilities, and create a buffer of net financial assets to allow the central government to absorb external shocks. The paper also noted that the rule was designed "to allow the automatic stabilizers in the budget to work uninhibited, while reducing the procyclicality of the fiscal policy, avoiding fine-tuning of fiscal policy to the phases of the cycle, and isolating the economy from transitory shocks." However, the rule, as defined in the policy paper, does not include an explicit debt ceiling or a floor for the government's net financial position that could help provide a medium-term anchor.

15.   **The initial methodology devised by the Budget Directorate to compute the structural balance was relatively easy to understand.** The initial methodology devised in Marcel et al. (2001) consisted in (i) estimating *ex-ante* the expected structural revenues $E(SR_t)$, i.e., the revenues that the government would have achieved if the economy was operating at potential and the copper price was at its long-term level; (ii) subtracting from the expected structural revenues the structural balance (SB_t, e.g., a 1 percent of GDP surplus as originally envisaged in 2001); and (iii) calculating the expenditures (E_t) as a residual, according to the following formulae:

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[6] The FRL indicates in its Article 16 that "the Budget Directorate (also known as DIPRES in Spanish) would compute the structural balance according to the methodology, procedures, and other applicable norms that would be established by a Supreme Decree of the Ministry of Finance". This Supreme Decree on the methodology of the structural balance has not been enacted yet.

[7] When the structural balance rule was announced for the first time in 2000, the long-term copper price was decided by the government. In the year 2002, and as way to enhance the rule's credibility, the government nominated an independent panel of experts to determine this price. The authorization to delegate on an independent panel the

$$E_t = E(SR_t) - SB_t$$

$$E(SR_t) = E(R_t) - E(A_t)$$

where $E(SR_t)$ will equal the expected government revenues ($E(R_t)$) minus the expected adjustments for the long-term copper price and the output gap, $E(A_t)$. This methodology, as explained in Marcel, et al. (2001), was predicated on (i) the absence in Chile of public spending programs with a cyclical component; and (ii) the need to preserve the simplicity of the rule by focusing on the essential cyclical adjustments.

16. **The expected fiscal outcomes are very sensitive to the estimates of structural revenues, which are unobservable.** Under the rule, any overestimation of the structural revenues will translate into higher expenditures and a more expansionary fiscal stance. For instance, any overestimation of the long-term copper price by the panel of experts would translate into an increase in expenditures. This implies that the expenditure level, and the fiscal policy stance devised under the rule, becomes endogenous to changes in key parameters, such as the long-term copper prices and other exogenous factors not related to the copper price and the cycle (such as the exchange rate, copper production, and inflation).

17. **During 2001–04 the computation of the structural balance was relative easy to replicate.** Initially copper prices were very stable, and the returns from the sovereign funds were small.[8] In addition, given the large investment levels in the 1990s, private mining companies' reported large amortizations and low levels of profits and income tax (see Figure 2). Therefore, during these years, (see Velasco et al. (2010)), the copper price adjustment entailed mainly computing the physical sales of the national copper company (CODELCO) at the long-term copper price. The rest of revenues, including the taxes paid by private mining companies, were adjusted according to the output gap of the total GDP, in an aggregate way and following the IMF guidelines on the calculation of structural balance.

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determination of the long-term copper prices was enshrined in the FRL enacted in 2006. This copper panel meets once a year to define the long-term copper price that determines the budget envelope for the following year.

[8] See Velasco et al. (2010). Returns from the sovereign funds in 2004 only accounted for 0.3 percent of total government revenues (or 0.1 percent of GDP).

Figure 2. Chile: Copper Price Evolution and Composition of Mining Revenues
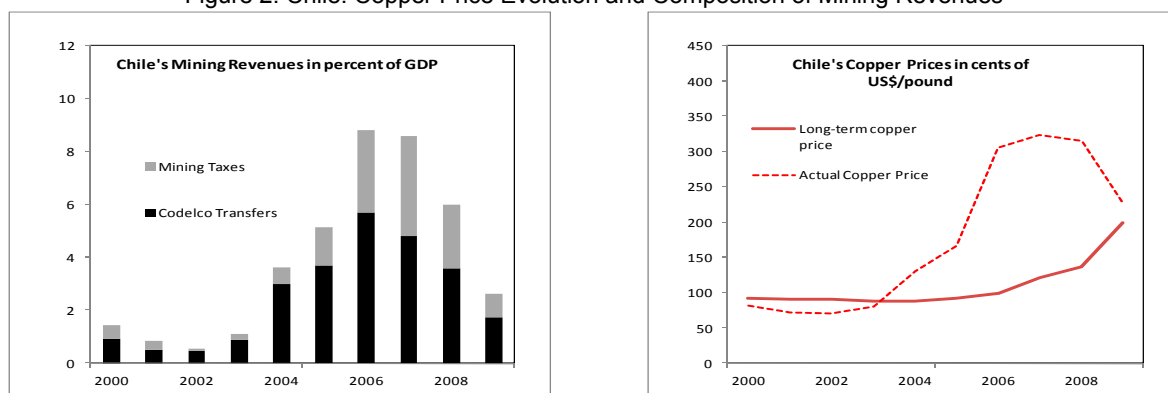
Sources: DIPRES and staff calculations.

18.   **After 2005, the computation of the structural balance became quite challenging, as
the structure of the economy evolved.** The main challenges derived from non-linear impact of
soaring copper prices in mining tax collections, the introduction of new specific mining taxes,
the coming into stream of the production of other minerals (e.g., molybdenum), and the increase
in the return of the sovereign funds (which reached almost 4 percent of total revenues in 2008,
reflecting an increase in the funds' balances and higher world interest rates). To avoid that these
developments could translate into an increase in structural revenues, and therefore, into an
increase in expenditure, the Budget Directorate included additional adjustments to the rule (see
Table 2). These adjustments have rendered the methodology for the calculation of the structural
balance difficult to replicate, and has opened the door for the introduction of discretionary
adjustments.[9]

Table 2. Chile: Modifications to the Methodology of Calculation of the Structural Balance, 2005–10

Type of Modification	Date
Long-term copper price adjustment extended to income tax of mining companies	August 2005
CODELCO's revenues adjusted by the long-term price of molybdenum	December 2005
Long-term copper price adjustment extended to specific tax on mining	January 2006
Long-term copper price adjustment extended to tax on repatriated profits of mining companies	December 2006
Long-term copper price adjustment extended to advanced payments under the specific tax on mining	December 2007
Adjustment of the sovereign funds' return according to an estimated "long-term interest rate"	September 2008
Exclusion of some transitory tax modifications	January 2009
Elasticities of individual taxes were updated and applied item by item (according to OECD methodology for the calculation of structural balance)	June 2009
Non-mining non-tax revenues are also adjusted according to the output gap	January 2010

  Sources: Velasco et al. (2010) and Rodriguez, Tokman, and Vega (2007).

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[9] The recalculation of the mining taxes under the long-term copper price is conducted separately for the currently
existing three mining taxes, including the income tax, the tax on repatriated profits, and the specific mining tax, and for
each of the main components of these taxes, including advanced payment, and return fillings (see Velasco et al., 2010).

19.   **The authorities' willingness and ability to revise the methodology in an open way has been a facet of strength.** The Budget Directorate has published ample and detailed information on the methodology for the computation of the structural balance, and all of its modifications. The Budget Directorate also publishes abundant information on the calculation, ex-ante and ex-post, of the structural balance. Publications include the actual values and projections of the overall balance along with the estimated cyclical components from which it is possible to derive the structural balance (see Table 3). The published information also readily allows for the calculation of other standard fiscal indicators, such as the primary balance.

Table 3. Chile's Fiscal

Structural Balance, Non-Mining Structural Balance and Real Expenditure Growth
(In percent of GDP, unless otherwise noted)

.	200	200	200	200	200	200	200	200	200
Overall Balance	-	-1.2	-	2.	4.	7.	8.8	5.2	-
Total cyclical adjustments	-	-1.9	-	1.	3.	6.	7.8	4.6	-
Structural Non-Mining Taxes	-	-0.9	-	-	-	-	-	0.2	-
Copper	-	-1.0	-	1.	3.	6.	7.9	3.4	0.
Molybdenum								0.0	0.
Private mining companies								1.0	0.
Specific mining tax								0.0	0.
Others								0.0	-
Structural Balance	1.	0.	1.	1.	1.	1.	1.0	0.6	-
Non-mining structural balance	-	-1.5	-	-	-	-	0.1	-	-
(in percent of non-mining GDP)									
Real expenditure	5.	4.	2.	5.	6.	4.	8.4	7.8	17.

Sources: Authorities and staff projections.

20.   **The assessment of Chile's fiscal policy focused almost exclusively on the structural balance, which at times has imparted an unintended procyclicality to government expenditures**. The structural balance is not necessarily a good indicator of the impact of fiscal policy on domestic demand. A more informative indicator of the fiscal policy stance is the *structural non-mining balance*, defined as the structural non-mining revenues minus total expenditures (see Medas and Zakharova, 2009). By looking at the non-mining structural balance during 2000–08, a slightly different, yet complementary, assessment of Chile's fiscal performance emerges. During these years, the government's structural balance of 1 percent of GDP was equivalent to non-mining structural deficits that hovered around 0.8 and 1.8 percent of the non-mining GDP, implying that in certain years the structural balance rule imparted a sizeable fiscal impulse to the economy. In particular, during the boom years (2007–08), the non-mining structural deficit and the real rate of growth of expenditures increased significantly, even though the output gap was positive (see Figure 3). The increase in expenditures in 2008 partly reflected the discretionary reduction in the structural surplus target, for 1 percent of GDP to 0.5 percent of GDP, but also the upward revision in the expert-determined long-term price of copper and the increase in the return of the sovereign funds (which was part of structural revenues until 2009).

21.   **The procyclicality of the rule may also have been driven by the absence of well-defined provisions to handle *ex-post* deviations.** The actual structural balance reported ex-post by the Budget Directorate (see Table 3) seems to indicate the implementation of end-of-the year adjustments to ensure the ex-post compliance with the rule. The fact that the Chilean government has in fact tried to comply ex-post with the target appear to have enhance the rule's credibility, but at the price of leading, at times, to procyclical fiscal tightening or loosening.

Figure 3: Chile's Key Fiscal Indicators
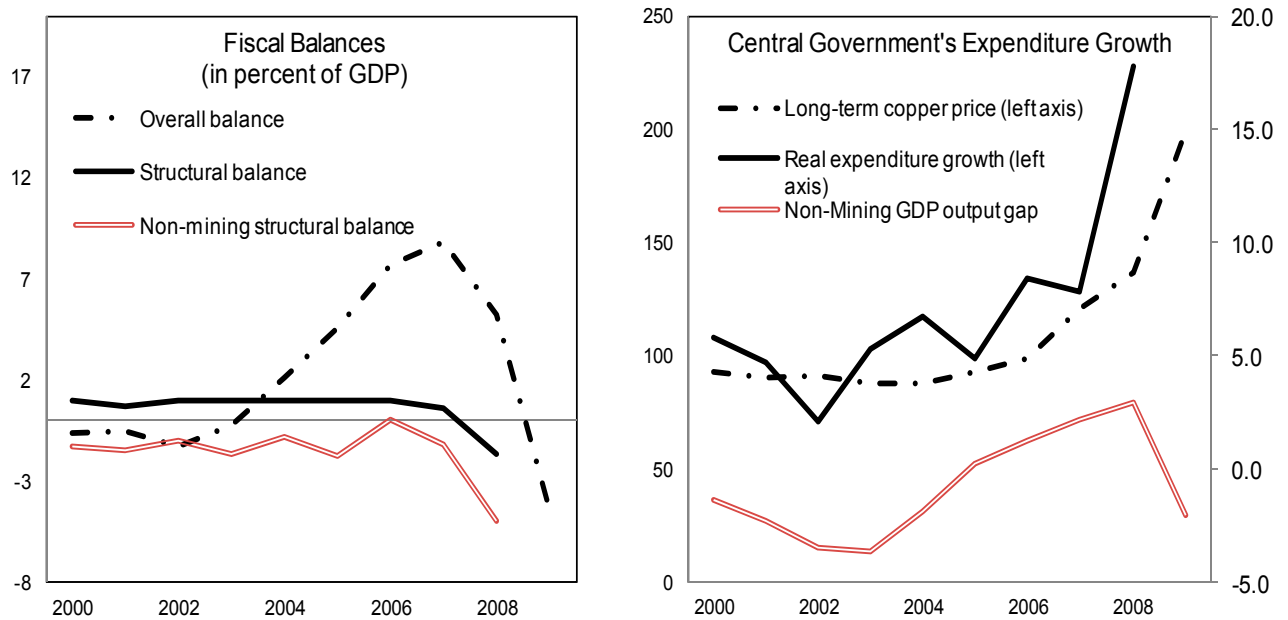
Source: DIPRES and staff calculations.

22.   **Chile's definition of the structural balance has no clear and straightforward link with fiscal sustainability**. The fiscal indicator that is relevant to maintain the government's net financial position at a positive and sustainable level is the overall balance and not the structural balance as defined under the Chile's rule. So far, by targeting a structural surplus, Chile's government has managed to post large overall balances, especially during 2004–08, and has improved substantially its net financial position. However, targeting a structural surplus or balance is not a guarantee of achieving an overall surplus or balance. This could be illustrated with an extreme case of a sharp and large fall in the copper price. If the actual copper price falls suddenly below the long-term copper price, the government could post an overall deficit, while at the same time posting a structural surplus. Under this scenario, the fiscal policy will reduce the government's net financial position, while at the same time not violating the structural surplus target.

Table 4. Assessment of Chile's Structural Balance Rule

Best Practices	Design	Practical Implementation
• A (or several) clear and simple *numerical target(s)* in terms of a (or several) specific fiscal indicator(s). • A clear definition of the *fiscal objectives or challenges.* • An *unambiguous and stable link* between the numerical targets or ceilings and the ultimate fiscal objectives. • *Exceptional circumstances clauses* that allow for temporary deviations in the face of a major shock. • Well-defined mechanisms to deal with *ex-post deviations.* • Provisions to undertake *periodic and rolling adjustments of the numerical targets*, if need be. • A *clear statutory basis.* • Effective *monitoring* and *transparency* mechanisms • *Accountability* arrangements.	• Yes; Chile's definition of *structural balance* is clear. • No; the rule aims at insulating expenditure from transitory shocks; but the FRL does not specify the rule's fiscal objective. It only focuses on the use of fiscal surpluses. • Mixed; the rule has (i) an excessive focus on the annual structural balance; and (ii) a weak connection with long-term fiscal goals. • No; the rule does not explicitly allow for a discretionary countercyclical response, even in cases of large shocks. • No; the rule does not specify whether compliance is ex-ante or ex-post, or envisage any mechanism to correct ex-post deviations. • Mixed; the rule is in principle very flexible because it does not constraint the government's capacity to modify the structural balance target, but it does not include any guidance on circumstances under which changes can be introduced. • Yes; the structural balance rule is supported by special legislation, the Fiscal Responsibility Law (FRL). • No specific provisions envisaged in the FRL, except for the obligation of the Budget Directorate to compute each year the structural balance. • Mixed; two independent panels are convened to provide the long-term copper price and the components of the output gap; no independent authority verifies compliance with the rule.	• The computation has become very complicated in last few years. • The rationale and methodology of the rule is laid out in policy papers published by the Budget Directorate. • No quantitative long-term target for the government's net financial wealth. Upward revisions in long-term copper prices have imparted an unintended procyclicality to government spending. • In the absence of these exceptional clauses, the rule has been the facto suspended in 2010, because of the earthquake in February. • The absence of mechanisms to handle ex-post deviations has incentivized the implementation of end-of-the year adjustments to ensure ex-post compliance. • The target has been changed over time for various reasons; although not required by the FRL, the changes have been usually supported by detailed analytical work. • The FRL is very generic and does not include any provision on transparency, accountability, exceptional clauses, and ex-post deviations. • Fiscal performance is monitored on an ongoing basis; strong responsiveness to new informational demands. • Public understanding of the rule is quite high, in spite of its complexity, which reflects the authorities' efforts to explain the performance under the rule.

23.   **In spite of the absence of specific escape clauses, in practice the government has made judicious changes to the structural balance target and clearly explained the rationale for them.** Since its inception, the numerical targets for Chile's structural balance rule have been changed two times. In 2008 the government reduced the structural balance from the initial target of 1 percent of GDP established in 2001 to 0.5 percent of GDP, and further to zero percent of GDP in 2009. In spite of not being required by the FRL, these changes have been usually accompanied by detailed evidence that the changes (in both cases, a reduction in the structural surplus) would not jeopardize fiscal sustainability. For instance, in 2007 the Budget Directorate issued a policy paper (see Engel, Marcel, and Meller (2007)) that notes that the reduction in the structural surplus undertaken in 2008 was justified as the government reached its objective for net financial assets. The reduction in 2009 was justified to allow for a countercyclical fiscal response to the global financial crisis. In 2010 the rule has been temporarily suspended after the earthquake in last February. In fact during 2009 and 2010, the rule *de facto* has been implemented in a different way, with expenditures determined by the government's immediate needs (and therefore not calculated as a residual as in previous years), and with the structural balance computed as the residual.

24.   **Despite its relative complexity, the structural balance rule, gives the public and markets important confidence-enhancing information about future macro-fiscal responses into the medium-term.** The rule is very well known to the public and has helped signal the future behavior of the government (e.g., everybody expects that the central government will not increase expenditure in line with copper prices or GDP growth, see IMF 2003, 2005). The rule's credibility is strong also because of the government's decision to rely on two independent panels of experts to determine critical inputs for the estimation of the structural balance: the long-term copper price and the rates of growth of the labor force, capital accumulation, and total factor productivity. Statements identifying the members and documenting the panels' results are published by the Budget Directorate on a regular basis.

How does Chile's structural balance rule compare to OECD practices?

25.   **Like Chile, most OECD countries have rule-based fiscal frameworks.** According to the OECD, 27 out of its 31 country members[10] have a rule-based fiscal framework. The countries that do not have a rule-based fiscal framework are Japan, Korea, Turkey and the United States. In most of the cases, the fiscal rules are supported by specific national legislation, guidelines or supranational agreements, except for the cases of Greece, Ireland and the Slovak Republic, in which fiscal policy is only constrained by the EU rule-based framework. The

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[10] The 31 member countries of the OECD are: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States.

rationales that OECD countries put forward for the adoption of a fiscal rule are very diverse and include a combination of objectives such as ensuring public debt sustainability, addressing common pool problems in highly decentralized countries or within international arrangements, restraining domestic demand expansions, and tackling future ageing-related spending needs. Although several OECD countries, as Chile, derive an important part of government revenues from natural resources, only two of them, Mexico and Norway, have adopted special mechanisms to manage these revenues.

26.   **In contrast with Chile's rule, which focuses only on one fiscal indicator, OECD countries' fiscal rules usually include a combination of fiscal indicators.** The most common combinations are (i) fiscal rules that include an upper limit on gross or net public debt or a desirable debt path and ceilings on one or several definitions of deficit (overall, structural balance, primary balance, and non-oil primary balance) (e.g., Maastricht Treaty and the Stability and Growth Pact); and (ii) fiscal rules that include ceilings for the overall balance and the level or the growth rate of expenditures (either in nominal or real terms) (e.g., Sweden, Finland, Netherlands) (see Appendix 2). The rationale for combining several fiscal indicators derives from the difficulties of tackling at the same time, and with only one individual fiscal indicator, both sustainability and cyclicality issues. A few countries also complement their fiscal rules with borrowing rules (e.g., prohibition of central bank financing; "golden rules" according to which government borrowing must be equal to public investment) and revenues rules (e.g., caps on tax rates or rules to save revenues windfalls).

27.   **Most OECD fiscal rules are embedded in comprehensive institutional arrangements.** These arrangements include fiscal responsibility laws; full-fledged medium-term fiscal and expenditure frameworks; well-defined escape clauses, which limit or suspend the application of the rule during exceptional circumstances; stringent transparency requirements; and special accountability mechanisms, such as the creation of non-partisan fiscal councils. In a few countries these institutional arrangements are even more important than the fiscal rule itself and some countries (New Zealand, Australia, and United Kingdom) do not even specify any numerical target.[11] The relevance of these institutional arrangements responds to an increasing debate, among OECD countries, to consider rule-based fiscal frameworks as devices that seek (i) to maximize the reputational costs of breaching commitments but without formally restricting discretion; and (ii) to guide the public debate on fiscal policy, rather than put fiscal policy on automatic pilot (see Kumar and Ter-Minassian, (2007)). This debate has been driven

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[11] For instance, New Zealand's Fiscal responsibility Act aims at maintaining public debt at "prudent" levels by running appropriate operating balances. See Lienert (2010).

by recent experience that shows that adequate institutional arrangements can deliver better fiscal outcomes than stand-alone mechanical numerical fiscal rules.[12]

D. Options to Strengthen Chile's Fiscal Rule

28.   **The previous analysis suggests that Chile's structural balance rule would benefit from a few adjustments.** The main areas for improvements could be: (i) simplifying the computation of the structural balance; (ii) avoiding any unintended procyclicality; (iii) adding a medium-term fiscal anchor; (iv) incorporating explicit escape clauses; (v) strengthening the rule's monitoring and transparency mechanisms; and (vi) enhancing the rule's enforcement and accountability procedures.

29.   **The methodology for the calculation of the structural balance needs to be easy to understand and replicate by independent third parties.** One way to improve the methodology could be to adjust non-mining tax revenues for to the output gap of the non-mining GDP, instead of total GDP, which would also facilitate the estimation of more reasonable elasticities for each of the components of non-mining taxes vis-à-vis the cycle. Moreover, the structural balance target should be defined in primary terms, i.e., excluding net interest payment (interest payments minus interest receipts), and especially the sovereign funds' returns. In addition, the current methodology to adjust mining revenues, which implies the recalculation of individual components of mining taxes at the long-term copper price, could be simplified and the existing room for discretion could be minimized. As an illustration, structural mining revenues (SR_t^m) could be computed by multiplying total mining revenues (R_t^m) by the ratio between the long-term and actual copper prices, according to the following formula:

$$SR_t^m = R_t^m * [\text{Long-term Copper Price}_t/\text{Actual Copper Price}_t]^\gamma$$

where Long-term Copper Price$_t$ < Actual Copper Price$_t$ and γ is the estimated elasticity of mining revenues to the ratio of the actual copper price to the long-term copper price. Assuming that $\gamma = 1$, Figure 4 shows that the profile and level of the structural mining revenues, and therefore expenditures, would have been broadly in line with the results obtained by using the methodology currently applied by the authorities.

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[12] In this respect the analogy with the "rules versus discretion" debate as regards monetary policy is instructive. Central bank reforms, including inflation targeting, have not eliminated discretion. Instead they have sought to create a framework and provide clear institutional guarantees that discretion would not be misused. In other words, monetary policy rules aim at preserving the benefits of both discretion and rules without facing the costs of either of them (see Bernanke et al. (1999), Wyplosz (2008), and Kumar and Ter-Minassian (2007)).

Figure 4. Chile: Structural Copper Revenues and Expenditures Under Alternative Price-based Corrections

Sources: Authorities, Haver Analytics, and staff calculations.
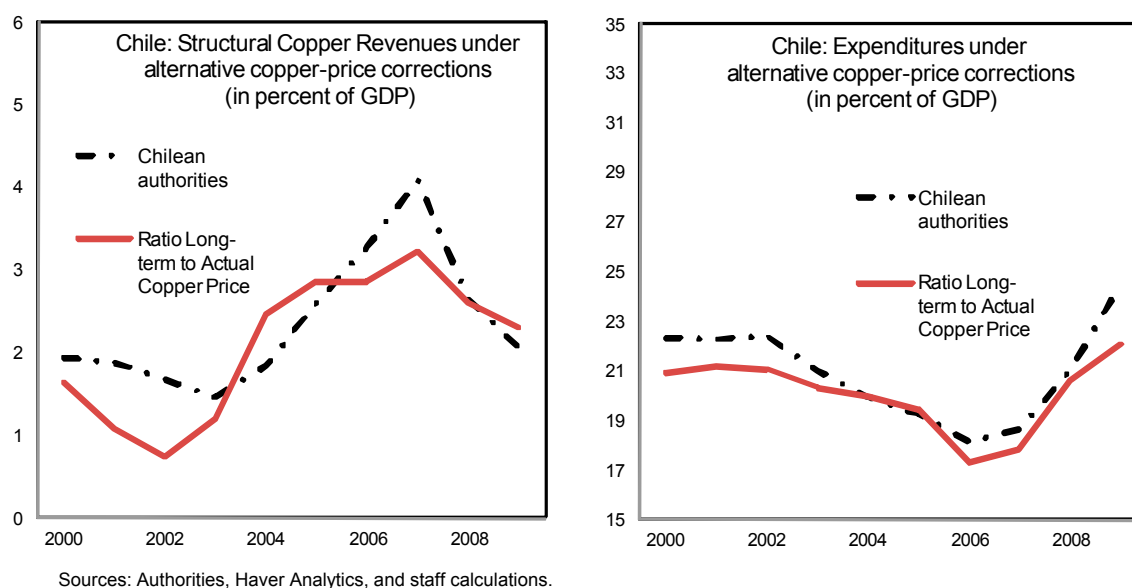
30.   **Unintended procyclicality could be reduced.** This can be done: by (i) capping the annual growth rate of government expenditures in real terms; (ii) publishing on a routine basis the calculation of the structural non-mining primary balance (as a percent of non-mining GDP); and (iii) adding provisions to handle ex-post deviations to avoid last-minute fiscal tightening or loosening at the end of the year to comply with the rule, similar to the provisions applied by Germany and Switzerland (see Table 5). For example, the expenditure level determined by the structural balance rule, E_t, could be considered as an upper limit. The ex-post deviations from the structural balance rule could be treated in the following way: (i) if the deviation is due to a larger ex-post level of structural revenues, the windfall will be saved, and the level of ex-post expenditure will be maintained at the initially planned level E_t; (ii) if the deviation is due to a lower level of ex-post structural revenues, and therefore a higher level of ex-post structural deficit, the ex-post level of expenditure could also be maintained at E_t. In this second case, the deviations in the structural balance could be stored in a notional account, with the obligation of adopting corrective actions in the next three years after the account reaches a certain level.

31.   **The Chile's fiscal rule could be strengthened by including well-designed escape clauses.** These clauses would define "exceptional circumstances" that would allow for temporary deviations in the face of a major shock. They should be limited to a short list (e.g., earthquake, the recent global crisis, a major demand imbalance under which the rule is declared in abeyance, see Table 6). They should also be precisely described with very limited discretion in interpreting events. An essential requirement also is to have pre-determined, credible and transparent procedural mechanisms (e.g., debate in congress) for the approval of the temporary departure from the rule. In addition, the rule should include provisions mandating the authorities to revise the government's medium-term fiscal framework in a way that would allow fiscal accounts to return back to the rule.

Table 5. Management of Ex-post Deviations from Fiscal Rules in Selected OECD Countries

Country	Mechanism	Correction Actions
Germany	If the expost outturn of the structural balance deviates from the 0.35 percent of GDP limit, the (positive or negative) gap is stored on a notional control account corrected from those errors deriving from real GDP growth projections.	If the notional account debit exceeds 1.5 percent of GDP, the authorities needs to implement an adjustment. The adjustment only needs to be launched during an economic recovery to avoid a procyclical tightening.
Switzerland	Ex-ante expenditures are computed as predicted revenues adjusted by the ratio of trend GDP to expected real GDP. At the end of the year, the expost expenditure ceiling is calculated by multiplying the actual revenue by the ratio of actual GDP to trend GDP. Any deviations of actual spending from the calculated ex post spending ceiling, independent of their cause, are accumulated in a notional compensation account.	If the negative balance in that account exceeds 6 percent of expenditures (about 0.6 percent of GDP) the authorities are required by law to take measures sufficient to reduce the balance below this level within three years.

Source: IMF (2009).

Table 6. Escape Clauses of Fiscal Rules in Selected OECD Countries

Country	Rule	Triggering Factors	Triggering Mechanisms	Correction
Spain (2001)	All levels of government must have a balanced or in-surplus budget	Exceptional circumstances, such as natural disasters; downturns (1 percent of GDP); periods of large public investment (0.5 percent of GDP).	Congress approval	The delinquent government (region or central) has to implement a three-year adjustment plan.
Switzerland (2003)	Cyclically adjusted balanced budget	Exceptional circumstances	Supermajority Congress approval	Medium-term adjustment plan
Germany (2009)	Structural balance budget must not exceed 0.35 percent of GDP	Exceptional circumstances or natural disasters	Supermajority Congress approval	Adjustment plan
Maastricht Treaty (1992) and Stability and Growth Pact (1997, 2005)	Deficit and debt of 3 and 60 percent of GDP; close to balance or in surplus structural balance.	Real GDP had decreased annually by at least 2 percent.	Verification by European authorities.	A medium-term adjustment plan

Source: Kumar and Ter-Minassian (2007) and IMF (2009).

32.   **The structural balance rule could benefit from the introduction of a long-term fiscal anchor.** The anchor could be established as a target (e.g., defined as a floor within a reasonable range) for the government's net financial wealth, which should be sufficient to cover existing contingent liabilities and provide the government with a buffer to counter unexpected shocks. This would require monitor the size of the overall balance on a routine basis as well as the number of consecutive overall deficits that will be allowed before modifying the numerical target of the structural balance. The achievement and monitoring of the long-term fiscal anchor could be supported by a full-fledged medium-term fiscal framework (MTFF), which will include rolling expenditures ceilings and non-mining revenues targets, long terms projections of copper revenues, and a full account of existing contingent liabilities. The MTFF could be subject to stress tests and sensitivity analysis, on a routine basis or under major changes in key parameters. The adoption of an MTFF is vital to limit, assess and correct ex-post deviations from the rule.

33.   **The transparency mechanisms of Chile's fiscal rule could also be enhanced.** Although not required by the FRL, the government provides the public with a large amount of high quality and relatively opportune information on budget formulation, execution and the performance under the structural rule. However, information is presented in a large number of documents that are difficult to reconcile. In addition, a consolidated assessment of the government's assets and liabilities, and reconciliation with key flows, is not provided on a regular basis. Reforms should focus on reflecting in a legal document (e.g., a supreme decree) a set of well-defined transparency provisions so that they become permanent components of Chile's fiscal framework, rather than depending on the goodwill of governments. The provisions should outline: (i) a clear calendar for fiscal reporting; (ii) the scope and contents of reports; and (iii) a clear mandate for the fiscal reports to include the financial statements and net asset position of public enterprises, the central bank and other public institutions and the consolidated net financial position of the government.

34.   **The rule's accountability mechanisms could be strengthened, by expanding the mandate of the current panels of experts, and transforming them into an independent fiscal council (FPC).** The adoption of a FPC is a reform that delegates part of the policy makers' mandate to an independent and specialized body. Cross-country experience shows that this type of reform usually occurs slowly and encounters stiff opposition. However, a variety of FPCs operates in a number of countries (see Table 7) and seems to have contributed to fiscal discipline (see Kumar and Ter-Minassian (2007)). Country experience also shows that the desirable mandate and set up of FPC should be country specific. Chile could take advantage of its successful experience with the adoption of independent bodies such as the central bank's independent Monetary Policy Committee and the two panels of experts that aid in the implementation of the structural balance rule. The FPC could provide: (i) objective analysis of current fiscal policy; (ii) independent projections and forecasts of key macrofiscal variables; and (iii) an assessment on the application of the rule, including by providing an opinion in the case the escape clauses are evoked and suggesting corrective actions. The FPC would have only an

advisory role, with the final decision made by the government and congress, and should be accountable to the legislative branch.

35. **Looking ahead, the structural balance rule could envisage a cyclical adjustment on the expenditure side.** At present, no cyclical adjustment is made to the expenditure side, because of the limited size of spending programs with a cyclical component, such as unemployment benefits. However, these programs could increase in size over time, which will translate into an increase in the size of the automatic stabilizers of Chile's budget as well. Larger automatic stabilizers would strengthen the structural balance rule's powers to minimize business cycle volatility and minimize the need for discretionary fiscal actions (see Kumhof and Laxton (2010)).

Table 7. Fiscal Councils in Selected OECD Countries

Country	Governance	Mandate	Accountability
U.S., Congressional Budget Office (CBO), established in 1975, 230 full staff.	The CBO director is appointed jointly by the House of Representatives and the Senate and can be removed by either house of Congress. He/she is appointed solely on his/her professional competence, without regard to political affiliation.	Advises Congress and the public on fiscal issues, assesses budget laws, monitors budget execution, and estimates fiscal impact of draft laws.	Congress; the CBO senior staff regularly testifies before Congress
Germany, Working Group on Tax Estimates, since 1950.	Representatives of federal and Laender administration, central bank, and biggest think tanks, appointed by the Ministry of Finance.	Publishes regular estimates of government revenues	Federal and Laender governments
Netherlands, Central Planning Bureau (CPB), since 1945, 170 full time staff.	Board of Directors appointed by the Minister of Economic Affairs in consultation with key economic line ministries.	Provides the economic assumptions for the budget and undertakes research on budget issues.	The CPB is a public entity. Subsequent ministries have respected and preserved the CPB's independence.
Korea, National Assembly Budget Office, 92 full time staff	Head appointed by Congress; the head appoints other staff solely on professional competence, not political affiliation.	Advises Congress on fiscal policy issues; analyzes budget policies, estimates fiscal impact of draft laws, and conducts research.	Congress
Japan, Fiscal System Council	It is an entity of the Ministry of Finance; composed of scholars, governor of the central bank, journalists, and business executives.	Advises the Ministry of Finance on fiscal policy and accounting issues.	It has big influence on budget formulation ideals and process; accountable to the Ministry of Finance.

Source: Kumar and Ter-Minassian (2007) and web pages of the selected fiscal councils.

E.   Conclusions and Summary

36.   **Chile has a broadly well-designed fiscal system, a strong reputation of prudent fiscal management, and an enviable fiscal position**. The cornerstone of Chile's impressive fiscal performance and strong fiscal system has been its structural balance rule. Since its inception in 2001, the rule has helped to preserve fiscal discipline, while leaving room for countercyclical policies. It has helped to insulate public spending from copper price cycles and improve the government's net financial position. In addition, the structural balance rule has proved to be an effective communication tool of Chile's fiscal policy.

37.   **Nonetheless, the rule could be strengthened in several ways.** The improvements should envisage: (i) the simplification of the calculation of the structural balance; (ii) the adoption of well-designed escape clauses to allow discretionary responses to negative shocks; (iii) the minimization of the rule's unintended procyclicality by incorporating provisions to deal with temporary ex-post deviations and capping the rate of growth of expenditures, especially in the context of sharp upward revisions in the long-term copper price; (iv) the introduction of an explicit long-term fiscal anchor, (e.g., in terms of a target for the government's net financial position); (v) the institutionalization and strengthening of the transparency practices currently used by the Chilean authorities, by specifying them in a legal document, such as a supreme decree and expanding its coverage; and (vi) extending the scope and mandate of the panels of experts beyond their current responsibilities, by allowing them to provide an objective analysis of current fiscal policy and assess compliance with rule.

38.   **In addition, Chile's authorities could seize this opportunity to strengthen their fiscal policy framework on a comprehensive way, beyond the strengthening of the fiscal rule, and in line with OECD countries.** Chile should adopt a full-fledged medium-term fiscal framework to improve fiscal planning and provide a framework for addressing temporary deviations from the fiscal rule. Publishing additional fiscal indicators in the budget, such as the non-copper structural balance, could provide more comprehensive information on the impact of fiscal policy on the domestic demand.

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APPENDIX 1. CHILE'S COPPER SECTOR

At present Chile is the world's largest copper producer, with an annual production of 5.5 millions of metric tons, which accounts for over 40 percent of world production. Within the Chilean economy, copper accounts for 45 percent of exports. Chile sells 35 percent of its copper to China, followed by Europe (20 percent), the U.S. (8½ percent) and South Korea (8½ percent). Mineral resources belong to the State that exploits them either through the State-owned enterprise CODELCO, which remains one of the country's largest copper producers (30 percent of Chile's total production) and a regime of concessions and joint ventures with private firms, most of them foreign.

As a result, copper production remains one of the most important sources of revenues for the government. Chile's tax regime on mining activities include (i) a small profit-related royalty, introduced in 2005, (ii) the standard corporate income tax, which is levied on all mining companies, included CODELCO; and (iii) the transfer of CODELCO to the central government budget. During 1987–2001, on average, copper revenues accounted only for 2½ percent of GDP. However, during 2001–09, reflecting increasing copper production, but above all increasing copper prices, copper revenues reached almost 5 percent of GDP.

Prospects of Chile's copper sector remain positive, given the large volume of existing reserves and expectation of increasing global demand. Chile hosts about 30 percent of the world known copper sub-soil assets. According to the most recent official information (see *Evolución de las Reservas y Recursos de Cobre, Molibdeno, Oro, Plata Nitrato y Yodo en Chile, 2001–2007*, by M. Gajardo and W. Vivallo, Servicio Nacional de Geología y Minería, Gobierno de Chile, 2009), Chile's total sub-soil copper assets amounted to 368 millions of metric tons in 2007, which are estimated to last for 63 years if the current annual production of 5.5 millions of metric tons is maintained. Due to the expected sustained increase in copper prices and demand, Chile's copper production is expected to expand further in the next few years.

APPENDIX 2. RULE-BASED FISCAL FRAMEWORKS IN OECD COUNTRIES

Country	Type of Rule	Statutory Basis	Coverage	Planning Horizon	Comments
Australia	Rules on Revenue, Balanced Budget, and Debt	Fiscal Responsibility Law (1998)	Central Government	Multiyear	The FRL provides a framework for the conduct of fiscal policy. Each annual budget must include a fiscal strategy statement covering the next four years. The strategy's key elements are to achieve budget surpluses on average over the cycle, keep taxes as a share of GDP on average below the level for 2007–08 and improve the government's net financial worth. The strategy does not require that the budget remains in surplus every year over the economic cycle. An additional expenditure rule, which comes into force once the economy grows above trend, restrains real growth in spending to 2 per cent a year until the economy returns to surplus.
Austria	Expenditure, Balanced Budget Rule and Debt Rule	National Law and European Union framework	Central and General Government	Multiyear for the Expenditure Rule and Annual for the Budget and Debt Rules	Balanced budget rules for central, regional and local governments contained in a National Stability Pact within a multiyear budget setting and with formal enforcement procedures. The expenditure rule was adopted in 2007 and took effect with the 2009 budget. At the supranational level the Euro area rules apply.1/
Belgium	Balanced Budget and Debt Rule (1992)	International Treaty	General Government	Annual	Euro Area rules.1/
Canada	Expenditure Rule, Balanced Budget Rule, and Debt Rule (1998)	Political Commitment and Fiscal Responsibility Law	Central Government	Annual	An independent body monitors budget developments.
Czech Republic	Expenditure Rule (2005) at the national level and Balanced Budget and Debt Rules at the supranational level (2004)	International Treaty and Law	General Government and Central Government	Multiyear for the Expenditure Rule	*Expenditure limits inserted in a medium term expenditure framework (MTEF) covering 2 years beyond the budget year. The government may change the MTEF for the originally second and third years when at the time of the presentation of the annual draft budget, but only in pre-defined cases. The government has to explain deviations from the approved MTEF to the parliament, who has to approve such deviations. At the supranational level the EU framework applies.1/*
Denmark	Expenditure Rule (1994), Revenue Rule (2001), Balanced Budget Rule, and Debt Rule (1992)	International Treaty and Political commitment	General Government	Cyclically Adjusted or Multiyear	*The structural budget balance should be in balance by 2015 and real public consumption on a national account basis must not increase by more than certain amounts per year. In addition, expenditure should not exceed 26.5 percent of cyclically adjusted GDP in 2015. Direct and indirect taxes cannot be raised. At the supranational level the EU rules apply.1/*

Country	Type of Rule	Statutory Basis	Coverage	Planning Horizon	Comments
Finland	Expenditure Rule (1999), and Balanced Budget and Debt Rules Treaty; Law (1995)	International Treaty and Political commitment	General and Central Government	Multiyear for the Expenditure Rule	Spending limits in the Spending Limits Decision 2010-2013 adopted in March 2009. Unemployment-related appropriations and similar automatic stabilizers are outside the spending limits (about ¼ of total spending). Target of structural surplus of 1 percent of potential GDP. Cyclical or other short-term deviations allowed, if they do not jeopardize the reduction of the central government's debt ratio. Central government's deficit must not exceed 2.5 percent of GDP. The government decided in February 2009 that it can temporarily deviate from the central government's deficit target if structural reforms are undertaken to improve general government finances (in the medium or longer term). At the supranational level the EU rules apply.1/
France	Expenditure rule (1998), Revenue Rule (2006), and Debt Rule (2008)	International Treaty; Political commitment	Central and General Governments	Multiyear expenditure rule	Limit on real increase in central government's expenditures. The central government defines the allocation of higher than expected tax revenues ex-ante. Each increase in the Social Security debt has to be matched by an increase in revenues. At the supranational level EU rules apply.1/
Germany	Balanced Budget Rule (1972), Expenditure Rule (1982) and Debt Rule (1992)	International Treaty; Constitution	Central and General Governments	Multiyear expenditure rule	"Golden rule" which limits net borrowing to the level of investment except in times of a "disturbance of the overall economic equilibrium." A new structural balance rule was enshrined in the constitution in June 2009. After a transition period, starting in 2011, it will take full effect in 2016 for the Federal government and in 2020 for the states. The rule calls for a structural deficit (net of one-off items) of no more than 0.35 percent of GDP for the Federal government and structurally balanced budgets for the Laender. At the supranational level EU rule apply.1/
Greece	Balanced Budget and Debt Rules (1992)	International Treaty	General Government	Annual	Only the Euro area regulations apply.1/
Hungary	Balanced Budget Rule and Debt Rule (2004)	International Treaty and Law	General Government	Annual	Primary budget surplus balance target. In November 2008, Hungary adopted a primary budget balance rule and a real debt rule which will take effect in 2012. Transition rules call for a reduction of the budget deficit (in percent of GDP) and limit real expenditure growth in 2010 and 2011. At supranational level EU rules apply.1/
Iceland	Expenditure Rule (2004)	Political Commitment	Central Government	Multiyear	De facto fiscal rule comprising three-year spending targets and countercyclical adjustments to public investment.
Ireland	Balanced Budget and Debt Rules (1992)	International Treaty	Central Government and General Government	Annual	Euro area rules apply.1/

Country	Type of Rule	Statutory Basis	Coverage	Planning Horizon	Comments
Italy	Balanced Budget and Debt Rules (1992)	International Treaty	Central Government and General Government	Annual	Euro area rules apply.1/
Japan	Expenditure Rule (1974)	Law	Central Government	Annual	There has been a golden rule under which current expenditure shall not exceed domestic revenues (Public Finance Law, Article 4). Since 1975, except during the period 1990–93, the government has requested a waiver of this rule every year.
Luxembourg	Expenditure and Debt Rules (1990) and Balanced Budget Rule (1992)	International Treaty; Political commitment	Central and General Government	Multiyear Expenditure Ceiling	In the course of the legislative period, public expenditure growth is maintained at a rate compatible with the medium-term economic growth prospects. Independent body sets budget assumptions. Some rules exclude public investment or other priority items from ceiling. The central government maintains public debt at a low level. New public debt can be issued to finance rail infrastructure projects. At supranational level the Euro area rules apply.1/
Mexico	Balanced Budget and Revenues Rules (2006)	Fiscal Responsibility Law	Central Government	Multiyear Expenditure Ceiling	Balanced budget on a cash basis. Starting with the 2009 fiscal year, the definition was changed to exclude the investment outlays of the state-owned oil company Pemex. This change reflects general reforms aimed at boosting investment in oil projects and the inclusion of all Pemex's investment projects as budgetary investment. Any excess revenue (relative to budgeted amounts) can first be used to compensate for certain additional non-programmed budget expenditures such as shared revenues with the states or higher interest costs. The remainder is split among three funds. The oil stabilization fund can be used to finance revenue shortfalls (compared to the budget) of the federal government.
Netherlands	Balanced Budget and Debt Rules (1992) and Expenditure and Revenue Rules (1994)	International Treaty and Coalition Agreement	General Government	Multiyear expenditure ceiling	Real expenditure ceilings are fixed for total and sectoral expenditure for each year of government's four-year office term. Expenditure includes interest payments. If overruns are forecast, the Minister of Finance proposes corrective action. At the beginning of the electoral period, the coalition agrees on the desired development of the tax base, and this multi-year path needs to be adhered to during the period. Additional tax increases are compensated through tax relief and vice versa. Independent body sets budget assumptions. Some rules exclude public investment or other priority items from ceiling. At the supranational level the EU framework applies.1/

Country	Type of Rule	Statutory Basis	Coverage	Planning Horizon	Comments
New Zealand	Balanced Budget and Debt Rules (1994)	Fiscal Responsibility Act (FRA)	General Government	Multiyear expenditure ceiling	The FRA sets out the principles for responsible fiscal management. The FRA also includes principle rules for the budget and debt: (i) the government needs to run operating surpluses annually until "prudent" debt levels are achieved; (ii) prudent debt levels need to be maintained on average over a reasonable period; and (iii) a buffer against adverse events should be established. Need to specify the reasons if these principles are breached. The FRA requires governments to set out specific fiscal targets for 3-year and 10-year objectives, typically in percent of GDP. Rules exclude public investment or other priority items from ceiling.
Norway	Non-oil structural balance (2001)	Political Commitment	Central Government	Cyclically Adjusted or Multiyear	Non-oil structural deficit of the central government should equal the long-run real return of the Government Pension Fund (GPF), assumed to be 4 percent. The fiscal guidelines, which also govern the GPF, allow temporary deviations from the rule over the business cycle and in the event of extraordinary changes in the value of the GPF.
Poland	Debt Rule (1997) and Balanced Budget Rule (2004)	International Treaty and Constitution	Central and General Government	Annual	Debt ceiling of 60 percent of GDP. The Public Finance Act includes triggers for corrective actions when the debt ratio reaches thresholds of 50, 55, and 60 percent of GDP. Rules exclude public investment or other priority items from ceiling at subnational levels. At the supranational level the EU rules apply.1/
Portugal	Balanced Budget Rule (1992) and Debt Rule (2002)	International Treaty and Law	Central and General Government	Annual	Balanced budget rule for the central government. Rules exclude public investment or other priority items from ceiling at subnational levels. At the supranational level the EU rules apply.1/
Slovak Republic	Balanced Budget and Debt Rules (2004)	International Treaty	General Government	Annual	Only the EU rules apply.1/
Spain	Balanced Budget and Debt Rule (1992)	International Treaty and Fiscal Responsibility Law	General Government	Cyclically Adjusted or Multiyear	In "normal" economic conditions, the general government and its sub-sectors must show a balanced budget or a surplus. In downturns, the overall deficit must not exceed 1 percent of GDP. In addition, a deficit of up to 0.5 percent of GDP is allowed to finance public investment under certain conditions. The "exceptional circumstances" and "special conditions" clauses have been activated during the current downturn and the provision to present plans to correct within 3 years have been put on hold without a specific time frame. At the supranational level the Euro area rules apply.1/

Country	Type of Rule	Statutory Basis	Coverage	Planning Horizon	Comments
Sweden	Expenditure rule (1996) and Balanced Budget and Debt Rules (1995)	International Treaty and Political Commitment	General and Central Government	Cyclically Adjusted and Multiyear	A surplus of 2 percent of GDP for the general government over the cycle targeted. Nominal expenditure ceiling for central government and extra-budgetary old-age pension system targeted. Some rules exclude public investment or other priority items from ceiling. At the supranational level the EU regulations apply.1/
Switzerland	Balanced Budget Rule (2003)	Constitution	Central Government	Cyclically Adjusted or Multiyear	One-year-ahead ex ante ceiling on central government expenditures equal to predicted revenues, adjusted by a factor reflecting the cyclical position of the economy. Any deviations of actual spending from the ex post spending ceiling, independent of their cause, are accumulated in a notional compensation account. If the negative balance in that account exceeds 6 percent of expenditures (about 0.6 percent of GDP) the authorities are required by law to take measures sufficient to reduce the balance below this level within three years.
United Kingdom	Balanced Budget and Debt Rule (1992)	International Treaty, Political Commitment and Fiscal Responsibility Law	General Government	Cyclically Adjusted or Multiyear	Golden rule: general government borrowing only allowed for investment, not to fund current spending. Performance against the rule is measured by the average surplus on the current budget in percent of GDP over the economic cycle. Sustainable investment rule: public sector net debt as a proportion of GDP should be held at a stable and prudent level over the economic cycle. Other things equal, net debt will be maintained below 40 percent of GDP over the economic cycle. Rules exclude public investment or other priority items from ceiling. Government could depart "temporarily" from the fiscal rules "until the global shocks have worked their way through the economy in full." Authorities have adopted a temporary operating rule: "to set policies to improve the cyclically adjusted current budget each year, once the economy emerges from the downturn, so it reaches balance and debt is falling as a proportion of GDP once the global shocks have worked their way through the economy in full." At the supranational level the EU rule apply.1/

Source: *Database on fiscal rules,* Fiscal Affairs Department, International Monetary Fund and IMF (2009).

1/ EU countries are bound to avoid excessive public deficits (defined with reference to a 3 percent of GDP threshold for the general government and reduce their public debt-to-GDP ratio to below 60 percent of GDP. In addition, they are committed to aiming at structural balances close to balance or in surplus (with country-differentiated margins). Sanctions for no compliance apply only to those countries that are members of the Euro area.

**II. TOO-CONNECTED-TO-FAIL RISK IN THE CHILEAN BANKING SYSTEM:
A BALANCE SHEET NETWORK ANALYSIS[1]**

1.   **Prudential supervision and financial surveillance requires assessing
Too-Connected-to-Fail (TCTF) risk in domestic banking systems.** The existence of direct
and indirect linkages between financial institutions, a natural consequence of the increased
interdependence and globalization of the financial system, gives rise to TCTF risk, i.e., the
risk that the failure of one institution could trigger the failure of interconnected institutions.
The costs and problems associated with TCTF risk were recently illustrated by the failures of
financial institutions during the financial crisis of 200809 and the turmoil in the financial
system brought about by the sovereign debt crisis in Greece in 2010.

2.   **This chapter uses balance sheet network analysis to measure TCTF risk in the
Chilean banking system.** Balance sheet network analysis is a simple tool that evaluates
TCTF risk from direct exposures across banks and other sectors of the economy.[2] The
analysis highlights that the main sources of domestic risk in the Chilean banking system are
shocks that affect banks' claims on households and domestic corporations. The analysis also
indicates that no bank operating in Chile appears to be a TCTF institution, and that from a
financial stability perspective, the focus should be placed on linkages with foreign banks and
the creditworthiness of claims on the non-bank financial sector.

A. Balance Sheet Network Analysis and Results

3.   **Balance sheet network analysis builds on a simple accounting identity to assess
how shocks affecting one institution affect the solvency of interconnected institutions.** In
an interconnected system, the failure of one institution affects other institutions through the
asset and liability sides of their balance sheets. On the asset side, the failure leads to a credit
shock that impairs the value of the claims on the failed institution and reduces the capital of
the bank. On the liability side, the failure leads to a funding shock as the failed institution
withdraws its funding and forces the sale of assets at fire-sale prices, which in turn, reduces
the capital of the bank. If the shocks are large enough, the failure of one institution leads to a
cascade of failures (Chan-Lau, 2010b) and justify TCTF capital charges (Chan-Lau, 2010c).

4.   **The analysis of TCTF risk was performed using monthly data on claims and
liabilities from the Banking Supervisory Agency (SBIF).** The data, collected from the
monthly reports published by the SBIF, covers twenty domestic banks and foreign bank
subsidiaries, and five foreign bank branches. For each supervised financial institution, the
report states the total amount the institution owes to other banks in the system but not to

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[1] Prepared by Jorge A. Chan-Lau.

[2] For an analysis of interconnectedness risk associated with indirect exposures, see Chan-Lau (2010a).

specific institutions. Similarly, the report states the total claims the institution has on other banks in the system but does not disaggregate claims by individual banks.

5.   **The matrix of interbank exposures was constructed by assuming that the amount a bank owes in the system is divided equally among all banks reported as having claims on other banks.** The above shortcut is analogous to assume that banks attempt to diversify their interbank exposure as much as possible. Possible alternatives that were not explored further include assigning the amount owed by one bank proportionally to the size of the claimant banks, or to use entropy techniques (Sheldon and Maurer, 1998, and Wells, 2004). Foreign banks were modeled as a single sector. The assumption of a single foreign banking sector errs on the conservative side as it implies that all foreign banks will be simultaneously affected by the same shocks.

6.   **The banking system network was augmented to include participants other than banks.** They included the Central Bank of Chile (BCCH), the non-bank financial institutions sector, the corporate sector, and the household sector. The BCCH has been an important provider of liquidity and financing to the banking sector in the aftermath of the 2008–09 global financial crisis. Non-bank financial institutions, especially pension funds and mutual funds, are important providers of wholesale funding to the banking sector. In the exposure matrix these institutions appeared as creditors. Corporations account for a substantial share of bank claims and appear as debtors in the exposure matrix. Finally, households appear both as creditors and debtors.

7.   **The analysis shows that domestic interbank exposure is relatively unimportant as the default of a single bank would not lead to further defaults,** as illustrated in Table 1 for the months of January, July, and December 2009, and April 2010. The average capital losses reported in Table 2 provides further support while pointing towards a reduction of interbank exposures during 2009. For instance, in January 2009 the hypothetical default of Bank 5 and Bank 3 would have triggered average capital losses of 10.2 percent and 7.4 percent respectively, but in December 2009 these losses declined to 1.1 percent and 0.7 percent respectively. Against this trend, risks from Bank 4 appear to have trended upwards. Average capital losses induced by its hypothetical default have increased to 6.9 percent from 0.3 percent. The hypothetical capital losses are mainly concentrated on Bank 12 (35 percent), Bank 21 (54 percent), and Bank 25 (47 percent).

8.   **Another important funding source during 2009 was the central bank.** On average, capital losses would have been approximately 3 percent if central bank funding were not available. These losses, however, are heavily concentrated in a handful of institutions. For instance, in December 2009, the institutions more affected by reduced funding from the central bank are Bank 4 (32 percent capital loss), Bank 11 (24 percent) and Bank 13 (22 percent).

Table 1.Chile: Potential Number of Induced Defaults

	Type of Shock											
	Credit Shock				Funding Shock				Credit and Funding Shock			
Number of bank failures when	2009			2010	2009			2010	2009			2010
shock comes from:	Jan.	Jul.	Dec.	Apr.	Jan.	Jul.	Dec.	Apr.	Jan.	Jul.	Dec.	Apr.
Bank 1	0	0	0	0	0	0	0	0	0	0	0	0
Bank 2	0	0	0	0	0	0	0	0	0	0	0	0
Bank 3	0	0	0	0	0	0	0	0	0	0	0	0
Bank 4	0	0	0	0	0	0	0	0	0	0	0	0
Bank 5	0	0	0	0	0	0	0	0	0	0	0	0
Bank 6	0	0	0	0	0	0	0	0	0	0	0	0
Bank 7	0	0	0	0	0	0	0	0	0	0	0	0
Bank 8	0	0	0	0	0	0	0	0	0	0	0	0
Bank 9	0	0	0	0	0	0	0	0	0	0	0	0
Bank 10	0	0	0	0	0	0	0	0	0	0	0	0
Bank 11	0	0	0	0	0	0	0	0	0	0	0	0
Bank 12	0	0	0	0	0	0	0	0	0	0	0	0
Bank 13	0	0	0	0	0	0	0	0	0	0	0	0
Bank 14	0	0	0	0	0	0	0	0	0	0	0	0
Bank 15	0	0	0	0	0	0	0	0	0	0	0	0
Bank 16	0	0	0	0	0	0	0	0	0	0	0	0
Bank 17	0	0	0	0	0	0	0	0	0	0	0	0
Bank 18	0	0	0	0	0	0	0	0	0	0	0	0
Bank 19	0	0	0	0	0	0	0	0	0	0	0	0
Bank 20	0	0	0	0	0	0	0	0	0	0	0	0
Bank 21	0	0	0	0	0	0	0	0	0	0	0	0
Bank 22	0	0	0	0	0	0	0	0	0	0	0	0
Bank 23	0	0	0	0	0	0	0	0	0	0	0	0
Bank 24	0	0	0	0	0	0	0	0	0	0	0	0
Bank 25	0	0	0	0	0	0	0	0	0	0	0	0
Central bank	0	0	0	0	0	0	0	0	0	0	0	0
Foreign Banks	0	0	0	0	1	1	1	1	1	1	1	1
Non-bank financial institutions	0	0	0	0	2	1	4	2	2	1	4	2
Corporates	17	16	14	14	n.a.	n.a.	n.a.	n.a.	17	16	14	14
Households	14	12	12	12	17	17	16	18	17	17	16	18

Sources: SBIF and staff calculations.

Table 2. Chile: Average Capital Losses
(In percent)

	Type of shock											
	Credit Shock				Funding Shock				Credit and Funding Shock			
Average bank capital losses when	2009			2010	2009			2010	2009			2010
shock comes from:	Jan.	Jul.	Dec	Apr.	Jan.	Jul.	Dec	Apr.	Jan.	Jul.	Dec	Apr.
Bank 1	0.0	1.1	0.0	0.5	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.5
Bank 2	4.4	0.0	0.1	0.1	0.0	0.0	0.0	0.0	4.4	0.0	0.1	0.1
Bank 3	7.4	1.7	0.6	0.3	0.0	0.0	0.0	0.1	7.4	1.7	0.7	0.4
Bank 4	0.3	3.1	5.7	6.7	0.2	0.0	0.0	0.0	0.5	3.1	6.9	6.7
Bank 5	10.2	1.0	0.8	0.5	0.0	0.1	0.1	0.1	10.2	1.1	1.1	0.6
Bank 6	3.2	0.0	0.0	0.8	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.8
Bank 7	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1
Bank 8	0.2	0.0	0.0	0.0	0.2	0.1	0.00	0.1	0.4	0.1	0.0	0.1
Bank 9	0.0	0.2	0.0	0.3	0.2	0.0	0.0	0.0	0.2	0.2	0.0	0.3
Bank 10	0.3	0.0	0.5	0.0	0.2	0.1	0.1	0.1	0.5	0.1	0.7	0.1
Bank 11	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.1
Bank 12	0.0	0.0	0.0c	0.0	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1
Bank 13	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
Bank 14	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
Bank 15	0.5	1.0	0.5	0.0	0.2	0.0	0.0	0.0	0.7	1.0	0.6	0.0
Bank 16	0.0	2.8	0.0	0.0	0.0	0.1	0.1	0.1	0.0	2.9	0.1	0.1
Bank 17	2.6	5.8	0.0	0.0	0.2	0.0	0.0	0.0	2.8	5.8	0.0	0.0
Bank 18	1.0	0.4	0.1	0.0	0.2	0.1	0.1	0.1	1.2	0.5	0.2	0.1
Bank 19	2.4	0.6	0.0	0.0	0.0	0.1	0.1	0.1	2.4	0.7	0.1	0.1
Bank 20	0.3	0.1	0.0	0.0	0.2	0.1	0.1	0.1	0.5	0.2	0.1	0.1
Bank 21	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1
Bank 22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bank 23	0.0	0.1	0.0	0.1	0.2	0.1	0.0	0.0	0.2	0.2	0.0	0.1
Bank 24	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.2	0.1	0.0	0.0
Bank 25	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1
Central bank	n.a.	n.a.	n.a.	n.a.	2.9	3.9	3.5	3.4	2.9	3.9	3.5	3.4
Foreign Banks	7.8	3.0	5.3	1.2	17.3	13.4	16.8	13.1	25.1	16.4	22.2	14.7
Non-bank financial institutions	0.0	0.0	0.0	0.0	43.1	41.7	43.7	35.1	43.1	41.7	43.7	36.3
Corporates	82.1	76.6	75.8	63.3	n.a.	n.a.	n.a.	n.a.	83.1	77.0	76.1	63.6
Households	68.0	64.5	58.5	53.0	86.5	85.9	85.4	71.2	86.5	85.9	85.5	73.7

Sources: SBIF and staff calculations.

9.   **Domestic banks have been reducing their exposure to the corporate and household sector while increasing their reliance on wholesale funding.** The number of banks that could default following a negative credit shock from the system-wide collapse of the corporate sector declined to 14 in April 2010 from 17 in January 2009 while average capital losses declined to 64 percent from 82 percent. Similarly, average capital losses following defaults on household loans fell to 53 percent from 68 percent. Reliance on wholesale funding from non-bank financial institutions increased during 2009 but decreased by April 2010. In December 2009, a hypothetical sudden withdrawal of non-bank financial deposits would lead to problems in four banks up from 2 in January 2009.

10.   **TCTF vulnerability is higher for foreign bank branches.** TCTF vulnerability is measured as the average capital loss the banks suffers from shocks to other banks in the system. TCTF risk is measured as the average capital loss the bank induces on other banks in the system. In the case of foreign bank branches, TCTF vulnerability has been higher owing to their large interbank exposures relative to their capital (Table 3).

Table 3. Chile: Too-Connected-to-Fail Risk and Vulnerability Measures

| | TCTF Vulnerabilty | | | | TCTF Risk | | | |
| | 2009 | | | 2010 | 2009 | | | 2010 |
	Jan.	Jul.	Dec	Apr.	Jan.	Jul.	Dec	Apr.
Bank 1	0.0	0.1	0.0	0.1	0.0	1.1	0.0	0.6
Bank 2	0.2	0.0	0.0	0.0	4.4	0.0	0.1	0.1
Bank 3	0.3	0.1	0.0	0.1	7.4	1.7	0.7	0.5
Bank 4	0.1	0.1	0.2	0.2	0.5	3.1	6.9	8.1
Bank 5	0.2	0.1	0.1	0.1	10.2	1.1	1.1	0.7
Bank 6	0.8	0.0	0.0	0.3	3.2	0.0	0.0	0.9
Bank 7	1.3	0.6	0.7	0.6	0.2	0.1	0.1	0.1
Bank 8	1.2	0.5	0.0	0.6	0.4	0.1	0.0	0.1
Bank 9	3.8	0.1	0.0	0.2	0.2	0.2	0.0	0.3
Bank 10	0.4	0.2	0.2	0.2	0.5	0.1	0.7	0.1
Bank 11	0.0	4.7	0.0	0.1	0.0	0.1	0.0	0.1
Bank 12	4.3	1.9	2.2	2.4	0.2	0.1	0.1	0.1
Bank 13	0.4	0.0	0.0	0.0	0.5	0.0	0.0	0.0
Bank 14	0.0	1.3	0.0	0.0	0.0	0.1	0.0	0.0
Bank 15	3.5	0.5	0.4	0.0	0.7	1.0	0.6	0.0
Bank 16	0.0	0.1	0.0	0.0	0.0	2.9	0.1	0.1
Bank 17	0.2	0.1	0.0	0.0	2.8	5.8	0.0	0.0
Bank 18	0.7	0.3	0.3	0.3	1.2	0.5	0.2	0.1
Bank 19	0.4	0.4	0.4	0.5	2.4	0.7	0.1	0.1
Bank 20	0.2	0.1	0.1	0.1	0.5	0.2	0.1	0.1
Bank 21	6.5	2.9	3.3	3.6	0.2	0.1	0.1	0.1
Bank 22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bank 23	5.1	2.3	0.0	0.1	0.2	0.2	0.0	0.1
Bank 24	0.6	0.3	0.0	0.0	0.2	0.1	0.0	0.0
Bank 25	6.0	2.6	2.9	2.9	0.2	0.1	0.1	0.1

Sources: SBIF and staff calculations.

B. Conclusions

11.   **Linkages with foreign banks and non-bank financial institutions are the main sources of TCTF risk in the Chilean banking sector.** No single domestic bank appears to pose substantial risks to the banking system since interbank exposures are small relative to the capital held by the banks. From a financial stability perspective, financial surveillance should be focused on assessing and understanding the domestic banking system exposures to foreign banks and non-bank financial institutions rather on interbank exposures. Foreign bank branches appear more exposed to TCTF risk than banks incorporated in Chile but their relatively small size, however, limits the risk they pose to the system.

12.   **Balance sheet data analysis should be complemented with the use of market-based measures of TCTF risk**. Balance sheet analysis is a useful tool for monitoring systemic risk in the banking system, and in the case Chile, easy to implement given the data availability. Balance sheet network analysis, however, may not be enough to capture all potential sources of risk so it should be complemented with market-based measures (Chan-Lau, 2010a).

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APPENDIX 1. BALANCE-SHEET NETWORK ANALYSIS: AN INTUITIVE EXPLANATION

Credit shocks are associated with losses on the asset side of the balance sheet. Claims on other banks are recorded as an asset. When other banks default, the value of the claim is reduced since it is unlikely that the creditor bank recovers the claim's full value, or in other words, the loss given default is strictly positive, or equivalently, the recovery ratio is less than one hundred percent. In consequence, the capital of the bank declines.


Credit Shock
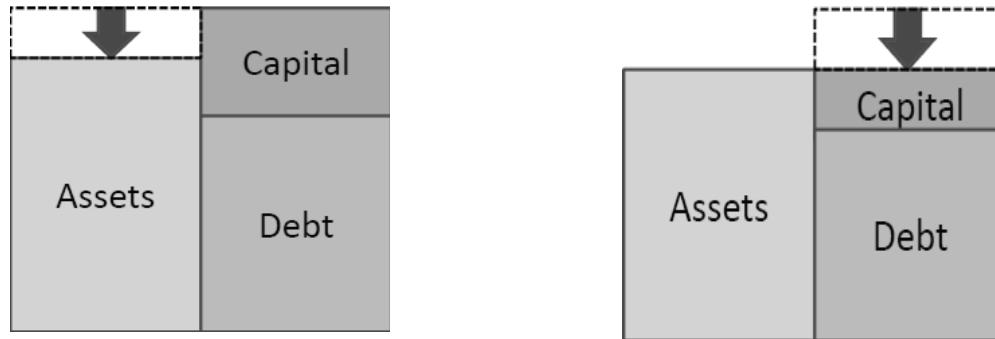
The bank defaults if the losses exceed the value of its capital:

$$\text{Capital} - \Sigma \text{ Claims on defaulted banks} \times \text{Loss Given Default} < 0$$

A simple simulation can determine whether the default of a bank can trigger a cascade of failures. After setting the default of a specific bank, the equation above is used to see whether losses to other banks could trigger their default. If another bank defaults, its defaulted claims are taken away from the capital of the surviving banks and again, it is necessary to check whether another bank defaults as a consequence of the new default. The previous step is repeated until no other bank defaults. When only credit shocks are analyzed, it is assumed that other banks can replace funding from defaulted banks without major difficulties.

Funding shocks are associated with the sudden withdrawal of funding and constitute a liability shock. Because assets need to be supported by liabilities, a sudden shortfall in funding sources leads to a reduction of the balance sheet of the bank if it cannot find alternative funding sources. Under normal market conditions the amount of assets the bank needs to sale is equal to the loss of funding and the bank capital is not affected. Furthermore, the leverage of the bank declines lowering the probability that it may become insolvent.

Funding Shock Under Normal Market Conditions
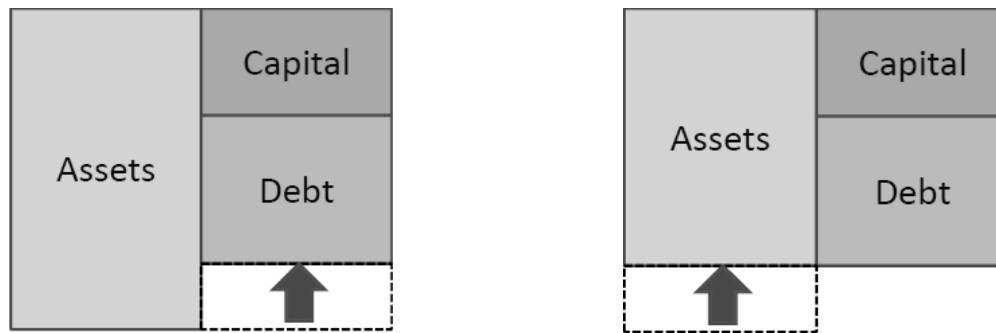
The bank, however, may be forced to liquidate assets at below face values under fire sale conditions, especially if the market is undergoing a liquidity shortage, the assets are very illiquid, or if the bank holds large positions in certain assets. In the latter case, if other banks and market participants know that the affected bank needs to liquidate certain assets, they may collude to mark these assets down in order to take advantage of the bank's distress. In this case, the bank may need to liquidate assets in excess of the funding withdrawn from the bank. These losses are reflected in capital losses.

Funding Shock Under Stressed Market Conditions
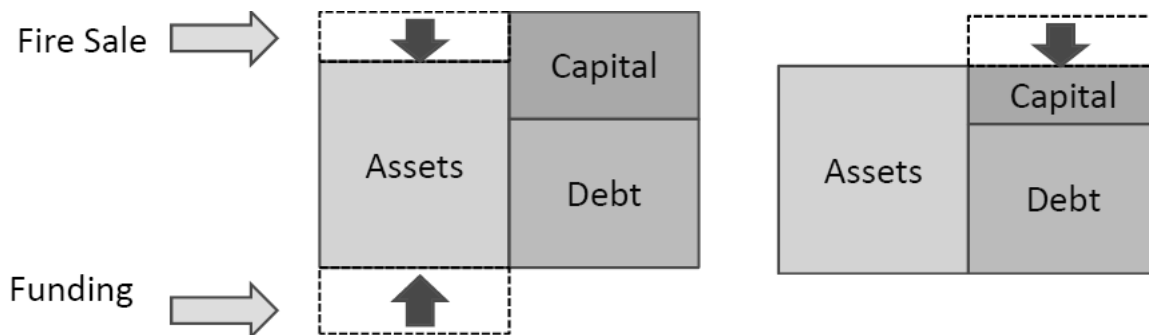
For some banks, funding losses could exceed their capital and cause their default. In this case, the initial funding shock leads to both subsequent credit and funding shocks as other banks default. The following inequality determines when a bank defaults:

$$\text{Capital} - \sum \text{Claims on defaulted banks} \times \text{loss given default}$$
$$- \sum \text{funding withdrawal} \times (1 - \text{replacement ratio}) \times \text{fire sale loss ratio} < 0$$

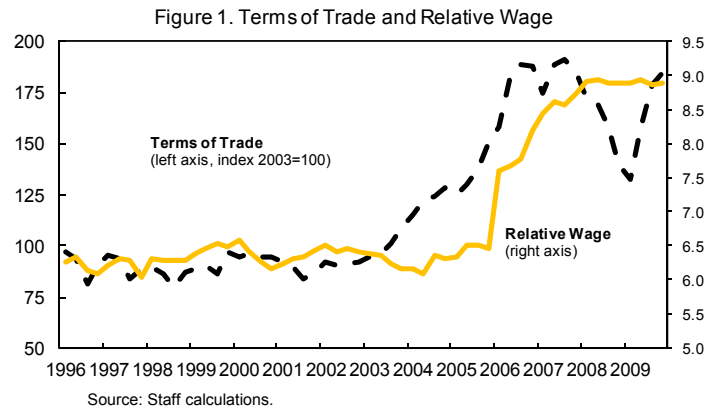### III. A NOTE ON TERMS OF TRADE SHOCKS AND THE WAGE GAP[1]

1.   **In the last two decades, income inequality improvements in Chile have been modest in spite of strong growth.** Average real GDP growth since 1990 has been 5 percent, while per capita real GDP increased 3.6 percent on average. Yet, income inequality has improved only marginally. Measured by the Gini coefficient, income inequality has remained virtually unchanged—it was 55.9 in 1990, and 55 in 2009.

2.   **This paper provides one possible answer to this puzzle, focusing on the effects of the terms of trade on income inequality.** Income distribution in this analysis is measured by the wage gap between skilled and unskilled workers. Even though other variables could certainly affect the country's income distribution, Chile's dependence on natural-resource exports warrants an analysis of the effects of terms-of-trade shocks.

3.   **There is ample evidence of high inequality in resource-rich countries.** Leamer et al. (1999), IMF (2007), and Spilimbergo et al. (1999) link inequality to increased globalization. Since new imported technologies require more intense use of skilled workers, the relative wages of skilled workers increase (see also Feenstra and Hanson, 2001). Chile has invested strongly in education in recent years. Yet, Chile lags behind OECD countries in terms of relative skills. A related literature shows a positive corelation between the skill premium and export growth (Brambilla et al., 2010, Klein et al., 2010, Reshef, 2007, and Acemoglu, 2002). However, none of these paper focuses on the impact of external shocks on the wage distribution in resource-rich economies.

4.   **This paper documents how improvements in the terms of trade favor skilled workers over unskilled workers given that non-tradable goods are skilled-intensive.** Using Chilean data, we show that for resource-rich small open economies the effects of terms of trade shocks on the wage gap (between skilled and unskilled workers) depend on factor intensities in the non-tradable sector. Following the model in Galiani, Heymann, and Magud (2009), we show that for a skilled-intensive non-tradable sector, improvements in the terms of trade benefit skilled workers. We also show that this relation holds at the industry level: the wage gap widens in skilled-intensive sectors while it shrinks in unskilled-intensive ones, the more so as terms of trade volatility decreases.
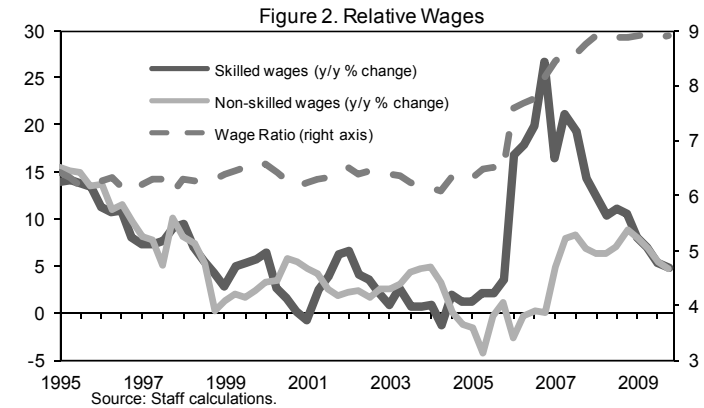
A. Motivation

5.   **To motivate the discussion, thus, we need to focus on two facts:** (i) the direct relation between terms of trade shocks and income distribution, and (ii) how the latter is conditional on factor intensities.

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[1] This chapter was prepared by Nicolas Magud and it is based on the IMF Working Paper "A Note on Terms of Trade and the Wage Gap" (forthcoming), by Nicolas Magud and David Coble.

6.   **In Chile, there is a co-movement between terms of trade and relative wages (skilled vs. unskilled).** These variables have been relatively stable until 2003, and since then they have jointly increased until the financial crisis that started in late 2008.

Figure 1. Terms of Trade and Relative Wage

Terms of Trade
(left axis, index 2003=100)

Relative Wage
(right axis)

Source: Staff calculations.

7.   **Most of the increase in the wage gap results from larger increases in wages paid to skilled workers.** Both types of wages had moved relatively closely prior to the sharp increase in the terms of trade starting in 2005. After that, however, skilled workers' wages increased proportionally more.

Figure 2. Relative Wages

Skilled wages (y/y % change)
Non-skilled wages (y/y % change)
Wage Ratio (right axis)

Source: Staff calculations.

8.   **The effects of shocks to the terms of trade on income distribution, in turn, depend on factor intensities**. In the classical Stolper-Samuelson case, they depend on relative factor intensities between tradable goods. However, countries do have a large share of their production being non-tradable goods. Theoretically, Galiani, Heymann, and Magud (2009) show the distributional effects of terms of trade shocks in the presence of non-tradable goods conditional on factor intensities. Thus, to evaluate the effects of the mentioned shocks in Chile we need to know the relative use of labor between tradable and non-tradable goods, as explained below.

9.   **In Chile, the non-tradable sector is skilled-intensive.** Using information from the Encuesta de Caracterizacion Socio-Economica Nacional (CASEN Survey), we observe that the non-tradable sector is skilled-intensive, as its relative use of labor favors skilled workers—compared to the production of tradable goods. The ratio of unskilled workers to skilled workers is over 2.5 times (5.6/2.2) *larger* than in the tradable sector.

Table 1: Labor Intensities by Sector

	Non-Tradable	Tradable	Total
Ratio Unskilled/Skilled Workers	2.2	5.6	2.8
Share of workers by sector (percent of total labor force)	72.01	27.99	100

Source: Staff calculations using data form CASEN Survey 2006.

10.   **Improvements in the terms of trade favor skilled workers over unskilled workers given that non-tradable goods are skilled-intensive.** Using Chilean information of income levels by level of human capital, we provide evidence of the redistributional effects of shocks to the terms of trade. Given a skilled-intensive non-tradable sector, the

wage gap worsens as the terms of trade improve—since skilled workers' relative wage increase. The following section summarizes the rationale behind it.

B.   Theory[2]

11.   **The economy produces three goods—two of which are tradable but not necessarily traded.** These are agricultural goods (its production given by the abundance of a natural resource) to represent primary goods, manufactures, and non-tradable goods. Factors of production include land (the natural resource), unskilled labor, and skilled labor. The model assumes, without loss of generality, that agricultural goods are produced using land and unskilled labor, while manufactures and non-tradable goods use skilled and unskilled labor. The model's benchmark consists of assuming that non-tradable goods are (relatively) skilled intensive. However, the paper shows the results for the case in which manufactures are skilled intensive and extends them is several directions, such as analyzing net importers, introducing physical capital, using imports as an additional input in production, alternative consumption preferences, and capital account dynamics, among many other things. It also extends the results to export taxes aimed at redistributing the effects of terms of trade shocks.

12.   **The model shows that if non-tradable goods are skilled intensive, skilled labor wage increases relative to unskilled labor** If the economy receives a (positive) terms of trade shock—defined as the relative price of exports to imports—clearly, the factor that owns the natural resource will unambiguously benefit in absolute and relative terms. (These would be the standard result of any Stolper-Samuleson or specific-factors type of model). If non-tradable goods are skilled intensive, skilled labor wage increases relative to unskilled labor (a Stolper-Samuelson result for non-tradable goods). The positive terms of trade generates a wealth effect for every agent in the economy. However, the relative price of agricultural goods increases in terms of manufactures. To clear the domestic market, the price of non-tradable goods in terms of manufactures also increases. Thus, the factor used intensively in the non-tradable sector increases at the expense of the factor used intensively in manufactures—to clear the labor market.[3] Thus, the relative wage of skilled workers increases with respect to unskilled workers'.

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[2] Details of the model can be found in Galiani, Heymann, and Magud (2009). Here we present a brief sketch of the structure of the model and some of its results, drawing heavily on that paper. The interest reader is referred to the original manuscript for the full details or Magud and Coble (2010) for a simplified summary.

[3] Given relative skill-intensity in manufactures, the decrease in labor demand of the manufacturing sector needs the unskilled real wage to decrease for the labor market to clear, as the demand for unskilled labor in agricultural and non-tradable goods is relatively smaller.

C. Empirics

13.   **Regressing the wage gap of skilled vs. unskilled workers on terms of trade we observe that the wage gap worsens in the terms of trade.** Based on the above, we collect Chilean data on wages conditional on the years of schooling and terms of trade for 1993–2009. This would be consistent with an economy in which the non-tradable sector is skilled-intensive. CASEN documents that in fact this is the case for Chile.

14.   **The data shows that the wage gap does worsen in skilled-intensive sectors and improves in unskilled intensive ones, in line with theory.** In order to delve into the details behind the above result we further exploit the data set. We have information of the wage gap disaggregated by production sector (mining, financial services, manufactures, etc.). We perform several robustness checks such as controlling for real GDP per capita growth, GDP per capita, lagged wage gap, volatility of the terms of trade, among others. The results remain robust to all the different specifications.

Data

15.   **Terms of trade data is provided by the Banco Central de Chile (BCCh).** It is computed as the ratio of export price index over the import price index (2003=100 for both of them). The data has quarterly frequency between 1996:1 to 2009:4.

16.   **The wage gap is based on data produced by the Instituto Nacional de Estadisticas de Chile (INE).** Following standard procedures, the wage series for skilled workers were proxied by the average income perceived by managers. The wages of unskilled workers were given by the category unskilled—some robustness checks were performed using alternative classification for skilled workers, conditional on the average level of human capital. The results were mostly unaltered. These data had monthly frequency for the period 1993:4–2009:12 for the aggregate economy. Similar exercises were conducted at the industry level, for which the monthly sample spanned 1993:4–2005:12. In each case, monthly incomes were averaged over each quarter so as to make it consistent with the terms of trade data.

Table 2. Descriptive Statistics

	Terms of Trade (index 2003=100)	Relative Wage	GDP per capita growth (q-o-q percent change)
Mean	119.80	6.9	2.2
Median	96.53	6.4	2.3
Maximum	191.43	8.9	10.2
Minimum	79.97	6.0	-5.8
Std. Dev.	37.29	1.0	2.9
Jarque-Bera	7.7	19.8	1.2
Probability	0.0	0.0	0.6
Observations	56	67	66

Source: Staff calculations based on Central Bank and National Bureau of Statistics data.

17.   **Some controls were added.** Among the controls, real GDP per capita growth (from BCCh) spanned the entire sample period. Volatility measures were constructed by computing 3-quarter moving average of standard deviations of the series.

18.   **Given that Chile is a small open economy the terms of trade, measured by the export to imports prices ratios can be taken as exogenous.** Thus, simple OLS regressions were run to test for the validity of the theoretical model. In order to focus on percentage changes logs of the variables (wage ratio and terms of trade) were taken before running the regression—thus the coefficients will represent elasticities.

Results

19.   **The aggregate economy's results show that the wage gap worsens as terms of trade improve.** The coefficient is statistically significant at the 1 percent level (see column (1)). It is also economically significant, as it implies that a 1 percent increase in the terms of trade increases the wage gap in close to half a percentage point. The R^2 is also quite solid.

Table 3. Sector Shares

Sectors' shares (percent of GDP)	
Manufacturer Industry	18.2
Financial Sector	17.2
Personal Services	12.1
Commerce	11.4
Transportations and Telecomunications	10.5
Mining	8.2
Construction	7.7
Rest	14.7

Source: Central bank of Chile

20.   **Despite unit roots, the specification is co-integrated.** 7 different tests for unit roots using *t* tests were performed (see Appendix I). Most of them came out suggesting the possibility of unit roots. However, Chumacero (2000) elaborates on the low power these tests, which tend to show false positives of the presence of unit roots. Yet, this could be a concern unless the series are co-integrated. Thus, Johansen's co-integration tests were performed. They support the existence of a long-term co-integration relationship for this specification—with a constant but no trend. This implies that regardless of the results of the unit root tests, there exist a long-term relation such that the long-run residuals are stationary, validating the level specification that we are using.

Table 4. Regression Output for the Aggregate Economy

Aggregate	(1)	(2)	(3)
Constant	-0.09	-0.12	-0.02
Terms of Trade (t-1)	0.43***	0.44***	0.41***
Growth of GDP per capita (t-1)		-1.13**	-1.11**
Std. Dev of TOT (-1)			0.02
R squared	0.75	0.79	0.79
N	55	55	54

Source: Staff calculations.

21.   **In order to obtain more robust results we controlled for the growth rate of real GDP per capita (column (2)) and the volatility of the terms of trade (column (3)).** Volatility is proxied by the standard deviation of the terms of trade. As an alternative measure of the wage gap we defined broader definitions of skilled and unskilled workers. Even though this might mask the true impact of terms of trade shocks on the wage gap—due to resulting from aggregating different types of wage-skill combinations jointly—the main message of the paper holds. Results remained robust for all the alternative specifications.

22.   **To delve into the details, disaggregated data (by sector) from INE was used.** For most of the sample period the same data is disaggregated by industry into (i) financial services, (ii) manufactures, (iii) construction, (iv) commerce, (v) transportation,

(vi) electricity, gas, and water (EGW), (vii) mining, and (viii) personal services. For each of these industries similar exercises were performed. Most of the results came out quite robust. Regarding skill-intensity, it is worth mentioning that recent data from INE (La Estructura de los Puestos de Trabajo en Chile, March 2010, pp. 7) support the results. They report that financial services and EGW are (relatively) skilled-intensive industries, while manufactures, mining, commerce, and construction are unskilled-intensive.

23.   **Financial services (with 17.2 percent of GDP) are mainly a skilled-intensive non-tradable service, in which the wage gap worsens as terms of trade improve.** It has a positive coefficient that is statistically and economically significant. It shows that in this industry the wage gap worsens as terms of trade improve. When using terms of trade as the sole explanatory variable (column (1)) we see that for each 1 percent increase in the terms of trade the wage gap increases more than half a percentage point. Controlling for real GDP per capita growth the worsening of the wage gap increases more (close to 2/3 of a percentage point) for any 1 percent increase in the terms of trade (column (2)). Results remain robust in terms of magnitude and significance when the volatility measure is added. The main coefficient in terms of our exploration, the terms of trade, increases. Furthermore, the volatility coefficient is not only very significant but negative, consistent with the theory.

Lower volatility enable skilled workers to take advantage of shocks to the terms of trade in a more favorable way—alternatively, the marginal effect of more volatility reduces the benefit of a higher human capital response to the terms of trade shock.

Table 5. Regression Output for Financial Services

Financial Services	(1)	(2)	(3)
Constant	-0.43	-0.9	-1.33
Terms of Trade (t-1)	0.53*	0.64**	0.76**
Growth of GDP per capita (t-1)		-1.88**	-2.44**
Std. Dev of TOT (-1)			-0.12***
R squared	0.12	0.17	0.32
N	39	39	38

Source: Staff calculations.

24.   **Manufactures (which represents 18.2 percent of GDP), is an unskilled-intensive tradable good; it depicts opposite results, as expected.** The wage gap improves in the terms of trade. Again it is not only significant (at the 1 percent level), but also economically significant. (A 1 percent increase in the terms of trade results in a 1/3 percent decrease in the wage gap—see column (1).) This holds when controlling for the growth rate of real GDP per capita the volatility of the terms of trade.

Table 6. Regression Output for Manufacturing

Manufacturing	(1)	(2)	(3)
Constant	3.26***	3.28***	3.3***
Terms of Trade (t-1)	-0.31***	-0.31***	-0.32***
Growth of GDP per capita (t-1)		0.09	0.05
Std. Dev of TOT (-1)			0.01**
R squared	0.59	0.59	0.64
N	39	39	38

Source: Staff calculations.

25.   **Similar results are obtained for other unskilled-intensive sector such as construction and commerce.** They show a negative coefficient given that transportation, construction, and commerce, are all unskilled-intensive—as opposed to financial services.

Table 7: Regression Output for Other Sectors

Construction	(1)	(2)	(3)
Constant	4.25***	4.47***	4.62***
Terms of Trade (t-1)	-0.51**	-0.57**	-0.61**
Growth of GDP per capita (t-1)		0.88	1
Std. Dev of TOT (-1)			0.05
R squared	0.18	0.19	0.23
N	39	39	38

Electricity Gas and Water	(1)	(2)	(3)
Constant	1.73**	1.54**	1.42**
Terms of Trade (t-1)	0.17	0.22	0.26*
Growth of GDP per capita (t-1)		-0.75	-0.64
Std. Dev of TOT (-1)			-0.06***
R squared	0.04	0.06	0.21
N	39	39	38

Commerce	(1)	(2)	(3)
Constant	3.2***	3.18***	3.12***
Terms of Trade (t-1)	-0.27***	-0.27***	-0.25***
Growth of GDP per capita (t-1)		-0.06	-0.21
Std. Dev of TOT (-1)			-0.01
R squared	0.64	0.64	0.68
N	39	39	38

Mining	(1)	(2)	(3)
Constant	2.9***	2.66**	2.58**
Terms of Trade (t-1)	-0.21	-0.16	-0.14
Growth of GDP per capita (t-1)		-0.95	-1.17
Std. Dev of TOT (-1)			-0.01
R squared	0.08	0.12	0.14
N	39	39	38

Transportation	(1)	(2)	(3)
Constant	-4.1**	-4**	-3.95**
Terms of Trade (t-1)	1.35***	1.32***	1.31***
Growth of GDP per capita (t-1)		0.41	0.54
Std. Dev of TOT (-1)			0.01
R squared	0.55	0.56	0.56
N	37	37	36

Personal Services	(1)	(2)	(3)
Constant	1.57***	1.68***	1.65***
Terms of Trade (t-1)	-0.02	-0.05	-0.04
Growth of GDP per capita (t-1)		0.43**	0.33*
Std. Dev of TOT (-1)			0
R squared	0.01	0.15	0.12
N	39	39	38

Source: Staff calculations.

D. Discussion, Conclusions, and Policy Implications

26.   **The results confirm that for countries in which non-tradable goods are relatively skilled-intensive, positive terms-of-trade shocks benefit skilled workers.** These results hold in the Chilean economy as a whole. Also, in response to the terms of trade shock, the wage gap between skilled and unskilled workers widens in skilled-intensive sectors (the more so the lower the volatility of the terms of trade) and narrows in unskilled intensive sectors. These results are consistent with theory, as in Galiani, Heymann, and Magud (2009), and robust to several specifications. The following questions are addressed next. What could be driving these facts—other than country endowments? What are the policy implications?

27.   **A driving force behind the impact of terms of trade in the wage gap for a small open economy could come from the degree of labor market flexibility.** Chile has a high share of temporary and young workers, many of which are relatively unskilled. There is a large body of research focusing on labor market flexibility. Caballero et al. (2004) show how labor market rigidities hamper the creative-destruction process, reducing growth. Cobb and Opazo (2010) document the downward inflexibility of wages for Chile and compares it to other international studies. These effects are particularly significant for young workers. Skilled workers tend to have more permanent and better paid jobs—the latter usually conditional on the years of schooling. As a consequence, in response to exogenous shocks to the terms of trade, it is temporary workers that are mostly laid off. Temporary contracts are more frequent within unskilled and/or young workers, since they are the cheapest to hire and

fire. In a sense, this asymmetric flexibility pattern between skilled and skilled workers could be behind the increase in the wage gap reported in this paper

28. **Labor market flexibility is especially important for a small open economy such as Chile, as trade openness tends to worsen income inequality in the short-run.** There is ample evidence of higher inequality in resource-rich countries. Leamer et al. (1999) and Spilimbergo et al. (1999) are some of the many examples. Globalization has been pointed out to help explain increases in income inequality. The latter, in turn, could be driven by the lack of sufficiently large skilled labor force. A related literature studies the skill premium (or returns to schooling) related to exports, showing a positive relation (see Brambilla et al. (2010) and Klein et al. (2010)).

29. **The most important policy message of the paper is the importance of investing in human capital.** The higher the share of skilled workers in the labor force, the greater the number of workers that can benefit from terms of trade shocks. This is especially important given the magnitude of the non-tradable sector. Moreover, a higher share of skilled workers imply that, in case a redistributive mechanism to smooth shocks to the terms of trade were to be implemented, there are more taxable individuals—implying, all else equal, a lower cost for each individual.

30. **Also, the paper lends support to a strategy to improve overall and especially manufacture's competitiveness, but not through protectionism.** Innovation to this sector can result in these tradable goods turning into actually traded goods—i.e., exported. In this case, manufactures will benefit when its relative price increases. (In other words, at least some part of the economy will always be better off, regardless of the nature of the terms of trade.) The higher the share of skilled workers in manufactures, the higher the share of workers that benefit. Thus, having more competitive manufactures helps enlarging the set of shock absorber mechanisms.

31. **Finally, relative factor intensity matters.** On the margin, it is better for factor intensity not to be that skewed toward one sector. The rationale for the latter goes as follows. One of the main channels behind the income re-distribution generated by the shock to the terms of trade is the mechanism by which the labor market clears. The increase in the price of the resource-based good is accommodated by an increase in the relative price of non-tradable goods jointly with a lower relative price of manufactures. The shock thus reduces demand for unskilled labor in the manufacturing sector, while it increases it in the agricultural and non-tradable sectors. Given factor intensity in the production of non-tradable and agricultural goods, the mass of unskilled workers that agricultural and non-tradable goods need to absorb is relative big given its demand for labor. Which implies that for the unskilled labor market to clear its real wage needs to be reduced. *Relative* factor intensity will almost always exist. However, if relative factor intensity is such that the relative demand

for factors does not differ substantially would help clear the unskilled labor market at a lower cost in terms of real wages reductions—consequently lessening the distributional effects.[4]

32.   **Increase in skilled labor must be accompanied by a higher degree of flexibility in the labor market.** Flexibility will contribute to making skilled (and to a lesser extent, unskilled) workers move from non-tradable to tradable sectors more easily. This will enable the labor force to accommodate to medium-term changes in terms of trade by being able to reap the benefits of the terms of trade shocks regardless of whether they are driven by increases in the price of manufactures or of agricultural goods. This matters for the Chilean case. The existence of large numbers of temporary contracts—which impact mostly unskilled and young workers—reflects the lack of sufficient labor market flexibility, as well as it asymmetry. Improving such flexibility will help to reduce the prominence of such types of contracts, diminishing the income distributional effects of terms of trade shocks.

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[4] For example, we can think that for a 0.55 ratio of skilled to unskilled labor in the non-tradable sector the unskilled workers wage drop would be smaller than if that ratio would be 0.95.

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APPENDIX 1. UNIT ROOT

Table 1.A. Various Tests

	ADF			ERS		PP			KPSS		ERSP		NP		ZA		
	Cons.	Cons. and Trend	None	Cons.	Cons. and Trend	Cons.	Cons. and Trend	None	Cons.	Cons. and Trend	Cons.	Cons. and Trend	Cons.	Cons. and Trend	Cons. and Trend	Cons.	Both
LN(TOT)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	*	Yes	Yes	Yes	Yes	Yes	*	**	Yes
LN(Wratio) aggregate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	*	Yes	Yes	Yes	Yes	***	*	Yes
LN(Wratio) Mining	*	Yes	Yes	Yes	*	*	Yes	Yes	Yes	Yes	*	Yes	**	*	Yes	Yes	Yes
LN(Wratio) Manufacturing	Yes	Yes	*	Yes	Yes	Yes	Yes	**	Yes	*	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LN(Wratio) EGW	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	*	Yes	Yes	Yes	***
LN(Wratio) Construction	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	*	Yes	*	Yes	Yes	Yes
LN(Wratio) Commerce	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**	*	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LN(Wratio) Transportation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**	Yes	Yes	*	Yes	Yes	***	***
LN(Wratio) Fin. Services	Yes	Yes	Yes	**	Yes	Yes	Yes	Yes	**	*	**	Yes	*	Yes	Yes	Yes	***
LN(Wratio) Personal Services	***	***	Yes	Yes	Yes	Yes	Yes	Yes	**	**	Yes	Yes	Yes	Yes	**	*	*
Real GDP per capita growth	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***

Note: "Yes" means that the test admits the presence of a unit root, depending on the performing test. All of them have the null hipothesis of existence of unit root, except KPSS test which have a null hypothesis of stationary process. ZA test search for a structural break endogenously, and tests if the series shows a unit root under this condition. *, ** and ***, show the possible existence of stationary process under 10, 5 and 1 percent, respectively.

APPENDIX 2. REGRESSION RESULTS
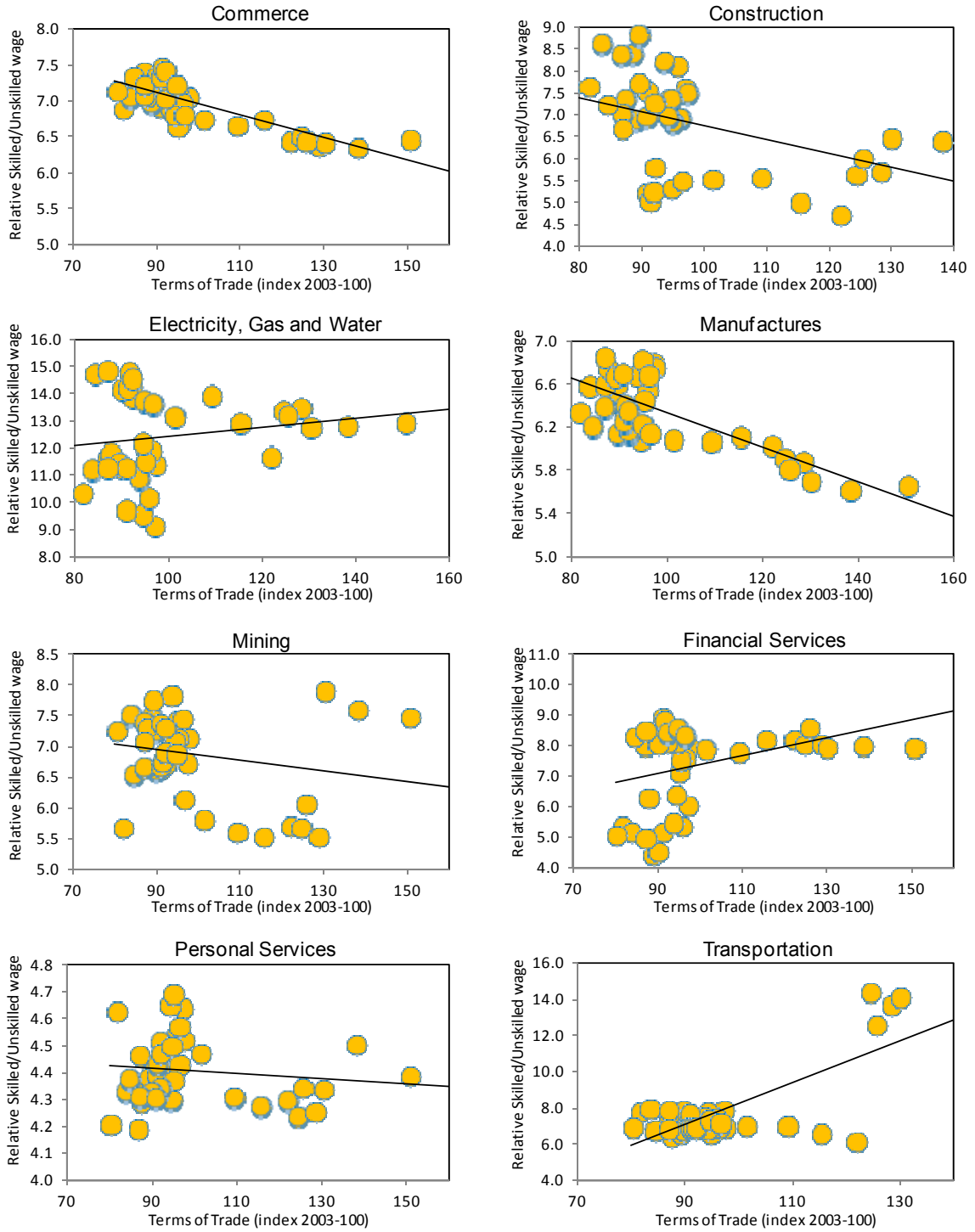
Source: Staff calculations.

IV. REVISITING THE ESTIMATION OF THE CHILEAN OUTPUT GAP[1]

A. Introduction

1.   **In this paper, various methods are applied to estimate Chile's output gap.** Since each econometric or statistical technique has its advantages and disadvantages, we aim not to have "a" measure of potential GDP growth and the output gap. Instead, having several estimations provides a reasonable range for these values. Most of the note is based on Fuentes et al (2007), updating it with more recent data.

B. Models

Univariate Methods

2.   **Four univariate methods have been used.** These include a piece-wise linear trend, Hodrick-Prescott filter, Baxter and King bandpass filter, and the methods in Christiano-Fitzgerald (2003).

- **Piece-wise linear trend (LT).** A linear trend is fitted through the log of GDP. The series is tested for structural breaks using the Chow and the Quandt-Andrews tests. A break is detected in the last quarter of 1998, in line with the Asian crisis. The Chilean economy was growing at an average 7.8 percent between the first quarter of 1986 and the last quarter of 1998. After the crisis, average real GDP growth lowered to 4 percent.

Figure 1. Piece-Wise Linear Trend
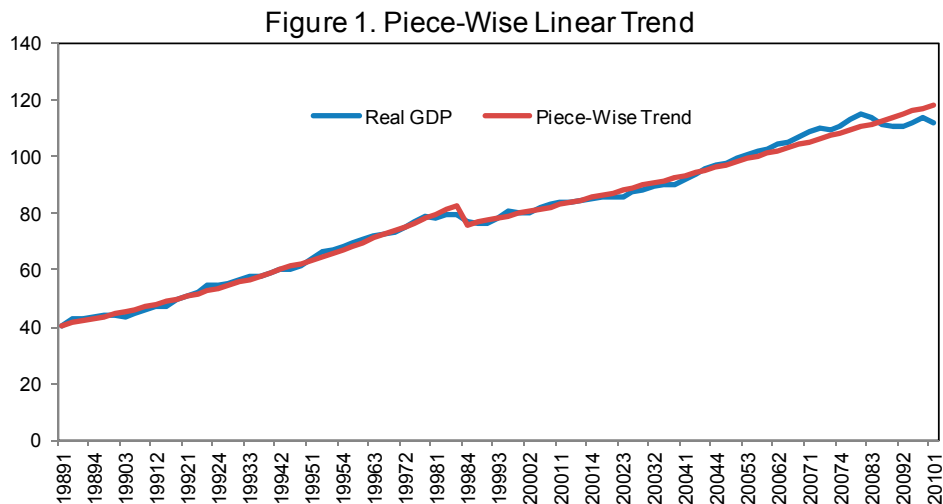
Source: Staff calculations.

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[1] Prepared by Nicolas Magud and Leandro Medina (all WHD).

- **Hodrick-Prescott (HP) filter.** As is standard, the HP-filter smoothes the deviations of a time series from its trend. Following standard practices we adopt a smoothness parameter equal to 1,600, as we are using quarterly data. This method computes an average growth rate of 7.2 percent for the period 1986:Q1–1998:Q4, while the post-crisis average growth rate is 3.6 percent.

### Figure 2. Hodrick-Prescott Filter
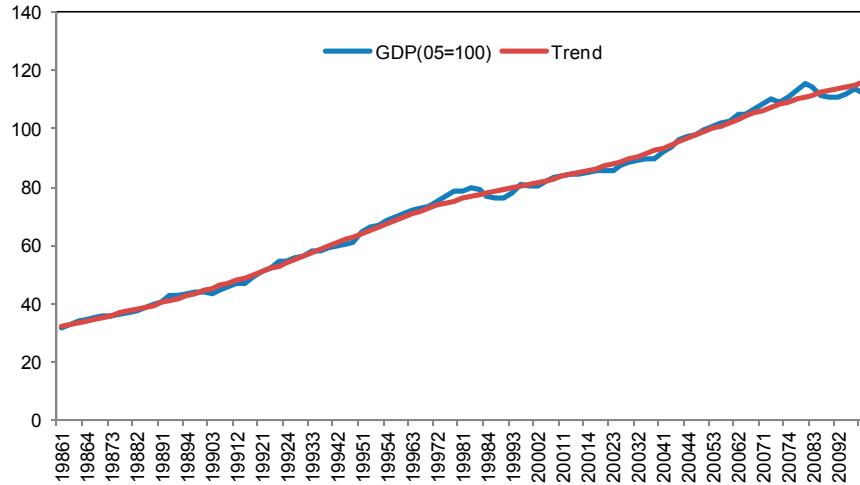
Source: Staff calculations.

- **Baxter-King (1999, BK) and Christiano-Fitzgerald (2003, CF) band-pass filter.** These methods adjust business cycles using a range of business cycles frequencies to compute the cyclical component. The estimation is consistent with the LT and the HP filters. Average growth rate before the structural brake was 7.2 percent with BK and 7.4 percent with CF, decreasing to 3.6 percent and 3.6 percent, respectively after the structural brake.

Figure 3. Baxter-King Filter
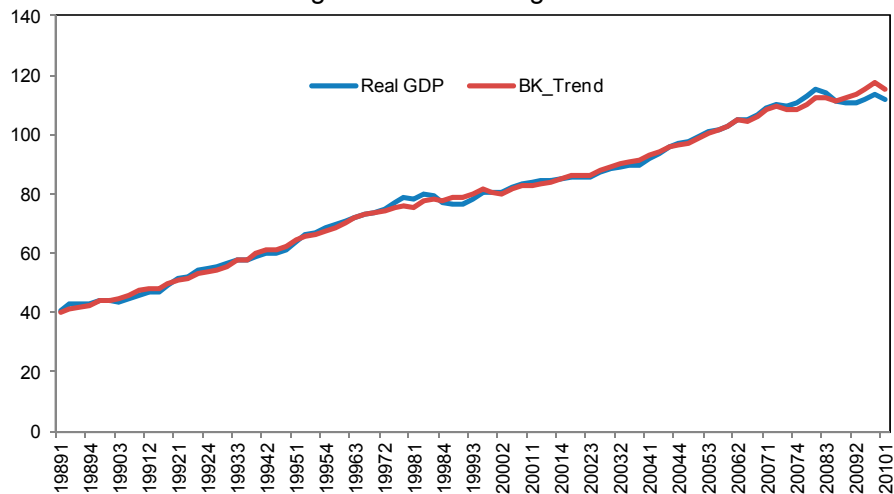
Source: Staff calculations.

In the figure below we depict the output gaps implied by each method. In general, all of them seem to depict a similar path for the output gap. These linear methods suggest that the output gap was close to 2 percent toward the end of 2009, increasing to the neighborhood of 3 percent in Q1–2010 due to the February earthquake.

Figure 4. Output Gap: Univariate Filters

Source: Staff calculations.
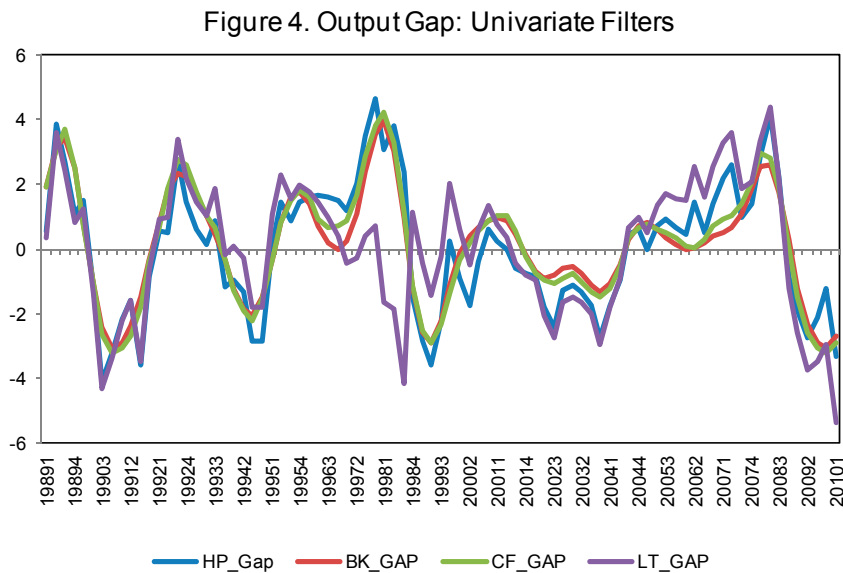
Multivariate Methods

3.   **Among the multivariate procedures, we use statistical filters and econometric methods.** Three different versions of the Kalman filter have been estimated. The econometric approaches include a production function method, a structural vector auto-regression, and the IMF's Global Projection Model.

- **Kalman filter.** Univariate filter estimations improve if macroeconomic information is added. Here we follow Fuentes et al (2007) and consider three alternative macro relations: a Phillips curve, an IS curve, and Okun's law.[2] The first restriction considers a backward-looking Phillips curve such that inflation deviations are positively linked to the output gap. The (backward-looking) IS curve model incorporates a relationship between the output gap and the central bank's monetary policy rate. Okun's law approach adds a relation between the output gap and deviations of the unemployment rate from the NAIRU. The plot below shows the output gap using each of these filters. We observe in Table 1 that before the Asian crisis real GDP was growing at a 7.2 percent in model 1, 7.2 percent in model 2, and 6.5 percent in model 3. After the crisis, average growth rates were 3.5, –3.5, and 3.6, respectively.

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[2] See Fuentes et al. (2007) and Medina (2010) for details on these restrictions.

Figure 5. Output Gap: Kalman Filters
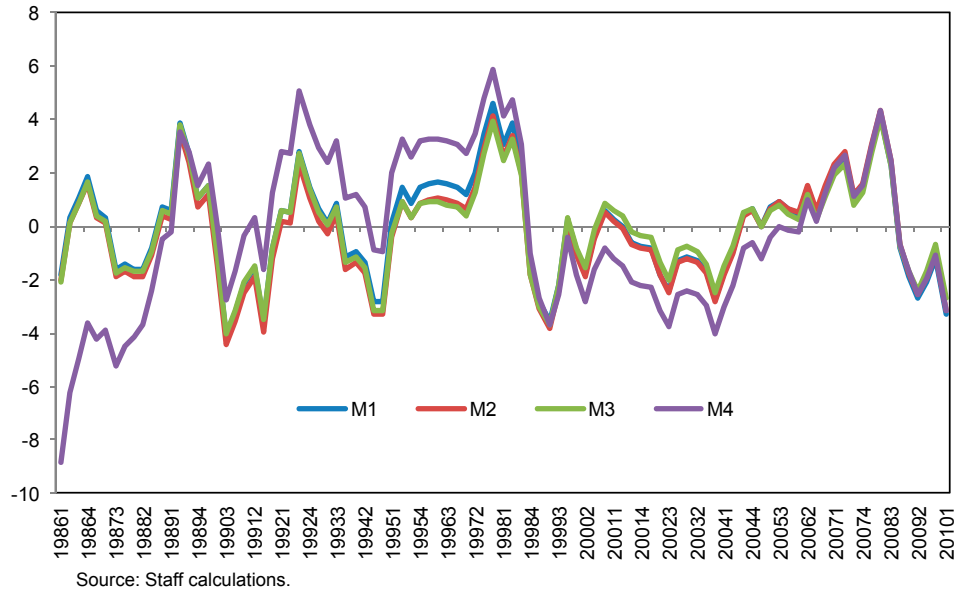
- **Production function.** We follow two approaches here. One approach follows the implementation of Menashe and Yakhin (2004) in Fuentes et al. (2007), taking a Cobb-Douglas production function in terms of capital and labor. Using logs, deviations of real GDP from potential output are a function of deviations of the capital stock utilization from its steady state (since the total capital stock is potentially available) and deviations of labor from full employment. Menashe and Yakhin (2004) elaborate on the irrelevance of deviations of TFP from its potential level in these estimations. Using quarterly data, results show that average growth rate of potential output after the structural brake was 3.8 percent. Another approach follows Estevao and Tsounta (2010). The latter computes total factor productivity (TFP) given real GDP, labor, and capital. An HP filter is applied to each series to compute potential values of capital, labor, and TFP. The latter are then used to compute potential output. The estimation was carried over in two different versions and for different data frequencies. The first one uses labor, whereas the second one corrects labor for years of schooling. Using annual data, the first approach gives an average growth rate of potential GDP equal to 6.3 prior to 1999 and 3.9 thereafter. When labor is corrected for years of schooling, the average growth rates are 7.3 and 4.5 percent instead. Using quarterly data, these figures are 7.2 and 3.5, respectively.

- **Blanchard-Quah (SVAR, 1989).** This method requires imposing structural restrictions to an otherwise standard Vector Auto-Regression (VAR). Blanchard-Quah decomposes demand and supply shocks. According to theory demand shocks should be considered temporary while supply shocks should be characterized as permanent. Following Fuentes et al. (2007), variables are de-meaned to account for the structural brake in late 1998. In this case, potential output average growth rate was estimated to be 7.5 percent before the Asian crisis and 3.3 after it.

- **IMF's Global Projection Model (GPM).** This is a Bayesian model in five stochastic behavioral equations. It estimates an output gap equation, an inflation equation, an interest rate equation, an expected real exchange rate equation, and a dynamic Okun's law equation.[3] The model estimates an average growth rate for potential output of 3.7 percent for the period 2001–09.

Figure 6. Output Gap: Production Function, Structural VAR, and GPM

Source: Staff calculations.
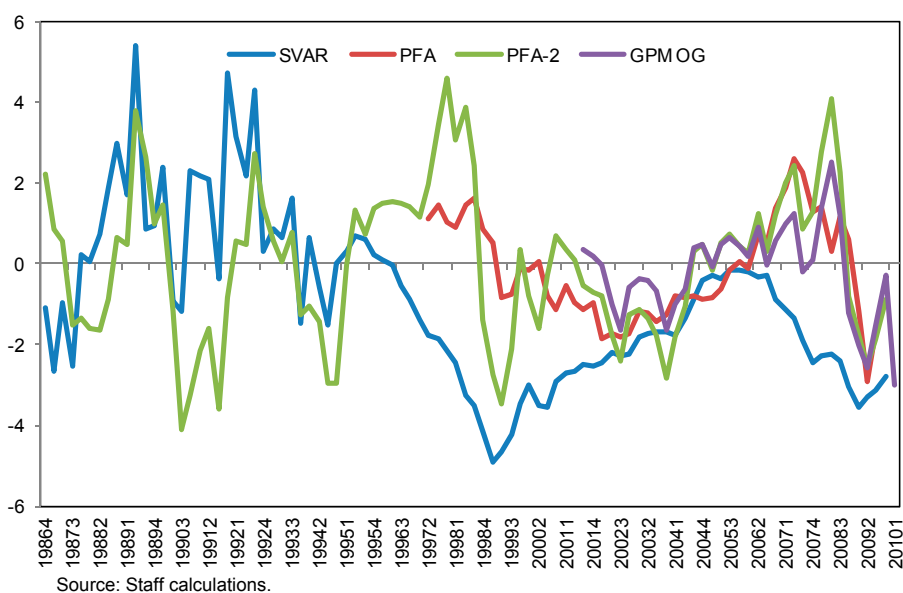
C. Comparison of Results

4.   **Table 1 summarizes the results from all of the above approaches.** Prior to the Asian crisis, most of the estimations point to an average growth rate for potential output between 6 and 7 percent. Post crisis, however, the average growth rate decreased to a 3–4 percent range. Only the production function approach, corrected for years of schooling, gives average growth above 4 percent.

5.   **The results for the output gap estimated with the different methods are quite similar.** Most suggest that the output gap just prior to 2010's earthquake was in the 2–3 percent range. The SVAR results are somewhat different, possibly due to the assumed restrictions. Demand shocks are assumed to be temporary. But the interaction of supply shocks (through the price of copper) with some persistence in demand might be explaining these differences. Further research needs to be done to explore the details.

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[3] See Canales Kriljenko, Freedman, Garcia-Saltos, and Laxton (2009) for details.

Table 1. Average Growth Rates

	86Q2-10Q1	86Q2-98Q3	99Q1-10Q1
Univariate			
Piece-wise linear de–trending	5.6	7.8	4.0
Hodrick and Prescott	5.5	7.2	3.6
Baxter and King	5.2	7.2	3.6
Christiano and Fitzgerald	5.2	7.4	3.6
average	5.4	7.4	3.7
Economic Models			
Kalman 1	5.4	7.2	3.5
Kalman 2	5.4	7.2	3.5
Kalman 3	5.1	6.5	3.6
Production Function Approach		-	3.8
Production Function Approach-2	5.5	7.2	3.5
Production Function Approach-2 1/	5.2	6.3	3.9
Production Function Approach-2 1/ 2/	6.0	7.3	4.5
Blanchard and Quah	5.3	7.5	3.3
GPM 3/			3.7
average	5.4	7.0	3.7

1/ Annual.
2/ Corrected for education.
3/ 2001-2009

Source: Staff calculations.

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