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CHILE

Selected Issues

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A. Introduction

1. **Chile's exchange rate has appreciated in recent years alongside the copper price boom.** The appreciation has raised concerns about the competitiveness of Chile's non-mineral exports. This paper uses two approaches to assess competitiveness. First, the IMF's Consultative Group on Exchange Rate Issues (CGER) methodologies are applied to assess the alignment of the overall real exchange rate with economic fundamentals. Second, an analysis of exchange rates and competitiveness is done at a sectoral level. The main finding is that Chile's real exchange rate is broadly in line with fundamentals. The sectoral analysis suggests that competitive pressures have been more pronounced in the industrial sector, pointing to the need to increase productivity and diversify into higher-value added products in this sector to maintain competitiveness.

2. **The chapter is organized as follows:** Section II discusses the stylized facts on Chile's trade performance; Section III assesses the exchange rate level using the IMF's CGER methodology; Section IV studies external competitiveness by sector; and finally, Section V concludes. An appendix contains more details on methodology and data description.

B. Stylized Facts

3. **Chile's exports have been increasingly dominated by mining, in particular copper exports, since 2003 (Figure 1).** The share of copper exports in Chile's total exports increased from 36 percent in 2003 to 57 percent in 2010, while the share of industrial and agricultural exports[2] declined from 43 and 10 percent in 2003 to 27 and 6 percent in 2010, respectively. Copper exports increased from US$7.8 billion in 2003 to US$40.3 billion in 2010. The ratio of copper exports to nominal GDP also increased from 11 to 20 percent.

4. **Chile's share of world copper exports almost doubled during 2003−10, to 44 percent, with China becoming the largest market.** The top five markets for Chile's copper exports (China, Japan, South Korea, the United States, and Italy) account for about two thirds of Chilean copper exports, with China's share doubling since 2003 to 35 percent. Imports from Chile accounted for about one quarter of China's total copper imports in 2010, significantly up from 7.5 percent in 1996. In contrast, Chile's share in Japan's copper imports declined from 21 percent in 1996 to 10 percent in 2010.

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[1] Prepared by Jiri Podpiera and Yi Wu.

[2] Excluding exports through the Free Trade Zone and exports acquired in ports.

5. **The Chilean peso has appreciated more than 50 percent against the U.S. dollar since 2003, and the real effective exchange rate appreciated 20 percent over the same period.**[3] The appreciation has been driven by substantial improvements in the terms of trade and net foreign asset position. The appreciation, however, has led to concerns about the competitiveness of Chile's non-mining exports.

6. **The growth of Chile's non-mining exports has increased markedly since 2003, notwithstanding peso's appreciation (Figure 2).** In particular, the average annual growth of industrial exports (measured in U.S. dollar) doubled from 5.8 percent over 1997−2003 to 11.8 percent over 2004−2010; and the average growth of agricultural exports (including livestock, forestry, and fishing exports) more than doubled from 4.4 percent to 11.2 percent over the same period. In volume, the average growth of agricultural exports increased from 5.1 percent over 1997−2003 to 6.7 percent over 2004−08, before declining substantially during 2009-10. The average volume growth of industrial exports only declined moderately from 8.4 percent over 1997−2003 to 7.7 percent over 2004−08, before turning negative over 2009-10. The decline over 2009-10 followed some exogenous shocks: the salmon industry was hit by a devastating virus; there was a decline of external demand amid the global recession; and the 2010 earthquake had a major impact on industrial exports. The ratios of agricultural and industrial exports to non-mining GDP have been stable between 2003 and 2008 before declining during 2009-10.

7. **There has been an increase in the share of Chile's agricultural and industrial exports going to emerging markets, such as China and Brazil.** Although the U.S. remains the single most important country for Chile's non-mining exports, its market share has declined from 51 percent in 2003 to 41 percent in 2010 for agricultural exports; and from 23 percent to 12 percent for industrial exports over the same period. China's share of Chile's agricultural and industrial exports has doubled during the period.

8. **Chile's world market share of agricultural and industrial exports has been broadly stable since 2003.** A real appreciation of the local currency could lead to a loss of competitiveness, as demand for local products declines via substitution effects. An appreciation, however, may not affect competitiveness adversely if it is accompanied by an improvement in product quality (see Bruha and Podpiera, 2011) or development of new products; or an increase in demand for local products (e.g., due to expansion to new markets); or if the demand for local products is relatively inelastic.

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[3] The real effective exchange rate index is compiled by the Statistics Department of the IMF, and is calculated as a geometric weighted average of bilateral real exchange rates between home country and its trade partners, where bilateral real exchange rates are calculated using nominal exchange rates and relative consumer price indices (CPIs). The real effective exchange rate index is very close to that calculated by the Central Bank of Chile, where the CPI of Chile but whole price indices of trading partners are used.

9. **Chile's ability to maintain relatively robust non-mining export growth in the face of currency appreciation seems to be attributable to a number of factors.** Berthelon (2011) documented a significant export diversification in terms of both markets and products from 1990 to 2007.[4] Monfort (2008) suggests that trade liberalization may have played a role in increasing Chile's exports and imports between 1990 and 2007. He noted that since 2003, Chile has ratified free trade agreement (FTA) with its major trading partners (the European Union, the United States, China, and Japan). This made Chile's goods more competitive in its FTA partner countries than goods from non-member countries. Consequently, the share of Chile's trade (exports and imports) covered by trade agreement has jumped from 25 percent at end-2002 to 83 percent by end-2007. Finally, the structure of Chile's industrial exports probably also played a rule: food, beverages and tobacco, forest and wood furniture, and pulp and paper account for two thirds of Chile's industrial exports. Chile was therefore able to largely avoid competing with China, the manufacturing powerhouse.[5]

10. **At the same time, non-petroleum imports have increased even faster, leading to a deterioration of the non-mineral trade balance.** Average annual growth of non-petroleum imports increased from 0.1 percent during 1996−2003 to 20 percent during 2003−2010. Although the increase is partly attributable to trade liberalization[6] and the proliferation of FTAs, the peso's appreciation probably also played a role.

C. Exchange Rate Assessment Using CGER Methods

11. **In this section we assess the real exchange rate between 1996 and 2010 using the IMF's CGER methodology.** The CGER methodology includes three different approaches: the macroeconomic balance approach, the equilibrium real exchange rate approach (ERER), and the external sustainability approach (ES) (see Lee et al., 2008). We apply the ERER and ES approaches as they are more suitable for a time series analysis. The exchange rate misalignment is estimated by comparing the equilibrium values to actual values of the variables, instead of to the medium-term projections, as in the standard CGER exercise.

Equilibrium Real Exchange Rate Approach

12. **The equilibrium real exchange rate approach models the real effective exchange rate as a function of a set of underlying fundamentals.** First, panel regression techniques are used to estimate an equilibrium relationship between real exchange rates and productivity differential between the tradables and nontradables (relative to trading partners), commodity

[4] However, OECD (2011) notes that Chilean exports remain much more concentrated than in other resource-rich OECD countries, such as Australia, Canada, New Zealand and Norway.

[5] Fruits account for about 85 percent of Chile's agricultural exports.

[6] Import tariff was reduced from 11 to 6 percent between 1998 and 2002 (Monfort, 2008).

terms of trade, net foreign assets (scaled by trade), and government consumption as a share of GDP (relative to trading partners). Chile's equilibrium real exchange rate is then computed as a function of its level of the fundamentals using parameters estimated from the panel regression, and the exchange rate misalignment is simply the deviation of Chile's actual real exchange rate from the equilibrium.

13. **The results suggest that the real effective exchange rate is now broadly in line with fundamentals (Figure 3).** The equilibrium real exchange rate appreciated by 22 percent since 2003, similar to the appreciation of the actual real exchange rate. The misalignment has fluctuated between ± 10 percent, which can be considered in line with fundamentals.

14. **The terms of trade and net foreign assets (NFA) have been the important drivers of Chile's equilibrium real exchange rate movements.** Higher NFA and an improvement in the terms of trade would lead to a more appreciated equilibrium real exchange rate. The copper price boom since 2003 is an important factor in driving the appreciation of Chile's equilibrium real exchange rate, as both NFA and terms of trade are affected by copper prices.

External Sustainability Approach

15. **The external sustainability approach relates the sustainability of a country's external asset position and the real exchange rate.** The first step involves determining the current account balance that would stabilize the net foreign asset position (as a share of GDP) at given "benchmark" values. The second step derives the gap between the NFA-stabilizing current account and the actual current account. And, finally, the third step consists of assessing the adjustment in the real effective exchange rate that is needed to close the gap. We apply the extended ES framework developed by Bems and Carvalho Filho (2009a, 2009b) for commodity exporters with exhaustible resources (see Appendix). These countries would optimally accumulate higher NFA to smooth consumption in the face of volatile commodity prices and/or to maintain a constant per capita income from accumulated assets after the depletion of mineral resources.

16. **The actual current account has been close to the level implied by the ES approach, suggesting a low exchange rate misalignment (Figure 3).** The misalignment fluctuates mostly within a band of ± 5 percent and never exceeds 10 percent, which is sufficiently low to suggest that the exchange rate is broadly in line with fundamentals.

D. Competitiveness in Tradables

17. **Sector-specific wholesale price-based real effective exchange rates are constructed for three tradable sectors to assess changes in competitiveness between 1996 and 2010**. Sector-specific analysis addresses differences in patterns of development across sectors, and supplements the assessment of the overall exchange rate. The real exchange rate is constructed as sP^*/P, where P^* and P denotes foreign and domestic (sector-

specific) wholesale price index, respectively, and *s* denotes the nominal exchange rate. The real exchange rate is then constructed as the weighted average of bilateral real exchange rates using trade weights for three sectors: agriculture, industry, and mining.

18. **The sectoral real exchange rates are decomposed into two components, one of which measures price competitiveness and the other is an indicator of pricing-to-market.** Following Cincibuch and Podpiera (2006), we decompose the real exchange rate into a price disparity component and a substitution ratio component. The *price disparity* component corresponds to the price differentials between domestic wholesale prices and export prices; and between foreign wholesale prices and Chilean import prices.[7] These differentials could arise from factors such as pricing-to-market (see, for example, Krugman, 1987) or international trade costs. The *substitution ratio* is calculated as $(hh^*)^{1/2}$, where h is the relative price of imported goods to locally-produced goods in Chile, and h^* is the ratio of prices of foreign-produced goods and goods exported from Chile to foreign markets. These are the relative prices that consumers face when choosing between local and imported products. An increase in the substitution ratio would imply an improvement in price competitiveness for Chilean producers.

19. **We also construct an indicator of relative real output to measure "real" competitiveness.** The relative real output is calculated as $(mm^*)^{1/2}$, where m is the ratio of the quantity of goods of a certain type (e.g. agricultural) produced in Chile to Chile's imports of this type of goods; and m^* is the ratio of the quantity of Chile's exports of the same good to the production of this good in Chile's trading partners.[8] Import/export quantities are derived using value deflated by import/export prices. Sector-specific relative output indexes are then calculated as weighted average across Chile's trading partners using trade weights. For Chilean producers, an increase in relative real output implies gaining market position, in either foreign or domestic markets, or in both.

20. **Chile's agricultural sector appears to have remained competitive despite some real exchange rate appreciation since 2003.** Following the appreciation of the nominal exchange rate, the agriculture sector's real exchange rate appreciated by 37 percent between 2003 and 2006. It subsequently depreciated by 18 percent between 2006 and 2008 (reflecting faster agricultural price increases in Chile's trading partners), and stayed broadly stable during 2009–10. The level in 2010 is very close to the long-term average over 1996−2007. Price competitiveness, as measured by the substitution ratio, broadly followed the same

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[7] The price disparity is calculated as $(dd^*)^{1/2}$-100, where $d = P^e/P$ and $d^*=sP^*/P^m$, and P^e and P^m denote Chile's export and import price index, respectively.

[8] It can be shown that $mm^*=(sP^*q^*P^mq^m / (PqP^eq^ehh^*))^{-1}$, where P^mq^m and P^eq^e are values of local import and export, respectively, and sP^*q^* and Pq are values of foreign and local production, respectively. This equation is consistent with the price equation in Cincibuch and Podpiera (2006).

trend, although by 2010 it has returned to the level of 2003. This suggests a small but non-trivial disparity between wholesale and export/import prices (mostly because of Chilean producers reducing their profit margins in 2010). Relative real output seems quite responsive to price competitiveness, although with some lag. After a decline of relative agricultural output during 2005−07, Chile has regained output competitiveness in the agricultural sector.

21. **The industrial sector has faced some stronger competitive pressures, mostly from the import side.** The sector-specific real exchange rate appreciated by 29 percent between 2003 and 2006, but has remained broadly stable afterwards.[9] The real exchange rate level in 2010 is 10 percent more appreciated than the average over 1996−2007, suggesting some deterioration in price competitiveness (given low price disparity). Relative real output appears to be quite responsive to changes in price competitiveness, suggesting little change in relative product quality and demand for Chilean products. Chile's relative real industrial output has declined substantially since 2003 and is currently back to the level of 1997. It's worth noting that the decline in Chile's relative industrial output has been mostly driven by the import side, as imports of industrial products have increased substantially, while Chile's export relative output has been broadly stable. Given the relatively high price sensitivity of industrial products, there is a risk that if the exchange rate appreciates further, investment in the sector would decline, which would constrain economic growth going forward. A loss of industrial productive capacity would be particularly problematic in case of a sustained decline in copper prices. To avoid such outcome, it is critical to diversify into higher-value added industrial products and broaden the export base (for example in mineral-related services, see OECD 2011 for more detailed suggestions).[10]

22. **Chile's mining market share has been more or less stable since 2003.** Despite the copper price boom, the real exchange rate for Chile's mining sector has depreciated after 2003 (the 2010 level is 6 percent below the long-term average). The data suggest that there are large price disparities in the mining sector. In particular, export prices appear to have been much higher than wholesale prices in Chile in recent years.

E. Conclusion

23. **Both macro-based and sectoral evaluations suggest that the real effective exchange rate is broadly in line with fundaments.** The CGER-based methodologies show that the appreciation of the aggregate real exchange rate in recent years has been driven by fundamentals, and the rate is now close to its equilibrium value. The sectoral view reveals

[9] Using unit value indexes, De Gregorio (2010) finds larger real appreciation in the agricultural sector than in the industrial sector.

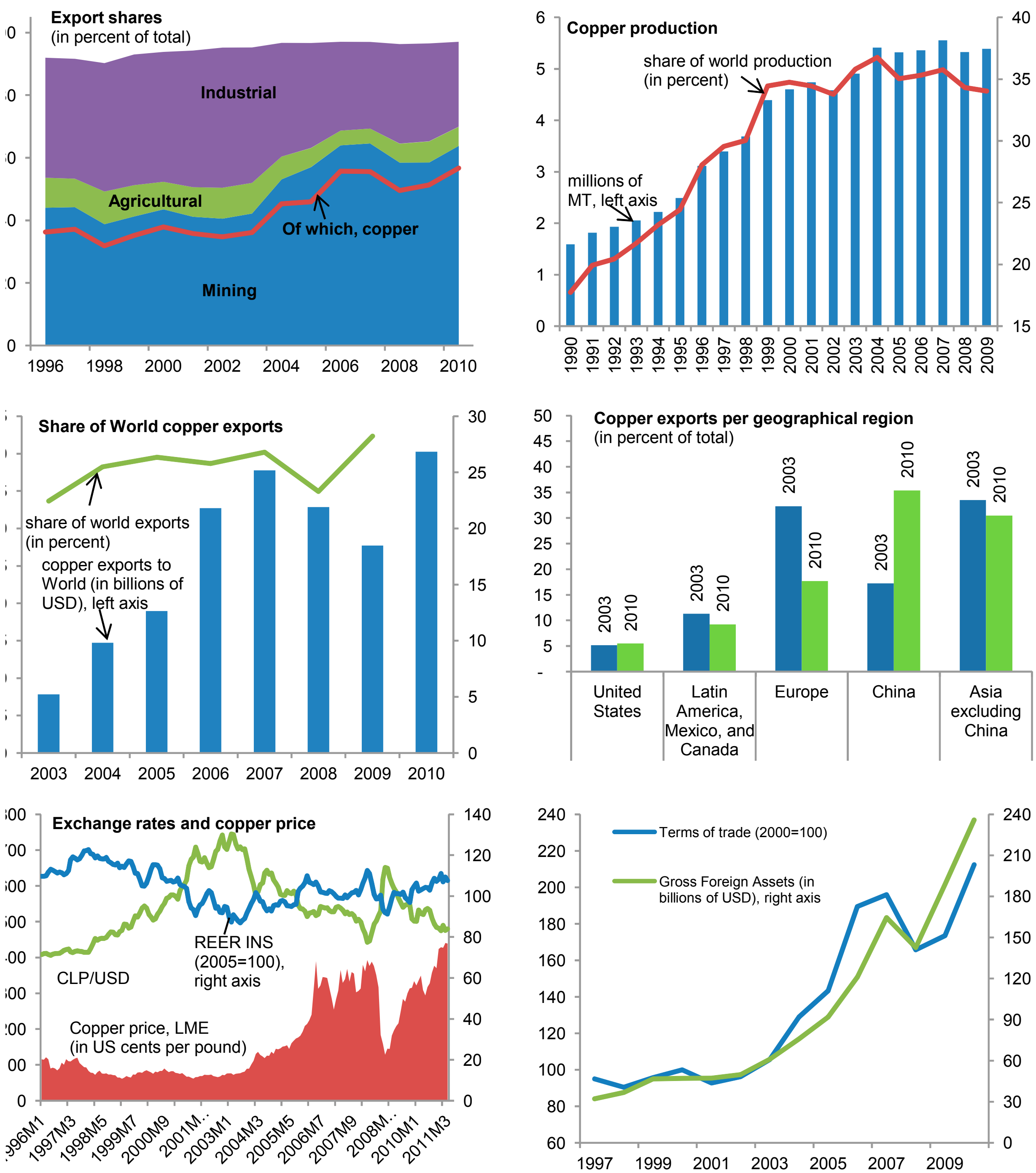
[10] OECD (2010) suggests that the growth of new products in Chile's exports has been below that expected for a country of Chile's income level.

some differences across sectors, although all sector-specific real exchange rates are not too far from their long-term averages.

24. **Competitive pressures appear to be the largest in the industrial sector, although export shares have remained stable.** Non-mining exports have been supported by a number of factors including a favorable export structure, the signing of free trade agreements with major trading partners, and some diversification into new markets and new products. However, non-petroleum imports have grown even faster, leading to a deterioration of the non-mineral trade balance. The loss of competitiveness appears to be the largest in the industrial sector. The sector should seek to regain competitiveness by moving into higher value-added products and diversifying the export base further. The development of services exports could be an important component of export diversification.[11]

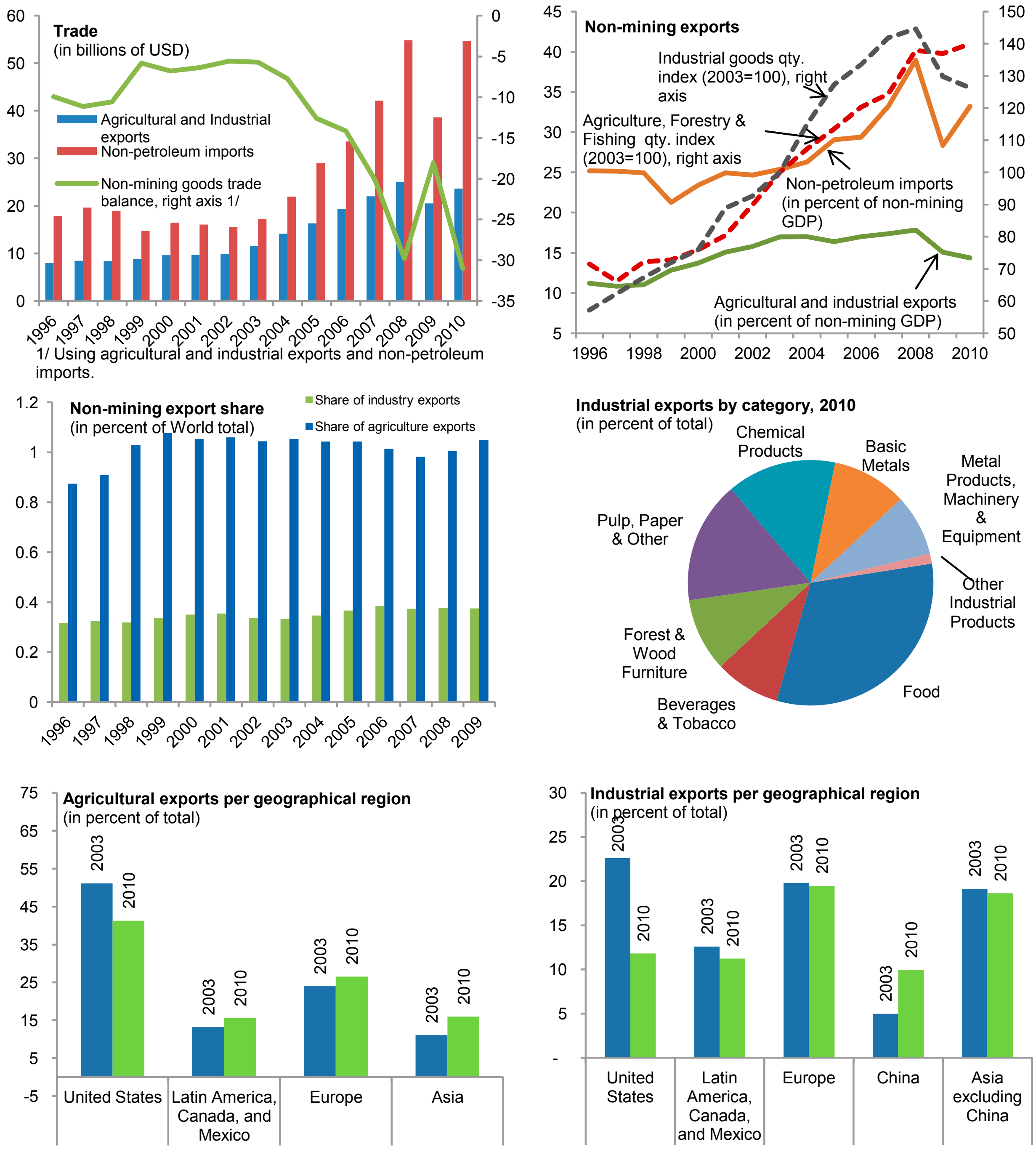
[11] Chile's National Innovation Council has identified eight clusters with high export growth potential. Five of these are based on natural resources (mining, aquaculture, processed food, fruit, and pork and poultry) while three are services based (tourism, off-shoring, and financial services) (OECD, 2011).

Figure 1. Chile: Copper Exports, 1990-2010



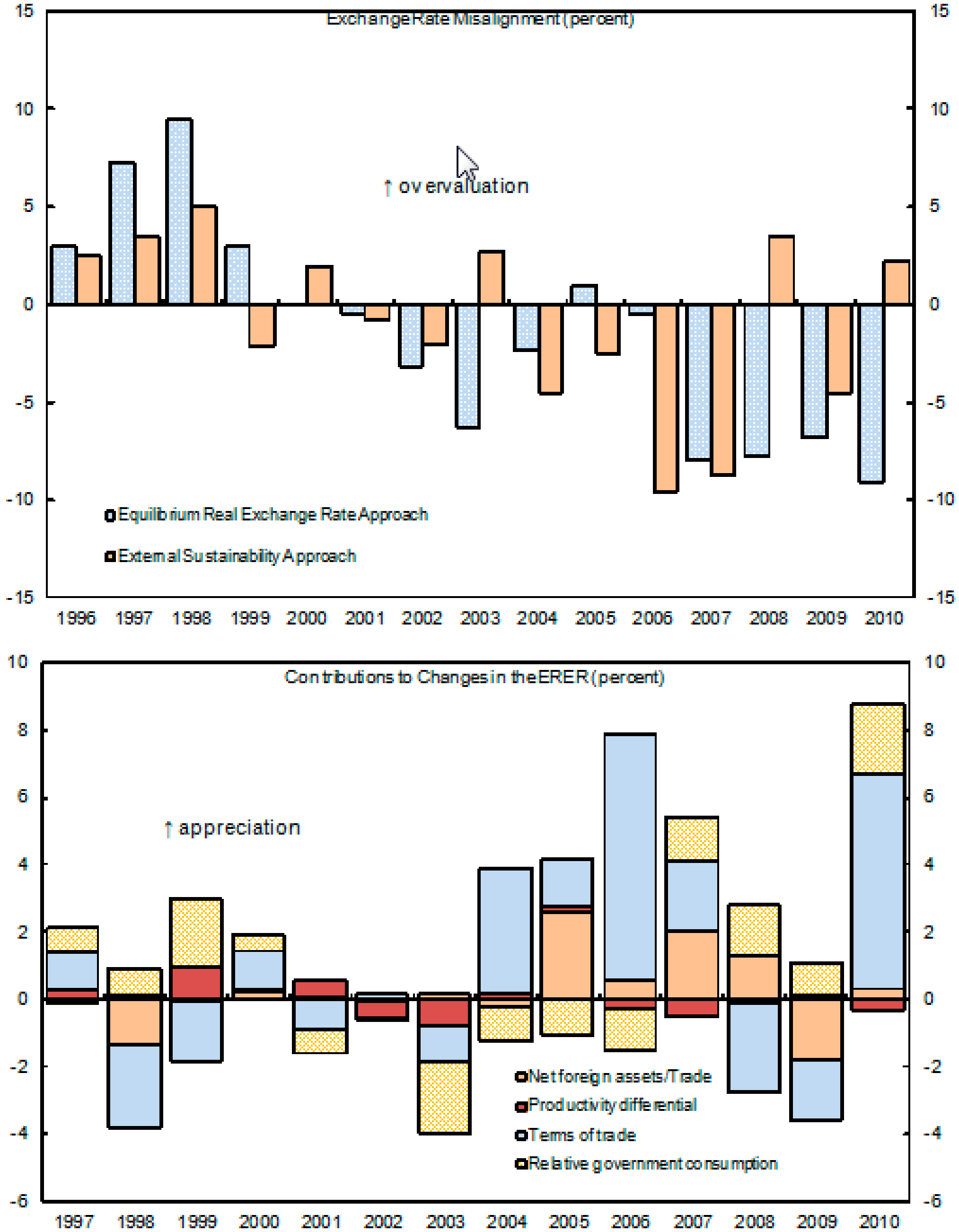
Source: Central Bank of Chile, UN Comtrade, Haver Analytics, and Datastream.

Figure 2. Chile: Non-mining Exports, 1996-2010



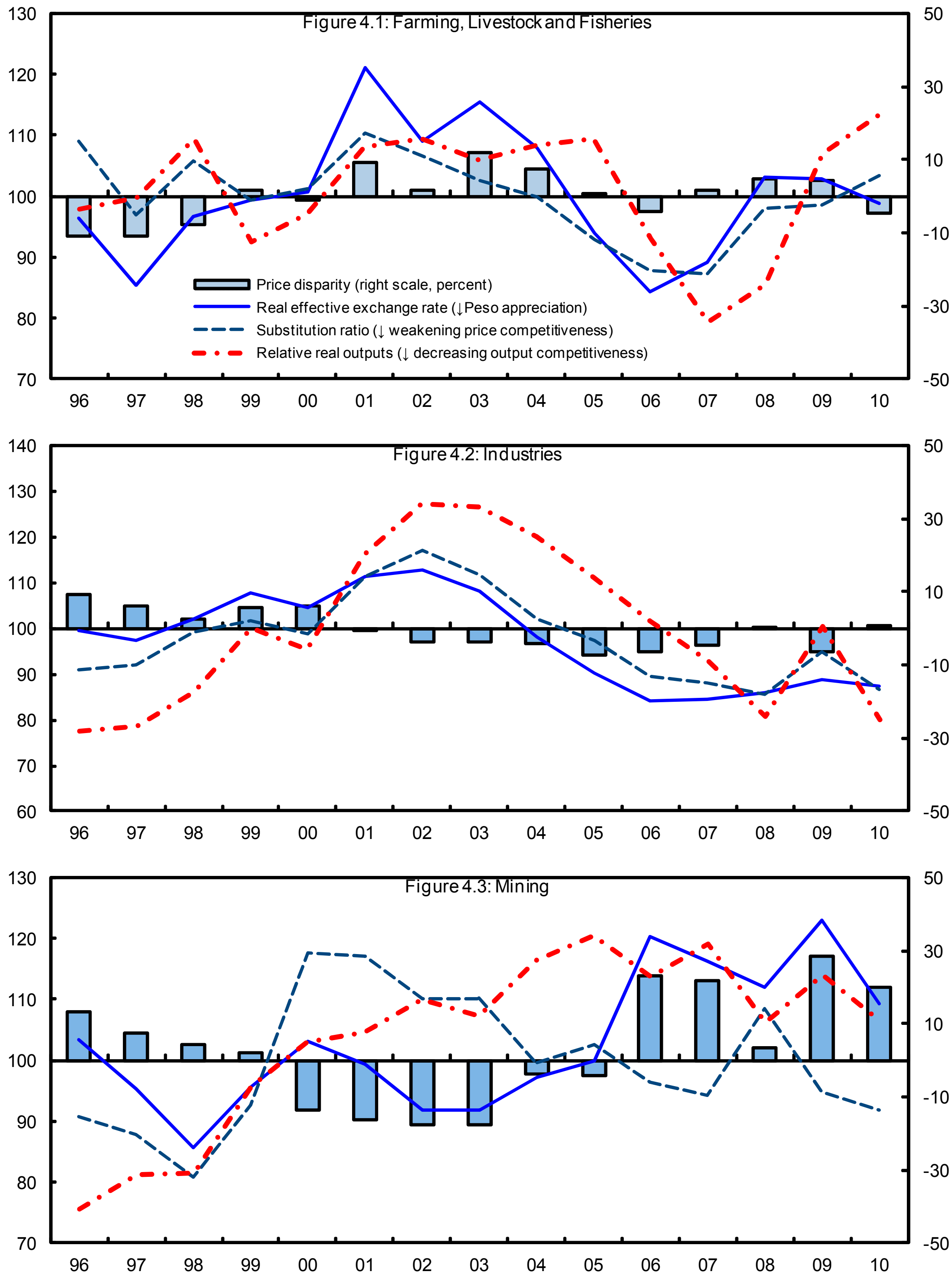
Source: Central Bank of Chile, UN Comtrade, and Haver Analytics.

Figure 3. Exchange Rate Assessment Using CGER, 1996–2010



Source: IMF staff calculations.

Figure 4. Competitiveness in Tradables, 1996-2010



Sources: Haver, regional statistical offices, Banco Central de Chile, and IMF staff calculations.
Note: Indexes rebased to 100 = average 1996-2007.

References

Bems, R. and I. Carvalho Filho (2009a). “Current Account and Precautionary Savings for Exporters of Exhaustible Resources”. IMF Working Paper 09/33.

______(2009b). “Exchange Rate Assessment: Methodologies for Oil Exporting Countries”. IMF Working Paper 09/281.

Berthelon, M. (2011), “Chilean Export Performance: The Role of Intensive and Extensive Margins,” Central Bank of Chile Working Paper No. 615.

Bruha, J. and J. Podpiera (2011). “The Dynamics of Economic Convergence: The Role of Alternative Investment Decisions”. Journal of Economic Dynamics and Control 35 (2011), pp. 1032–1044.

Cincibuch, M. and J. Podpiera (2006). “Beyond Balassa-Samuelson: Real Appreciation in Tradables in Transition Countries”. Economics of Transition 14 (3), pp. 547–573.

De Gregorio, Jose (2010). “Exchange Rate, Macroeconomic Policies, and the Global Scenario”. Speech, Chilean Senate, Valparaiso, Chile.

Krugman, P. (1987). “Pricing-to-Market When the Exchange Rate Changes”, in Arndt, S. and Richardson, J. D. (eds) Real Financial Linkages Among Open Economies, Cambridge, MA, MIT Press, pp. 49–70.

Milesi-Ferretti, G.M. and P.R. Lane (2006). “The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970–2004 “. IMF Working Paper 06/69.

Lee, J., G. M. Milesi-Ferretti, , J. Ostry, A. Prati, and L. Ricci (2008). “Exchange Rate Assessment: CGER Methodologies”. IMF Occasional Paper 261.

Monfort, B. (2006), “Chile: Trade Performance, Trade Liberalization, and Competitiveness,” IMF Working Paper No. 08/128.

OECD (2010). “OECD Economic Surveys: Chile 2010”. OECD Publishing.

______ (2011). “Diversifying Exports and Improving Competitiveness”. Chapter 11 in Maintaining Momentum: OECD Perspectives on Policy Challenges in Chile.

APPENDIX: METHODOLOGY AND DATA

A. Equilibrium Real Exchange Rate Approach

The equilibrium real effective exchange rate (ERER) is estimated from the following equation:

$$Ln(ERER)_t = 2.83+.043*NFA/TR_{t-1}+.128*PD_t+.43*ln(ToT)_t+2.593*GC_t - .02*ln(ToT)_t*D,$$

where PD denotes the tradables-nontradables productivity log-differential relative to trading partners; ToT denotes the commodity-based terms of trade; NFA/TR is the ratio of net foreign assets to trade; and GC denotes the ratio of government consumption to GDP relative to trading partners. *D=1* for periods following the onset of the commodity boom 2001-2010. The specification closely follows that in Lee et al. (2008), with updated parameters estimated by the IMF's Research Department.

B. External Sustainability Approach

As in Bems and Carvalho Filho (2009b), the intertemporal budget constraint is:

$$C_t + B_t = (1+i)B_{t-1} + Y_t + Z_t,$$

where C stands for domestic absorption; Y is the non-mineral output; B is the end-period stock of the net foreign assets; and Z is the income from exhaustible resources, which we assume will stay at its current level for 70 years in the case of Chile. Mineral income and income from net foreign assets are allocated across time based on an optimization of discounted utility in an intertemporal current account model, and the following current account norm (*CAN*) is derived:

$$CAN_t \equiv B_t - B_{t-1} = i\, B_{t-1} + Z_t - (r-n)*PV(\pi, B_{t-1}, r, \{Z_s\}^T_{s=t}),$$

where π is U.S. inflation, r is the real return on net foreign assets, n is the population growth, and PV represents the present value. The allocation rule maintains constant real per capital annuity from the mineral wealth even after its depletion. The exchange rate misalignment (M) is derived according to the following formula:

$$M_t = (CA_t - CAN_t)/e,$$

where CA_t is the actual current account, and e is the trade balance elasticity to the real effective exchange rate.

C. Data Description

C.1. Equilibrium Real Exchange Rate Approach

The following series span 1996-2010:

- The real effective exchange rate is the trade-weighted REER computed by the Statistics Department of the IMF.

- Tradables-nontradables productivity differential relative to trading partners is constructed as the differential of productivity–value added over employment–in the tradable vs. non-tradable sector in Chile and its trading partners. The log-difference between the Chilean and the trading-partners' weighted average of the productivity differential between tradables and nontradables is the variable used. The data are from the IMF's *CGER* database.

- Commodity-based terms of trade are derived using the component-based goods trade exports and imports deflators. The data are from the IMF's *WEO* Global Economic Environment database.

- Net government consumption to GDP relative to trading partners is constructed as the difference between Chile's net government consumption over GDP and the weighted average of the same variable for its trading partners. The data are from the IMF's *WEO* database.

- The ratio of net foreign assets to trade is constructed using the definition of net foreign assets in Milesi-Ferretti and Lane (2006) and updated using the actual NFA. Trade is the average of exports and imports. The data are from the IMF's *WEO* database.

C.2. External Sustainability Approach

The data series used are from the period 1996-2010 and include:

- The U.S. consumer price index, Chile's population, value of copper exports, and GDP at current prices. The data are from the IMF's *WEO* database.

- Copper prices (in USD) are from Banco Central de Chile.

C.3. *Competitiveness in Tradables*

Production prices are used for countries where wholesale prices are not available, as both indexes measure the cost of production. The exact definitions are as follows:

- *Local wholesale price index* measures the weighted wholesale prices of goods produced in Chile (*P)*. The data are from Banco Central De Chile for all three sectors.

- *Export price index* measures the weighted export prices of Chilean goods exported to foreign markets (P^e). The data are from Banco Central de Chile for all three sectors.

- *Import price index* measures the weighted prices of imported goods to Chile (P^m). The data are from Banco Central de Chile for all three sectors.

- *Foreign wholesale price index* measures the weighted wholesale (or production) prices of foreign countries (Chile's trading partners) converted to pesos (sP^*). For industrial and agricultural sectors, the data are compiled based on Chile's import shares of its major trading partner countries (the U.S., U.K., China, Japan, France, Germany, Spain, Mexico, Brazil, and Argentina) covering 75 percent of Chile's imports. For the mining sector, the data are constructed as the weighted average of the U.S. producer price index for copper and copper products and Argentina's IPIB for mining. Data are from the Food and Agriculture Organization (FAO), Haver, Banco Central de Chile, Banco de Mexico, Banco Central de Brazil, and INDEC. Table 1 reports the import weights used in the calculations.

Table A.1. Weights of Chile's Imports by Source Country

	Farming, Livestock, and Fisheries	Industries	Mining
Argentina	0.16	0.02	0.36
Brazil	0.07	0.08	
Mexico	0.09	0.18	
U.S.A.	0.13	0.11	0.64
China	0.4	0.39	
Japan	0.08	0.16	
France	0.03		
Germany	0.03	0.04	
Spain		0.01	
U.K.	0.01	0.01	

Source: Staff compilation based on data from Banco Central de Chile.

Value indexes are derived as follows:

- *Local production value index* measures the value of the Chilean production. The data are constructed as the product of the quantity index and the wholesale price index. The quantity index is from Haver.

- *Export value index* measures the value of Chilean export. The data are from Banco Central de Chile.

- *Import value index* measures the value of imported products to Chile. The data are from Haver.

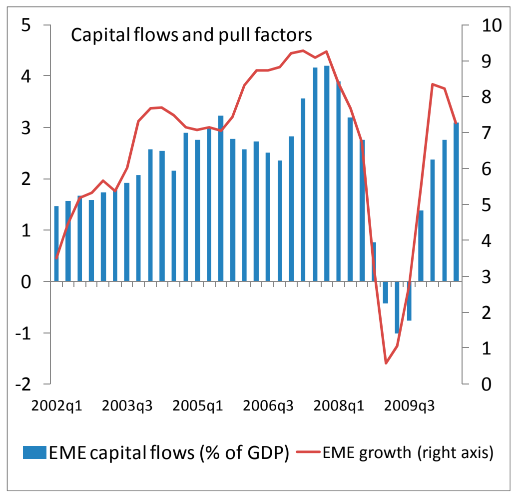
- *Foreign production value index* measures the weighted (by import shares) value of production of countries that export to Chile. The data are constructed as the product of weighted quantity index and the wholesale price index. The quantity index is constructed based on data from FAO, Haver, and FIEL. Import weights are the same as those used to construct the weighted price index.[12]

[12] Quantities of agricultural production from FAO are available only until 2009. The 2010 data are projected based on historical values.

II. Capital Inflows, Exchange Rate Flexibility, and Domestic Credit[1]

1. **Capital inflows bonanzas have become more frequent after restrictions to international movements were relaxed worldwide during the last decades**.[2] Capital flows to emerging economies can finance investment and foster economic growth, as well as increase welfare by facilitating consumption smoothing. However, inflows may also induce excessive monetary and credit expansions, build vulnerabilities associated with currency mismatches, and distort asset prices.[3] Large inflows tend to be associated with expansionary macroeconomic policies and behave procyclically (see Kaminsky et al.,(2004). Moreover, highlighting the importance of designing the right mix of instruments to manage these flows, Montiel and Reinhart (2001) show how some policy responses to capital inflows may actually increase the inflows.

2. **The prospects of expansionary monetary policies in advanced countries have renewed the debate over policy options to cope with large capital inflows in emerging economies.** As in the past, spillovers from a loose monetary stance in advanced countries will likely have a significant impact in emerging economies, and it may turn out to be stronger this time around, for two reasons. First, expansionary policies in advanced economies may be on place longer than in the past (a 'push factor').[4] Second, emerging markets have been conspicuously resilient during the financial crisis, increasing investors' appetite for the asset class (a 'pull factor'). The debate over the right policy mix to cope with capital flows has been extensive.[5] However, few studies discuss the role of the exchange rate regime.



3. **This paper documents that during periods of excessive capital inflows the rigidity of the exchange rate regime affects domestic credit.** To this end, we construct a panel of 25 emerging countries (from Latin America, Europe, and Asia) for up to 10 years

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[1] This chapter was prepared by Nicolas Magud and it is based on the forthcoming NBER Working Paper "Capital Inflows, Exchange Rate Flexibility, and Domestic Credit," by Nicolas E. Magud, Carmen M. Reinhart, and Esteban R. Vesperoni.

[2] See, for example, Reinhart and Reinhart (2008), and references therein.

[3] See Magud et al., (2011) describing the 'four fears to capital inflows.

4 For the importance of 'push factors' during large capital inflows episodes in emerging economies, see Calvo et al.,(1995).

5 See Eyzaguirre et al., (2011) for a recent contribution.

each. The first result is that there is no clear relationship between exchange rate regimes and the volume of capital flows. However, during capital inflows booms, the volume of credit is larger, the more so for more rigid exchange rate arrangements. Also, the rigidity of the exchange rate regime seems to reduce short-term currency risk perceptions, as reflected in the composition of credit. We document that in periods of excessive capital inflows the share of domestic credit in foreign currency (to total credit) increases, especially if the exchange rate arrangement becomes less flexible.

4. **Together, these facts should keep the policymaker alert of potential credit boom-bust cycles triggered by sudden reversals in capital inflows.** When capital inflows are above their long term trend, more rigid exchange rate regimes increase the likelihood of such credit cycles as they exacerbate the pass-through of capital inflows to leverage that increases domestic credit, especially foreign currency credit.

A. Motivation

5. **The collapse of several pegged exchange rate regimes during the 1990s led to the perception that these exchange rate arrangements were more prone to currency and financial crises.**[6] In their study of the occurrence of twin crises, Kaminsky and Reinhart (1999) show that banking crises and currency crises occur in close succession. Overall, evidence on the link between crises and alternative exchange rate regimes is not clear-cut, but the literature suggests that the exchange regime may have an impact on developments in financial markets and asset prices, through several channels.[7]

6. **We test whether fixed exchange rate regimes attract larger volumes of capital inflows than flexible ones.** By reducing nominal exchange rate volatility—compared to flexible regimes—pegs can reduce transaction costs, encouraging cross-border investment. On shorter horizons, nominal exchange rate stability can place strong incentives for foreign investors to take advantage of even small interest rate differentials through carry trade.[8] Another reason why a fixed exchange rate regime may attract more capital is associated with sterilized intervention, a policy tool ubiquitous in pegs to prevent inflation and lower real interest rates in the presence of large capital inflows. Sterilized intervention introduces a wedge between domestic and foreign interest rates and can magnify the volumes of capital inflows.[9]

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[6] See, for example, Ghosh et al.,(2003) and Ghosh et al.,(2010).

[7] For a discussion on the probability of crises and the severity of their macroeconomic impact under alternative exchange regimes, see Ghosh et al.,(2003), Bubula and Otker-Robe (2003), and references therein.

[8] On carry trade, see for example Plantin and Shin (2011) and Brunnermeier et al.,(2009).

[9] On sterilization, see for example Calvo (1991), Fernández Arias and Montiel (1996), Montiel and Reinhart (2001), and Reinhart and Reinhart (2008).

7. **By extending improperly priced guarantees, fixed exchange regimes may contribute to stronger credit growth than flexible regimes, especially in the context of large capital inflows.** Montiel and Reinhart (2001) argue that deposit guarantees and a peg are perceived as a guarantee to foreign currency claims, increasing the scope for banks' expansion through external funds, which can potentially feed into domestic credit. Backé and Wójcik (2007) develop a simple framework with an increasing trend in productivity growth in an emerging economy that pegs its domestic currency to a developed economy with constant productivity growth. The peg gives rise to lower interest rates and higher domestic credit compared to an equilibrium with a flexible exchange rate regime.

8. **A credible fixed exchange regime may also create incentives for taking debt in foreign currency.** A small differential between interest rates in domestic and foreign currency may create incentives to borrow in the latter, as debtors would deflate a lower interest rate by expected domestic inflation or wage growth.[10] In a different context, Cavallo and Cottani (1997) analyze the Argentinean experience with the currency board, where the peg, as a nominal anchor, played a fundamental role in the dollarization of the financial system. While policies allowing liability dollarization created challenges in Argentina, Cavallo and Cottani highlight that they were critical to extending the maturity of financial assets, thus reducing the risks associated with short-term debt overhangs.

9. **The findings in this paper suggest that the flexibility of the exchange rate regime should be an important element in deciding the policy mix to cope with large capital inflows and domestic credit expansions.** It also emphasizes the importance of macro-prudential regulations to contain domestic credit—in domestic and foreign currency—given that more rigid exchange rate arrangements exacerbate the effects of capital inflows on domestic credit, and potentially through domestic credit on asset prices, both contributing to increasing the probability of boom-bust cycles. Yet, it would not imply the usefulness of capital controls, as capital inflows to emerging economies are observed regardless of the exchange rate regime.

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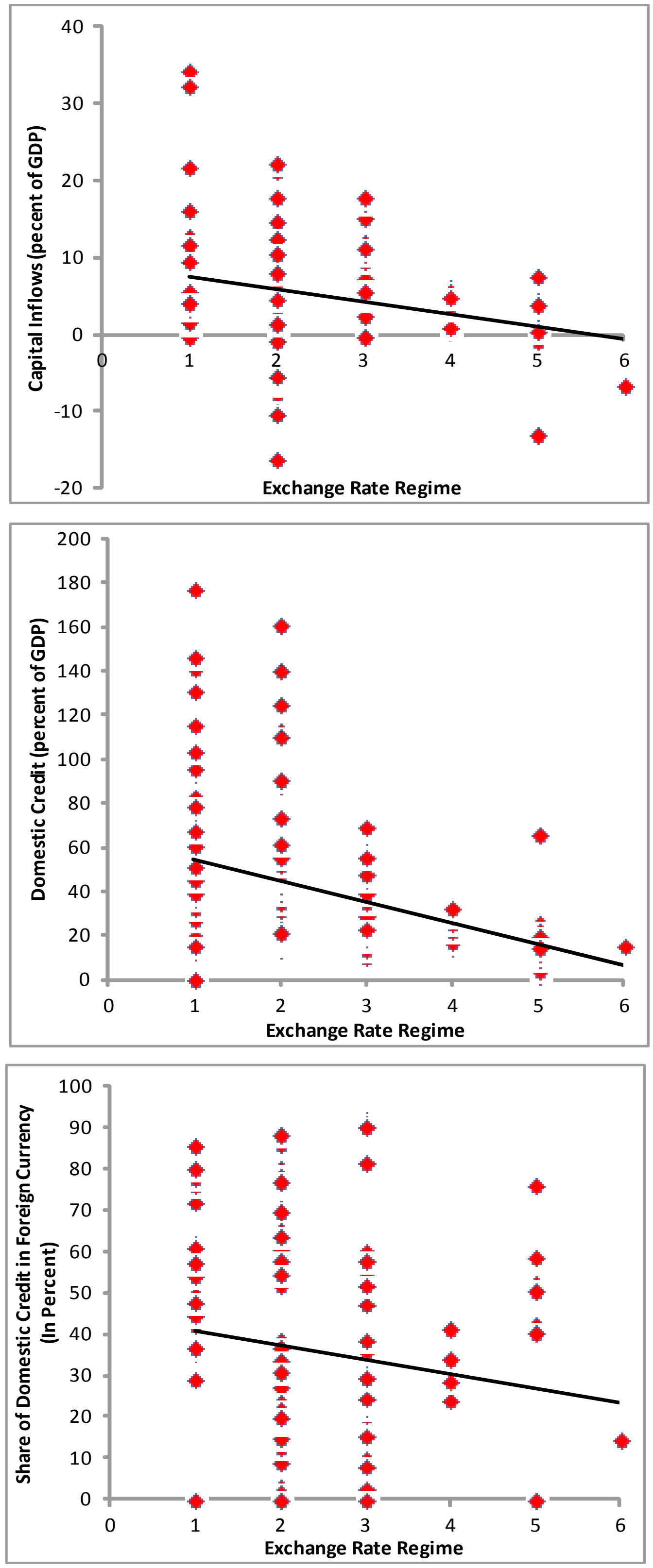
[10] See Rosenberg and Tirpák (2008), and the underlying theoretical model on the determinants of credit dollarization developed by Jeanne (2003).

Figure 1. Exchange Rate Regime, Capital Inflows and Credit



B. Results

10. **Before formally assessing the impact of capital inflows on domestic credit and the share of domestic credit on total credit, we start by inspecting the data.** Figure 1 shows a negative relation between the exchange rate regime and the volume of capital inflows, the ratio of domestic credit to GDP, and the share of credit in foreign currency. Table 1 shows that the first relation is not statistically significant, however.

Table 1. The Exchange Rate Regime and Capital Flows

Dependent Variable: Capital Flows/GDP

	OLS			GLS		IV
	(1)	(2)	(3)	(4)	(5)	(6) 1/
C	-1.102451	-7.722196 ***	-2.58451	0.306635	1.078489	-0.90445
Exchange Rate Regime	0.2712	-0.1002	0.3377	0.0642	-0.0750	0.0247
Financial Deepness (-1)	-0.008402	0.155505 ***	-0.051099 *	-0.011164	0.003482	-0.025148
Financial Integration (-1)	0.917619 ***	1.21284 ***	0.565159 *	0.458206 ***	0.695476 ***	0.733191 ***
Trade Openness (-1)	0.043914 ***	0.089041 ***	0.053286 ***	0.031734 ***	0.036974 ***	0.046383 ***
Real GDP	-1.38E-06	-1.07E-06	-2.41E-06	-2.55E-06 ***	-8.20E-07	-2.04E-06
Output Growth	-0.079056	0.090578	0.02786	0.059101	-0.100852	-0.025759
External Debt/GDP (-1)	0.053519 ***	0.015164	0.044158 ***	0.042359 ***	0.040645 ***	0.05682 ***
International Interest Rate	0.001791	0.180591	0.3922	0.018963	-0.106281	0.084464
Dummy Crisis	-1.13E+01 **	-7.58E+00 *	-1.12E+01 **	-9.4141 ***	-10.8535	-9.41E+00 *
Fixed Effects	No	Yes	No	No	No	No
Time Effects	No	No	Yes	No	No	No
Cross-Section Weights	No	No	No	Yes	No	No
Period Weights	No	No	No	No	Yes	No
Observations	202	202	202	202	202	189
Adjusted R-squared	0.2978	0.6965	0.3198	0.528285	0.2525	0.3232
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

1/ Instruments are lagged independent variables for real GDP, output growth, and the exchange regime.

11. **Several controls were added.** As an economy is more open to international trade receives more capital inflows. Higher external debt is also related to more capital flows. Likewise, economies that are more integrated into international financial markets depict higher volume of capital inflows. Deeper financial markets tend to be associated with more capital inflows as well. It is worth noting that for all these variables, the p-values reveal a very strong explanatory power. These variables have been lagged to avoid potential endogeneity biases given that the trade balance—through the balance of payments—is related to capital inflows, as well as the indebtedness financing, and financial deepness and integration. The crisis dummy variable is significant and negative, implying that capital

actually outflows in crisis periods. Table 1 document the strength of these results across the different regressions (OLS, GLS, IV, with cross-section and period effects).

12. **Economies with more rigid exchange rate regimes, all else equal, have higher domestic credit (Table 2).** Domestic credit is explained by the size of the capital inflows in the pooled sample. More rigid exchange rate arrangements result in higher domestic credit. Again, this relation is highly statistically significant across specifications. It is also economically significant, as the effect of increasing the exchange rate rigidity is reflected in an about 10 percent increase in average domestic credit (the sample average is close to 40 percent of GDP). Similar results can be observed for broad money: higher broad money is reflected in higher domestic credit—as broad money increases, it pushes domestic credit upwards. These variables are also economically and statistically significant for the alternative specifications. Inflation is only significant in the instrumental variables regression but with a small effect. Yet, in all specifications it has the expected sign, as more inflation should reduce domestic credit. Crises tend to be associated with period of high credit, as reflected in the crisis dummy variable. Note that these regressions depict high R^2, of about 60 percent.

Table 2. The Exchange Rate Regime and Domestic Credit

Dependent Variable: Domestic Credit/GDP

	OLS			GLS		IV
	(1)	(2)	(3)	(4)	(5)	(6) 1/
C	13.52512 ***	-5.858718	15.38236 ***	9.315921 ***	12.82253 ***	14.508 ***
Capital Inflows	1.038 ***	0.939 ***	0.927 ***	0.548 ***	1.039 ***	1.2382 ***
Exchange Rate Regime	-4.260724 ***	-5.185019 ***	-4.586926 ***	-2.592493 ***	-3.675734 ***	-4.389073 ***
Inflation (-1)	-0.006224	0.003172	-0.004707	-0.007412 *	-0.007028	-0.015592 **
Broad Money/GDP	0.714345 ***	1.164151 ***	0.703286 ***	0.749037 ***	0.689101 ***	0.725176 ***
Dummy Crisis	26.813 *	31.1244 ***	26.68 *	18.84632 **	26.731 **	17.16301
Fixed Effects	No	Yes	No	No	No	No
Time Effects	No	No	Yes	No	No	No
Cross-Section Weights	No	No	No	Yes	No	No
Period Weights	No	No	No	No	Yes	No
Observations	202	202	202	202	202	202
Adjusted R-squared	0.5734	0.8840	0.5664	0.6420	0.5800	0.5884
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

1/ Instruments are lagged independent variables for capital inflows and broad money.

13. **Transmission channel of capital inflows to domestic credit (Table 3).** To study the channel through which this effect operates, we do a similar specification to the previous set of regressions, other than including the interaction of capital inflows with the exchange rate regime. Periods of high capital inflows increase domestic credit, especially when the

exchange rate regime is more rigid, as shown by the interaction term. Broad money increases raise domestic credit and inflation would tend to lower it.

Table 3. The Exchange Rate Regime and Domestic Credit: Transmission

Dependent Variable: Domestic Credit/GDP

	OLS			GLS		IV
	(1)	(2)	(3)	(4)	(5)	(6) 1/
C	3.199546	-16.59257 ***	4.153166	2.686316 *	3.638239	4.623481
Capital Inflows	1.875 ***	1.402 ***	1.821 ***	0.935 ***	1.798 ***	2.4962 ***
Capital Inflows*Exchange Rate Regime	-0.414804 ***	-0.228583	-0.437471 **	-0.183603 *	-0.375398 *	-0.644334 ***
Inflation (-1)	-0.008997	0.001071	-0.007512	-0.010203 *	-0.009187 *	-0.018601 ***
Broad Money/GDP	0.731663 ***	1.145555 ***	0.722851 ***	0.779834 ***	0.706704 ***	0.732543 ***
Dummy Crisis	6.9851	9.559189	5.775867	3.193802	11.80781	11.75178
Fixed Effects	No	Yes	No	No	No	No
Time Effects	No	No	Yes	No	No	No
Cross-Section Weights	No	No	No	Yes	No	No
Period Weights	No	No	No	No	Yes	No
Observations	202	202	202	202	202	202
Adjusted R-squared	0.5666	0.8774	0.5580	0.6907	0.5779	0.5873
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

1/ Instruments are lagged independent variables for capital inflows and broad money.

14. **Tables 4 and 5 report similar results for the share of domestic credit in foreign currency to total domestic credit.** Periods of high capital inflows puts upward pressure on the share of domestic credit in foreign currency. More rigid exchange rate regimes display a higher share of foreign currency credit. We observe that the impact on domestic credit from the supply side for credit, as per capital inflows and domestic deposits, and the demand side for credit, as per the interest rate differential (between borrowing domestic currency vs. in foreign currency). The latter effect shows that borrowing in foreign currency becomes more attractive as it is "cheaper" in terms of interest rates.

15. **The effect of capital inflows on the share of foreign currency credit is amplified when the exchange rate regime is less flexible—as per the interaction term in Table 5.** Capital inflows increase the share of foreign currency credit. This effect is exacerbated as the exchange rate regime becomes more rigid, as can be seen in the interaction term. The other interaction terms shows that the impact of the interest rate differential is also exacerbated when the exchange rate arrangement is more rigid. Additionally, the share of domestic deposits in foreign currency (to total deposits) explains the increase in foreign currency credit share, as one would have expected. The statistical and economical significance of all these variables is high across specifications and controls.

Table 4. The Exchange Rate Regime and Credit Composition

Dependent Variable: Domestic Credit in Foreign Currency/Total Domestic Credit

	OLS			GLS		IV
	(1)	(2)	(3)	(4)	(5)	(6) 1/
C	60.01866 ***	38.4247 ***	60.68955 ***	49.74613 ***	59.39937 ***	43.77254 ***
Capital Inflows	0.551094 *	0.423 ***	0.537 *	0.934 ***	0.621 **	0.539 *
Exchange Rate Regime	-14.14148 ***	-4.168146 **	-14.47905 ***	-11.13677 ***	-14.04107 ***	-8.593321 ***
Domestic deposit in FC/Tot Deposits	0.273 ***	0.347888 ***	0.270084 ***	0.333108 ***	0.266243 ***	0.489078 ***
Inflation (-1)	0.105195	0.177322 ***	0.134988	0.089996	0.107762	-0.029168
Interest Rate Differential	0.750554 ***	0.063884	0.750716 ***	0.447151 ***	0.764045 ***	0.016877
Dummy Crisis	16.12851	-5.514184	15.55917	21.13095 ***	16.17645	-12.87435
Fixed Effects	No	Yes	No	No	No	No
Time Effects	No	No	Yes	No	No	No
Cross-Section Weights	No	No	No	Yes	No	No
Period Weights	No	No	No	No	Yes	No
Observations	150	150	150	150	150	158
Adjusted R-squared	0.3086	0.9389	0.2722	0.7706	0.3087	0.3161
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

1/ Instruments are lagged independent variables for the capital inflows, domestic deposits in foreign currency (share of total deposits), and the interest rate differentia

Table 5. The Exchange Rate Regime and Credit Composition: Transmission

Dependent Variable: Domestic Credit in Foreign Currency/Total Domestic Credit

	OLS			GLS		IV
	(1)	(2)	(3)	(4)	(5)	(6) 1/
C	30.02836 ***	29.36434 ***	30.09062 ***	23.24649 ***	29.67284 ***	26.30693 ***
Capital Inflows	2.618109 ***	0.798 ***	2.622 ***	2.896 ***	2.792 ***	2.974 ***
Capital Inflows*Exchange Rate Regime	-1.080141 ***	-0.24212	-1.065898 ***	-1.128129 ***	-1.129928 ***	-1.253216 ***
Domestic deposit in FC/Tot Deposits	0.306434 ***	0.356624 ***	0.306115 ***	0.535403 ***	0.298817 ***	0.464309 ***
Inflation (-1)	0.004083	0.148928 ***	-0.018737	-0.126693	0.016219	-0.03419
Interest Rate Differential	1.571079 ***	0.514693 ***	1.599634 ***	0.519066	1.605373 ***	0.006233
Exch Rate Reg*Interest Rate Differential	-0.327264 ***	-0.123296 ***	-0.3361 **	-0.120161	-0.331099 ***	-0.001215
Dummy Crisis	-29.30369	-21.81813 *	-28.64349	-30.10534 ***	-30.13561	-33.08297
Fixed Effects	No	Yes	No	No	No	No
Time Effects	No	No	Yes	No	No	No
Cross-Section Weights	No	No	No	Yes	No	No
Period Weights	No	No	No	No	Yes	No
Observations	150	150	150	150	150	158
Adjusted R-squared	0.269651	0.9401	0.2298	0.6894	0.2723	0.3128
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

1/ Instruments are lagged independent variables for the capital inflows, domestic deposits in foreign currency (share of total deposits), and the interest rate differentia

C. Policy Implications

16. **This note documents that more rigid exchange rate regimes result in larger volumes of domestic credit, possibly increasing vulnerability to boom-bust cycles.** As such, the less flexible the exchange rate regime is, the larger the relevance of policies to contain domestic credit (prudential regulations). The more flexible the exchange rate regime is, the easier it is to absorb capital inflows and partially dampen the effects of the latter on domestic credit—in domestic and foreign currency. In addition, we find that domestic credit in foreign currency increases as the exchange rate regime becomes more rigid.

17. **It would be important to rein in excessive domestic credit growth to limit the build-up of vulnerabilities.** The global financial crisis of 2009 brought about excess liquidity in international financial markets as a side effect of expansionary monetary and credit policies in advanced economies. As a result, large capital inflows to emerging countries are likely to continue for some time. However, the excess liquidity is likely to be eventually withdrawn as developed countries recover. Therefore, containing domestic credit growth in emerging markets now would be desirable to reduce the risk of a boom-bust cycle. Macroprudential tools could be used to complement monetary policy in containing domestic credit. Possible tools include changes in debt-to-income ratios, loan-to-value ratios, dynamic capital or provisioning requirements, and others.

References

Backe, P. and C. Wojcik, 2008, "Credit Booms, Monetary Integration, and the Neoclassical Synthesis," *Journal of Banking and Finance*, 32, 458–470.

Brunnermeier, M. S. Nagel, and (2009), L. Pedersen "Carry Trades and Currency Crashes," in NBER Macroeconomics Annual 2008, 2009, 23, 313–347

Bubula, A., and I. Ötker-Robe, 2003, "Are Pegged and Intermediate Regimes More Crisis Prone?" IMF Working Paper 03/223 (Washington: International Monetary Fund).

Calvo, G. 1991, "The Perils of Sterilization," IMF Staff Papers, 38, Issue 4, December, 921－926

G. Calvo, L. Leiderman, and C. Reinhart, 1995, "Capital Inflows to Latin America with Reference to the Asian Experience," in Sebastian Edwards, ed. *Capital Controls, Exchange Rates and Monetary Policy in the World Economy*, (Cambridge: Cambridge University Press, 1995), 339–382.

Eyzaguirre, N., M. Kaufman, S. Phillips, and R. Valdes, 2011, "Managing Abundance to Avoid a Bust in Latin America," IMF Staff Discussion Note 11/07, April (Washington: International Monetary Fund).

Fernandez Arias, E. and P. Montiel, 1996, "The Surge of Capital Inflows to Developing Countries: an analytical Overview," The World Bank Economic Review, 10, Issue 1, January, 51–77.

Ghosh, A., A. Gulde, J. Ostry, and H. Wolf, 2003, "Exchange Rate Regimes: Choices and Consequences" (Cambridge, Massachusetts: MIT Press).

Gosh. A., J. Ostry, and Ch. Tsangarides, 2010, "Exchange Rate Regimes and the stability of the International Monetary System," IMF Occasional Paper 270 (Washington: International Monetary Fund).

Jeanne, O., 2003, "Why do Emerging Markets Borrow in Foreign Currency?," IMF Working Paper 03/177 (Washington: International Monetary Fund).

Kaminsky, G., C. Reinhart, and C. Végh, 2004, "When It Rains, It Pours: Procyclical Capital Flows and Macroeconomic Policies," NBER Working Paper 10780.

Magud, N., C. Reinhart, and K. Rogoff, 2011, "Capital Controls: Myth and Reality—A Portfolio Balance Approach," NBER Working Paper 16805.

Magud, N., C. Reinhart, and E. Vesperoni, 2011, "Capital Inflows, Exchange Rate Flexibility, and Domestic Credit," forthcoming as NBER Working Paper.

Montiel, P. and C. Reinhart, 2001, "The Dynamics of Capital Movements to Emerging Economies During the 1990s," in Stephany Griffith-Jones, Manuel Montes, and Anwar Nasution eds. Short-term Capital Flows and Economic Crises, (Oxford: Oxford University Press, 2001), 3–28.

Pantin, G. and H. Shin, 2011, "Carry Trades, Monetary Policy and Speculative Dynamics," mimeo, Princeton University.

Reinhart, C. and V. Reinhart, 2008, "Capital Flow Bonanzas: An Encompassing View of the Past and Present," NBER Working Paper 14321.

APPENDIX

Methodology

To test our hypothesis[11] we constructed a 25-emerging-economy panel. To have a broad balance of countries/regions we collected data for 7 Latin American economies (Argentina, Brazil, Chile, Colombia, Mexico, Peru and Uruguay), 13 Emerging Europe nations (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Slovak Republic, Serbia, and Turkey), and 5 Asian countries (Indonesia, Korea, Malaysia, the Philippines, and Thailand).

The countries in the panel, however, have not necessarily experienced capital inflows booms simultaneously. Asian countries received large capital inflows in the early 1990s. Latin America also got capital inflows in the 1990s. Emerging Europe, on the contrary, observed large capital inflows in 2000s. Furthermore, even though both Latin America and Asia received strong capital flows the same decade, the specific years in which capital inflows were strong could differ. Therefore, for a coherent analysis the first task is to identify periods of excessive capital inflows in a systematic way—in order to “balance” the panel in a consistent manner before pooling the data.

Identifying capital inflows’ booms

Definition 1. *We define a capital flows boom as either:*

(i) *a period in which trend capital inflows monotonically increase with a structural trend change; or*

(ii) *if capital inflows do not monotonically increase over the sample with a structural trend change, as a period* t: $[t \in \daleth | \daleth = t_1, t_2, \ldots, T]$ *in which observed capital inflows exceeds their long-term trend, i.e.* $CF_{t,i} > \overline{CF_{t,i}}$, *where* $CF_{t,i}$*.refers to capital inflows in region* i *during period* t*. A bar over a variable represents its long-term value.*

To systematically identify periods of capital flows booms we compute the cyclical components of Hodrick-Prescott de-trended series of capital inflows.[12] Given heterogeneity among regions but relative homogeneity within regions, we run this exercise separately for each region (Asia, Emerging Europe, and Latin America).

For each region *i*: $[i \in I | I = 1, 2, 3]$, we compute the total volume of capital inflows by adding the dollar-value of capital inflows of each country c_n^i: $\left[c_n^i \in C^i \middle| C^i = c_1^i, c_2^i, \ldots, c_{Ni}^i\right]$

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[11] See Magud et al.,(2011b) for details.

[12] See the section Data below for details on the time-series used.

for the $n = 1, 2, ..., Ni$, countries in each region i as $CF_t^i = \sum_{c_1^i=1}^{c_{Ni}^i} CF_{t,c_n^i}^i$ to obtain the total volume of capital flows of each region in each year t.

In turn, for each region *i* the series of total capital inflows are de-trended using the standard Hodrick-Prescott filter. As we are using annual data, we chose $\lambda = 100$. The cyclical components are computed by subtracting the HP-trended value from the actual observation of total capital inflows in each period t. Following Definition 1, capital inflows booms are marked by the sequence of periods such that these cyclical components are positive.

Figure A.1 depicts trend and observed total component in their left panels and the cyclical component in the right panel for each region. The first row of figures shows the Asian data, while the second and third row depict Latin America and Emerging Europe, respectively. In the early 1990s Latin America and Asia received large volumes of capital inflows, to decrease in the 2000s—tuning negative for Asia that provided their savings to finance developed countries. For developing Europe these flows were virtually zero before the late 1990s when EU access raised the flow of capital to these countries. They sharply increased form then onwards.

Given *Definition 1*, we identify the periods of capital flows booms in each region. For Asia, the period is 1990-1997, while for Latin America is 1993-2002. For Emerging Europe, we use 1999-2008. For Latin America and Asia the Hodrick-Prescott filters are necessary to establish capital inflows booms. This is evident given that the observations, over the entire sample period, are mean-reverting—with strong capital inflows in the 1990s and likewise strong capital outflows thereafter. As such, the filter is needed to appropriately identify excess capital inflows periods given that would up to zero intertemporally. However, applying the same procedure to Emerging Europe will prove incorrect. Visual inspection of the lower left panel shows that capital inflows to this region were virtually zero before the late 1990s. Since then we observe a very strong increase in the level and trend of these capital inflows. Given the latter, we included in the sample the period for which capital flows' trend stops being zero.

After correcting for the different periods in which each region was experiencing a boom of capital inflows, the observations are homogeneous enough to be pooled in a panel. These periods can be verified graphically by inspection. In Latin America, even though 1995 has a negative cyclical component, we chose to keep it as part of the capital inflows boom. We also added dummy variables were appropriate, such as crises variables or country-specific variables.

Thus, we build a balanced panel of 25 cross-sections with 10 observations each. The maximum sample size would be 250 annual observations, reduced to 240 given that we only have 8 years of cyclically adjusted capital flows boom for each of the 5 Asian economies.

Econometric Model

To study the impact of alternative exchange regimes on capital inflows, domestic credit and the share of domestic credit in foreign currency, we use the approach in Ghosh et al.,(2010), Ghosh et al.,(2003) the current literature. Given that we focus on capital flows, though, we extend the analysis to control for the degree of domestic financial development and the financial integration with international capital markets. We also control for macroeconomic factors that turn important in the evolution of capital flows and domestic credit.

The three dependent variables we study are as follows. The capital flows variable is defined as the ratio between capital flows and gross domestic product at current prices, both in U. S. dollars. The domestic credit variable is the ratio between banking system credit to the private sector and gross domestic product at current prices. The third variable—foreign currency credit—is defined as the ratio between credit to the private sector in foreign currency and total credit to the private sector.

The explanatory variables can be grouped in four different categories: (i) a variable capturing the flexibility of the exchange rate regime (described in more detail in the next section), (ii) macroeconomic factors, (iii) financial sector variables, and (iv) country and time effects.

The second category involves macroeconomic variables. The real GDP level intends to capture how the level of economic development affects the amount of capital flows in a particular economy. Real GDP growth captures whether higher economic growth attracts more capital inflows. The ratio of external debt to GDP and the ratio of exports and imports to GDP capture how the level of indebtedness and trade openness affect the amount of capital flows in the economy. The annual rate of inflation controls for the effect of the latter on the amount and composition of domestic credit. The ratio of broad money to GDP intends to control for factors that affect the amount of disposable resources for credit in the financial system. The ratio of foreign currency deposit to total deposits measures the impact of foreign currency financing on foreign currency lending. Finally, the real exchange rate level controls for the incentives to shift towards foreign currency lending. All these variables are standard in the literature.

The variables in the third category measure the effects of financial sector developments on capital flows and credit. Interest rate captures opportunity cost of investing/borrowing. International interest rate differentials capture incentives for international investors to enter a given market (deposit rate differentials), and domestic interest rate differentials look at incentives for borrowers to demand credit in foreign currency (lending rate differentials). To control for financial integration we use Chinn-Ito's index, while we construct an indicator for financial deepness (described in the data section below).

As a last category, country dummies are included to control for idiosyncratic shocks, and time dummies to control for aggregate time shocks, i.e. international developments.

We estimate panel regressions for every dependent variable. The basic regression uses annual data for the thirteen, five, and seven emerging economies in Europe, Asia, and Latin America, respectively, pooled sample panel under ordinary least squares. The equations estimated for are:

$$Y_{i,t} = \eta + \beta' X_{i,t} + \gamma' M_{i,t} + \theta' F_{i,t} + \omega_{i,t}, \qquad (1)$$

such that $i = 1,...,N$, and $t = 1,...,T$. We assume that the error term ωi,t can be characterized by independently distributed random variables with mean zero and variance $\sigma^2_{i,t}$.

$Y_{i,t}$ represents the four dependent variables defined above. The sub-indexes i and t stand for country and time respectively. $X_{i,t}$ stands for the variable capturing exchange rate flexibility. $M_{i,t}$ denotes variables controlling for macroeconomic effects. $F_{i,t}$ captures the impact of financial sector variables.

As a first alternative, we report within (or fixed effects) and time effects estimates. These models are estimated as:

$$Y_{i,t} = \phi' f_{i/t} + \beta' X_{i,t} + \gamma' M_{i,t} + \theta' F_{c,t} + \varepsilon_{i,t}, \quad (2)$$

such that $f_{i/t}$ are country and time specific effect respectively. We assume that the error term $\varepsilon_{i,t}$, can be characterized by independently distributed random variables with mean zero and variance $\sigma^2_{i,t}$. Finally, for robustness, through generalized least squares we estimate the panel allowing for heteroskedasticity and autocorrelation of the residuals.

Instrumental variables. The above estimations assume exogeneity of the explanatory variables. However, if some of the right hand side variables were endogenously determined, we would need to use instruments. To control for potential endogeneity biases and to check the robustness of the results, we estimate instrumental variable models of equation (1), as the third alternative specification.

Data Description

The series span different periods, chosen using the criterion defined above for identifying capital inflows booms. For Latin America we use 1993–2002; for Asia, 1990–1997; and for Emerging Europe we use 1999–2008.

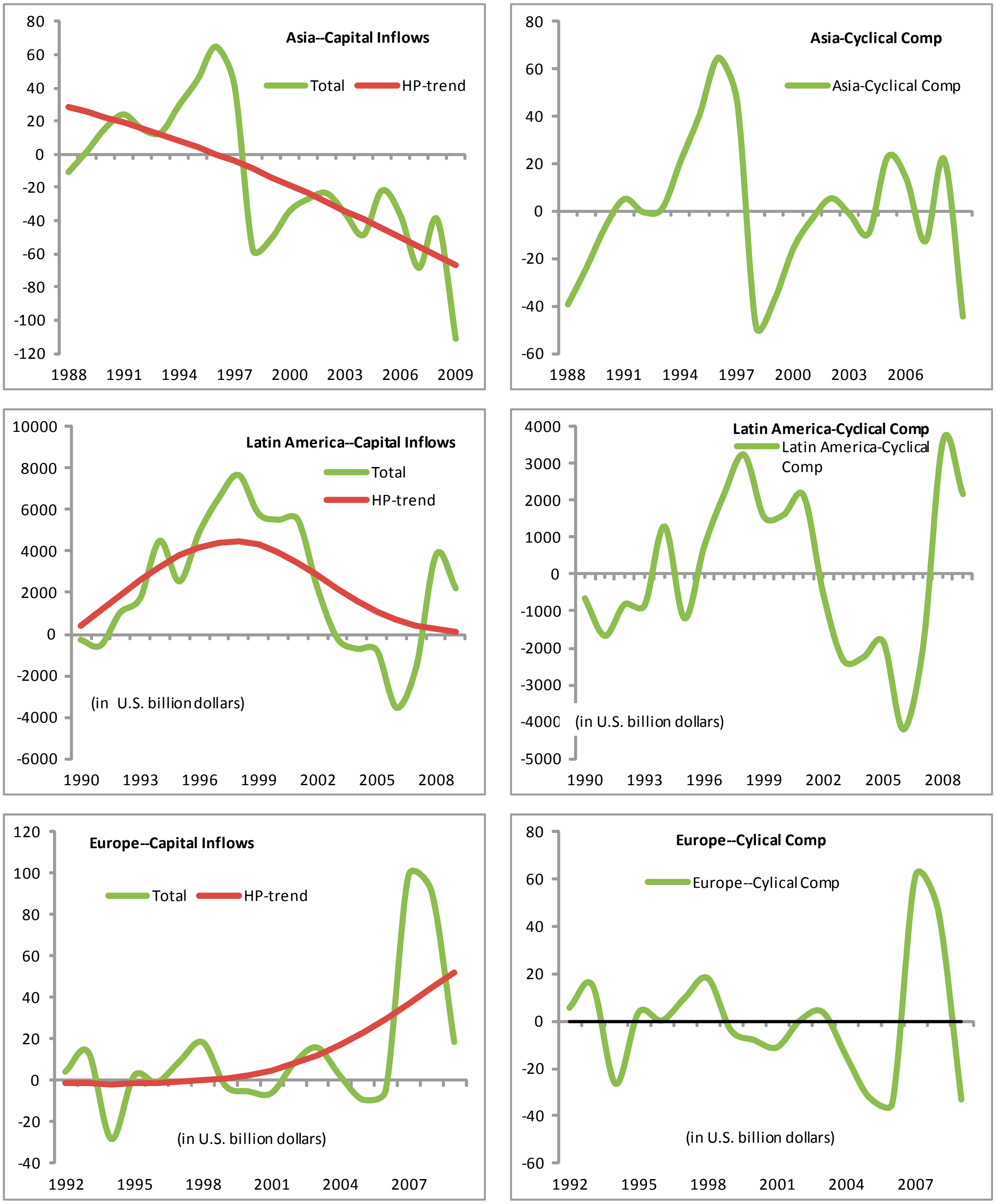
Most of the time series were obtained from the International Monetary Fund's International Financial Statistics, and complemented by information from the countries

central banks and IMF's Staff Reports to extend the observations as much as possible. These series were real GDP, the growth rate of output, external debt (as a percentage of GDP), trade openness (measured as exports plus imports as a percentage of GDP), capital inflows (measured by the financial account balance as a percentage of GDP), domestic credit (as a percentage of GDP), the rate of inflation (measured as the growth rate of the CPI), broad money (as a percentage of GDP), the real effective exchange rate, and domestic credit in foreign currency (as a share of total domestic credit). For the international interest rate we used the U.S. 2 year Treasury bonds, as well as Fed funds rate, lending rates, and deposit rates. Interest rates we obtained from the Federal Reserve Bank of Saint Louise' FRED, as well as interest rate differentials (as per the difference between a country's lending and deposit rate and the U.S. rate, respectively).

For the exchange rate regime classification we used the Reinhart and Rogoff de-jure exchange rate regime classification. We conducted robustness exercises by using the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) data base and obtained similar results—given that both series are highly correlated.

Financial deepness is based on the data set in Beck and Asli Demirgüç-Kunt (2009). We computed an index of financial deepness as the sum of: deposit money bank assets to GDP, stock market capitalization to GDP, private bond market capitalization to GDP, and public bond market capitalization to GDP. Financial integration is based in the Chinn-Ito index.

Figure A.1


Asia--Capital Inflows
Total
HP-trend
80
60
40
20
0
-20
-40
-60
-80
-100
-120
1988
1991
1994
1997
2000
2003
2006
2009
Asia-Cyclical Comp
Asia-Cyclical Comp
80
60
40
20
0
-20
-40
-60
1988
1991
1994
1997
2000
2003
2006
Latin America--Capital Inflows
Total
HP-trend
(in U.S. billion dollars)
10000
8000
6000
4000
2000
0
-2000
-4000
-6000
1990
1993
1996
1999
2002
2005
2008
Latin America-Cyclical Comp
Latin America-Cyclical Comp
(in U.S. billion dollars)
4000
3000
2000
1000
0
-1000
-2000
-3000
-4000
-5000
1990
1993
1996
1999
2002
2005
2008
Europe--Capital Inflows
Total
HP-trend
(in U.S. billion dollars)
120
100
80
60
40
20
0
-20
-40
1992
1995
1998
2001
2004
2007
Europe--Cylical Comp
Europe--Cylical Comp
(in U.S. billion dollars)
80
60
40
20
0
-20
-40
-60
1992
1995
1998
2001
2004
2007

III. Do Dynamic Provisions Enhance Bank Solvency and Reduce Credit Procyclicality? A Study of the Chilean Banking System[1]

A. Introduction

1. **It has long been acknowledged that procyclicality could pose risks to financial stability as noted by the academic and policy discussion centered on Basel II, accounting practices, and financial globalization**.[2] Recently, much attention has been focused on regulatory dynamic provisions (or statistical provisions). Under dynamic provisions, as banks build up their loan portfolio during an economic expansion, they should set aside provisions against future losses.[3]

2. **The use of dynamic provisions raises two questions bearing on financial stability**. First, do dynamic provisions reduce insolvency risk? Second, do dynamic provisions reduce procyclicality? In theory the answer is yes to both questions. Provided loss estimates are roughly accurate, bank solvency is enhanced since buffers are built in advance ahead of the realization of large losses. Regulatory dynamic provisions could also discourage too rapid credit growth during the expansionary phase of the cycle, as it helps preventing a relaxation of provisioning practices.

3. **However, when real data is brought to bear on the questions above the answers could diverge from what theory implies**. This paper attempts to answer these questions in the specific case of Chile. It finds that the adoption of dynamic provisions could help to enhance bank solvency but it would not help to reduce procyclicality. The successful implementation of dynamic provisions, however, requires a careful calibration to match or exceed current provisioning practices, and it is worth noting that reliance on past data could lead to a false sense of security as loan losses are fat-tail events. Finally, since dynamic provisions may not be sufficient to counter procyclicality alternative measures should be considered, such as the proposed countercyclical capital buffers in Basel III and the countercyclical provision rule Peru implemented in 2008.

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[1] Prepared by Jorge A. Chan-Lau with comments by Jorge Cayazzo, Francesco Columba, Dora Iakova, and especially Patricio Jaramillo, David Pacheco, and Torsten Wezel. The Superintendencia de Bancos e Instituciones Financieras, Chile, kindly provided the data used in this study.

[2] Borio, Furfine, and Lowe (2000) are among the first to discuss the interaction between procyclicality and financial stability; Brunnermeier et al.,(2010) provide a more recent discussion building on the experience of the 2008-9 crisis. Regulatory and accounting practices could contribute to procyclicality: see for instance Gordy and Howells (2006), and Plantin, Sapra, and Shin (2008); which may have been further exacerbated as the financial systems become globally integrated (Chan-Lau, 2008).

[3] Dynamic provisions were first introduced in Spain in 2000 (Poveda, 2000, and Fernández de Lis, Martínez Pagés, and Saurina, 2000).

4. Below, section B explains the rationale for dynamic provisions concisely for the benefit of the reader unfamiliar with the literature. Section C describes the Spanish model. Section D discusses the results of a simulation analysis of the Spanish model calibrated to Chilean banks. Section E analyzes the joint dynamics of aggregate provisions and domestic credit. Section F concludes.

B. The Rationale for Dynamic Provisions

5. **Provisions, together with capital, ensure the viability and solvency of a bank by protecting it against loan portfolio losses**. But banks have strong incentives for under-reporting provisions, including differences in the tax treatment of general and specific provisions and compensation schemes directly related to lending volumes, profits, and earnings (see Box 1). The practice of under-reporting provisions during good times appears common in both advanced and emerging market countries (Bikker and Metzemakers, 2005).

6. **Under-reporting of provisions contributes to procyclicality** (Brunnermeier et al, 2009, Burroni et al, 2009). During good times it raises net income and bank capital enabling a substantial acceleration of the loan flow. When the cycle turns, a credit crunch is likely to ensue as under-provisioned banks need to provision against large losses out of meager earnings. For large enough losses, banks could incur substantial capital losses and fail.

7. **Dynamic provisions aim to improve upon standard provision practices by requiring them to build up provision buffers ahead of realized losses**. All regulatory dynamic provisions schemes build on the principle that provisions should be set in line with estimates of long-run, or through-the-cycle expected losses (Mann and Michael, 2002), and can be expressed as variations of the formula below (Burroni et al, 2009):

(1) Dynamic provisions = Through-the-cycle Loss Ratio × Flow of New Loans

Minus Flow of Specific Provisions,

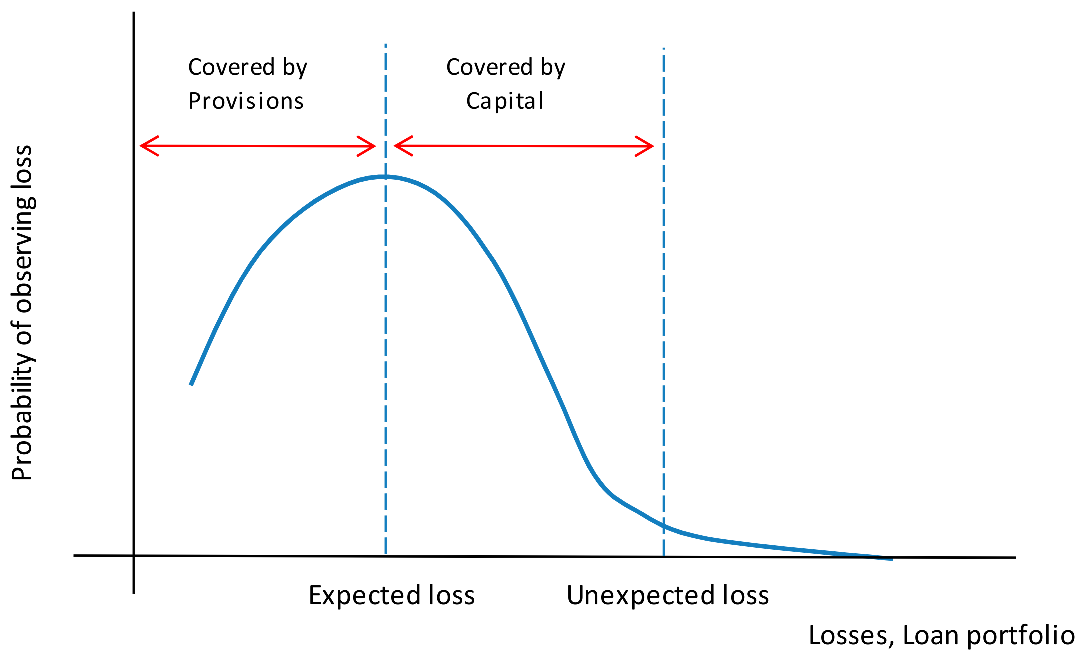
where specific provisions correspond to realized losses. Equation (1) shows that during good times dynamic provisions are positive and add up to loss provisions as realized losses are lower than their through-the-cycle estimates. During bad times, the opposite takes place and negative dynamic provisions deplete the loss provision buffer. Hence, provisions consistent with consistent with through-the-cycle estimates reduce the probability of failure of banks during a downturn.[1] Moreover, by smoothing provisions, dynamic provisions lead to smooth earnings over the cycle and dampen procyclicality.

[1] Dynamic provisions are criticized n the basis that income and profit smoothing works against financial statement transparency (FASB-IASB, 2009). The Financial Stability Board, and the Basel Committee on Banking and Supervision, the International Accounting Standard Board and the US Financial Accounting

(continued…)

Box 1. Provisions, Capital, and their Tax and Regulatory Treatment

To guard against losses in the loan portfolio, banks set aside provisions and capital. Provisions can be either general, to account for expected losses in the portfolio that have yet to be identified since they have not realized yet; or specific, to account for losses from specific impaired loans and write-offs. Because ex-ante loss estimates may differ from realized losses a bank holds another buffer, capital, to be able to cover unexpected losses, or losses beyond the mean ex-ante estimate. Clearly, the adequacy of provisions and capital to withstand losses depends on how reliable the estimated loss distribution is.



Additions to provisions reduce reported profits but are accounted differently. Specific provisions are considered a current expense and can be deducted from taxes. General provisions are considered appropriations of retained earnings so their increase reduces the capital of the bank. The differential tax treatment provides banks with incentives to under-report general provisions. Under Basel II, the incentive was partly offset by the allowance to count general provisions towards Tier II capital up to a maximum of 1.25 percent of risk-weighted assets (Sunley, 2003, and Ryan, 2007).

C. The Spanish Dynamic Provisions Formula

8. **As described in Saurina (2009), the Spanish dynamic provisions formula is designed to build up general provisions that account for**: (1) expected losses in new loans extended in a

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Standard Board published a proposed common solution for impairment accounting for public comments on January 31, 2011.

given period; and (2) expected losses on the outstanding stock of loans at the end of that period after netting off specific provisions incurred during the period.[2]

9. Algebraically, for new loans of an homogeneous category k, ΔC_t^k, general provisions, GP_t, should be increased by the amount $\alpha^k \Delta C_t^k$, where α^k is representative of the average credit losses during a business cycle of loans in category k. This first component is an incremental provision that account for expected losses in new loans.

10. **It is also necessary to hold an amount of specific provisions reflecting the average specific provisions made during the business cycle but that have not realized yet**. This amount is equal to $\beta^k C_t^k$, where $\beta^k$is the average specific provision for loans in category k and C_t^k is the outstanding amount of loans. Finally, the specific provisions component should be corrected for specific provisions already incurred during the period, SP_t^k . As a result, provisions accumulate according to the formula below:

(2) $$GP_t = \sum_{k=1}^{N} \left(\alpha^k \Delta C_t^k + \beta^k C_t^k - SP_t^k \right),$$

where the different loan categories, and the choice of parameters in the formula above are determined by the banking regulatory agency for all banks, as is the case in Spain, or could be calibrated individually for each bank based on individual historical data on loan losses and provisions.

11. **The Spanish system allows for six different loan categories in ascending order of risk: negligible risk, low risk, medium-low risk, medium-risk, medium-high risk, and high risk**. The general provision parameters, or alpha-parameters, corresponding to these groups are 0, 0.6, 1.5, 1.8, 2, and 2.5 percent respectively; and the specific provision parameters, or beta-parameters, are 0, 0.11, 0.44, 0.65, 1.1, and 1.64 percent respectively. The system also specifies that cumulative provisions should not exceed 125 percent of the inherent losses of the loan portfolio, $\sum_{k=1}^{N} \alpha^k C_t^k$.

12. **Equation (2) indicates that banks can reduce their stock of provisions when specific provisions exceed expected losses from new loans and expected average specific provisions, a situation encountered during an economic downturn**. Therefore, successful implementation of a dynamic provisions system hinges on building up an adequate stock of provisions early on in the credit cycle.

D. Dynamic Provisions and Bank Solvency in Chile: A Simulation Analysis

13. **The assessment of bank solvency under the Spanish dynamic provision rule was based on a simulation analysis. The analysis used data for 14 commercial banks**

[2] For a concise description of dynamic provision regimes other than the Spanish one, see Chan-Lau (2011).

established in Chile. The data contains end-month information on the outstanding stock of consumer, commercial, and mortgage loans from January 2004 to June 2010. The data set also includes information on provisions, recovery in the event of default, and loan write-offs.

14. **The parameters in the dynamic provision formula (equation 2) were calibrated individually for each bank based on its historical data on loan portfolios, provisions, and loan losses for three different loan categories**: consumer loans, commercial loans, and mortgage loans. The choice of an individual bank calibration rather than a system-wide calibration was guided by substantial differences in business models across banks, which suggests a one-size-fits-all model may not be appropriate. For instance, some banks are not active in mortgage lending, and some banks lend mainly to upper-income households while others target the middle and low-middle income sectors.

15. **Simulation analysis was used to assess differences in bank solvency under the provisioning regime prevalent prior to January 2011 and under dynamic provisions**. The simulation analysis was based on 20000 draws of a loan loss cycle lasting 78 months (6½ years) for each bank.[3] In each simulation draw, the initial stock of provisions was set equal to 1.5 percent of the total amount of outstanding loans. The loan origination in each loan category, consumer, commercial, and mortgages was set equal to the observed historic series. Dynamic provisions were calculated using historical bank-specific data on loan losses and recoveries. For each bank, the aggregate losses were generated randomly from either unit root or autoregressive processes of order one (AR(1)) fitted to the bank's historical write-off series to capture as close as possible the cyclical nature of loan losses. Since the residuals in the estimated processes exhibit non-normality, they were generated from extreme value distributions fitted to the data (Table 1). Once the artificial write-off data was generated, the path of provisions under the current regime and dynamic provisions were calculated.

[3] Other studies use counterfactual simulation based on historical data to assess the hypothetical performance of provisions under a dynamic provisions. In a counterfactual simulation, the loan and loan losses data is taken as given, and provisions are calculated according to the dynamic provision rule. The counterfactual provision time series under the dynamic provisions rule is then contrasted with the historical provision time series. See for instance Balla and McKenna (2009), Burroni et al.,(2009), Fillat and Montoriol-Garriga (2010), Saurina (2009), and Wezel (2010),.

Table 1. Write-off Series: Unit Root Tests; AR(1) Coefficients, and Extreme Value Distribution Parameters

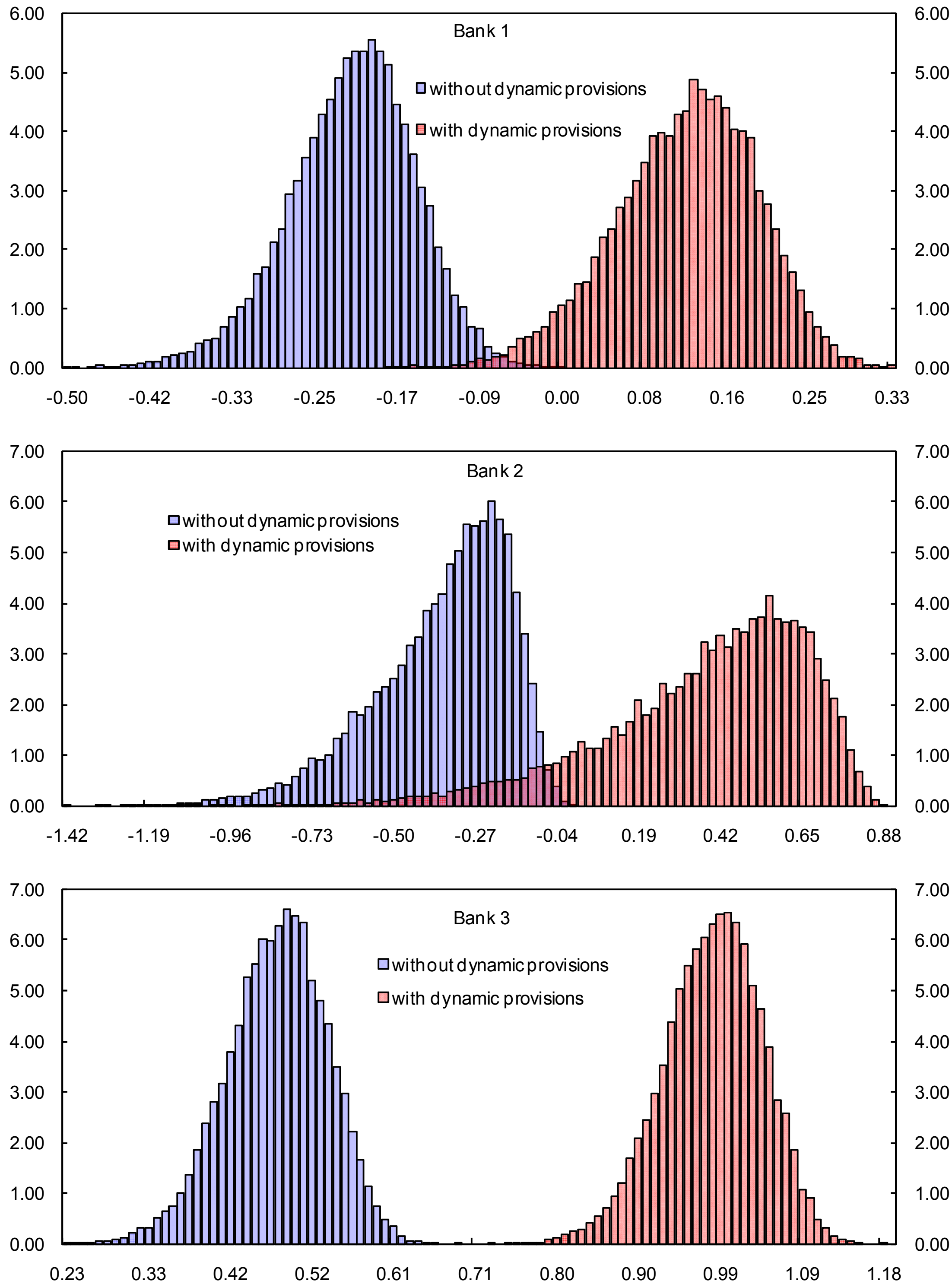
Bank	Augmented Dickey-Fuller test		AR(1)	Residuals, EV distribution 3/	
	t-statistics	p-values 1/	coefficient 2/	Location	Scale
1	-8.28	0.00	0.17	154.6	309.0
2	-1.43	0.56	1.00	1435.9	3273.9
3	-9.20	0.00	0.17	540.6	1109.3
4	-2.77	0.07	0.93	2545.8	5095.5
5	-0.74	0.83	1.00	510.2	1100.7
6	-1.45	0.55	1.00	848.8	1674.4
7	-1.12	0.70	1.00	293.3	729.4
8	-3.62	0.01	1.00	2923.7	4589.5
9	-4.72	0.00	0.23	311.1	491.6
10	-2.05	0.27	1.00	258.9	626.8
11	-1.77	0.39	1.00	1424.6	2785.0
12	-7.67	0.00	0.23	5388.6	12779.9
13	-7.84	0.00	0.59	571.5	903.4
14	-2.53	0.11	1.00	1029.6	2439.3

Source: SBIF and staff calculations.
1/ McKinnon one-sided probabilities.
2/ A value of 1 indicates write-offs follow a unit root process.
3/ Extreme value distribution type 1, fitted to residuals of unit roor or AR(1) process, in million pesos.

16. **After performing the simulation, the impact of the different provisioning regimes processes was assessed by examining the distribution of the minimum provision buffer, or minimum provision shortfall**. In each simulation draw, the minimum provision buffer was calculated as the lowest level of provisions net of write-offs (or loan losses) measured in percent of total loans. If the minimum provision buffer was negative, it indicated that the bank could not meet the loan losses using provisions exclusively. Figure 1 shows the distribution of the minimum provision buffer under regimes with and without dynamic provisions.

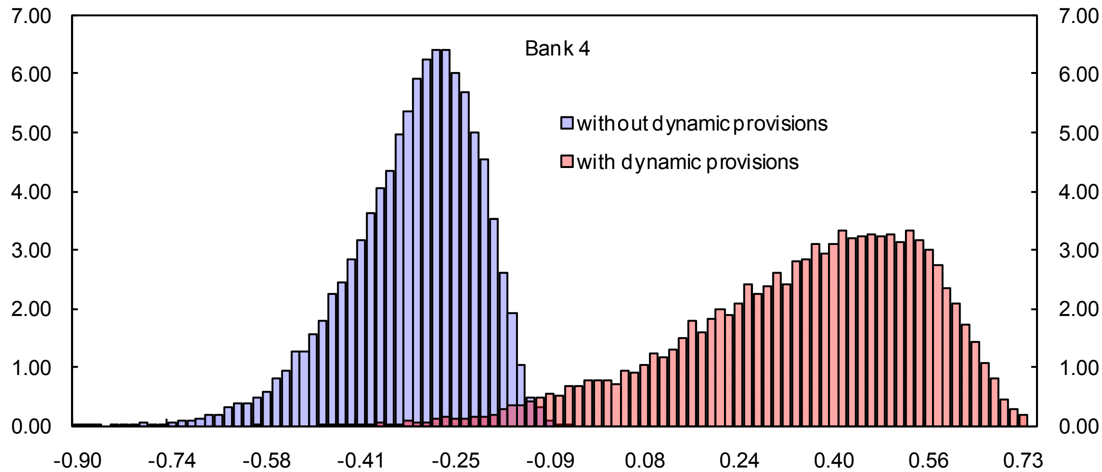
17. **The adoption of dynamic provisions improves substantially the solvency of Chilean financial institutions**. Under dynamic provisions, the distribution of the minimum provision buffer shifts markedly to the right, implying a lower likelihood that the provisions would be insufficient to cover bank losses. Because loan losses exhibit fat-tails, even the introduction of a dynamic provisions regime could not avoid prevent provisions from falling short as shown by negative realizations of the minimum provision buffer. Nevertheless, the likelihood and magnitude of these events are lower than under standard provisioning.

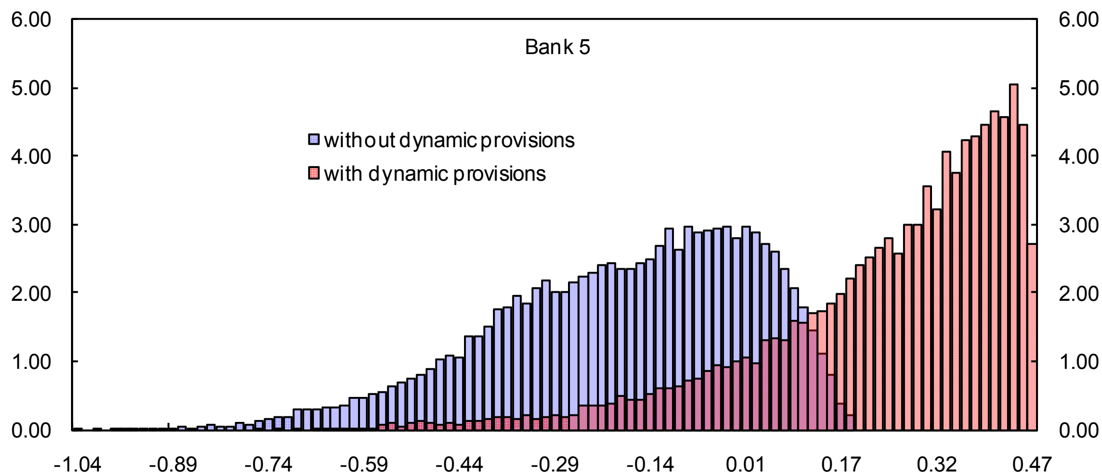
Figure 1. Minimum Provision Buffer, Probability Distributions 1/2/

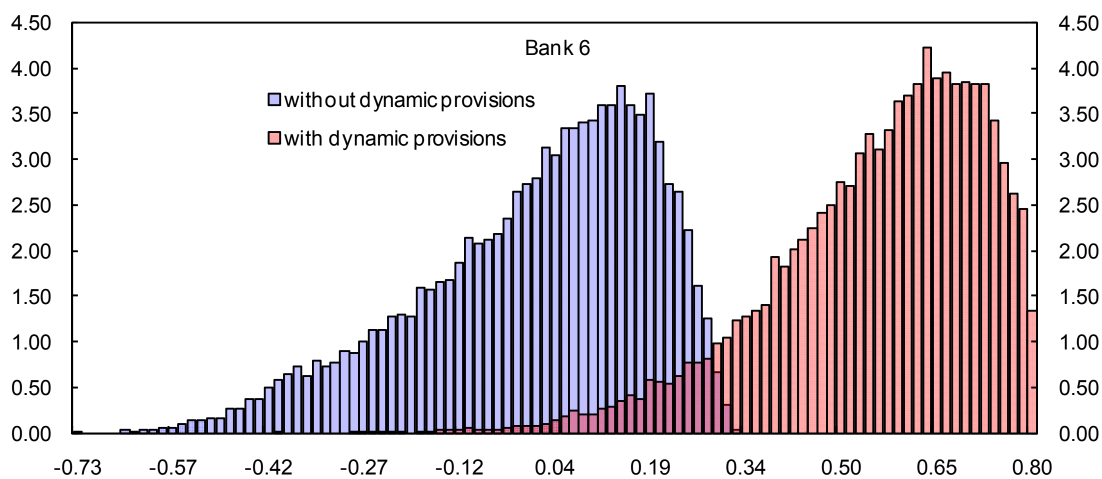


Source: SBIF and staff calculations.
1/ Horizontal axis: provisions in percent of total loans; vertical axis; probability, in percent.
2/ A negative number indicates that provisions are insufficient to cover loan losses.

Figure 1. (cont.) Minimum Provision Buffer, Probability Distributions 1/2/

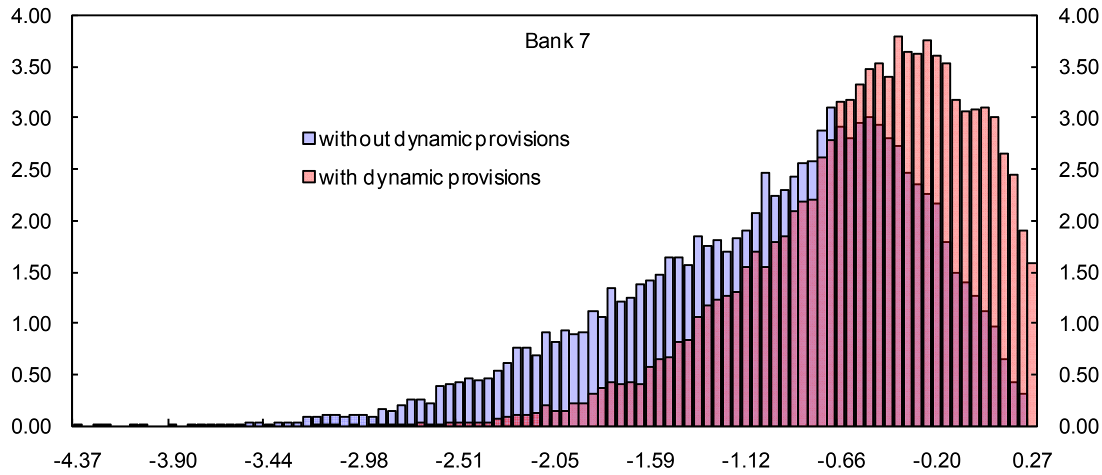


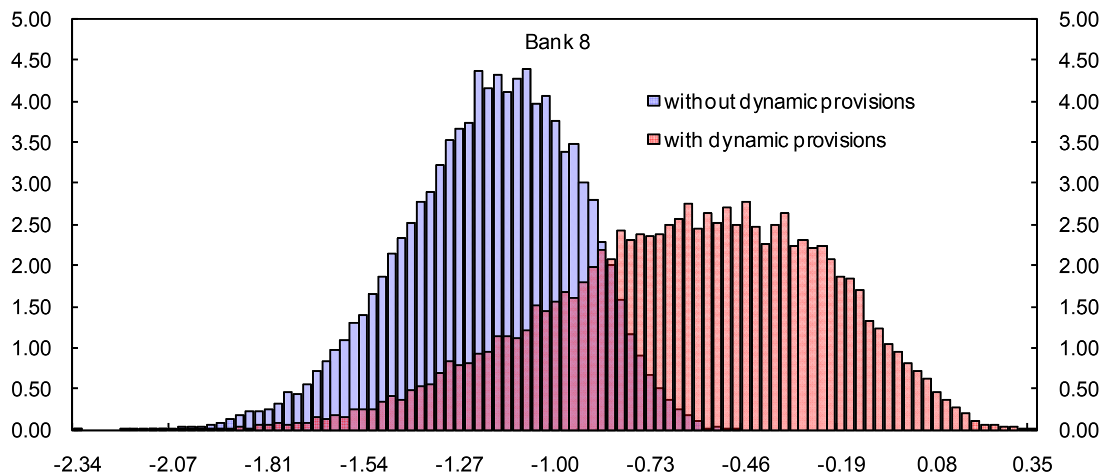


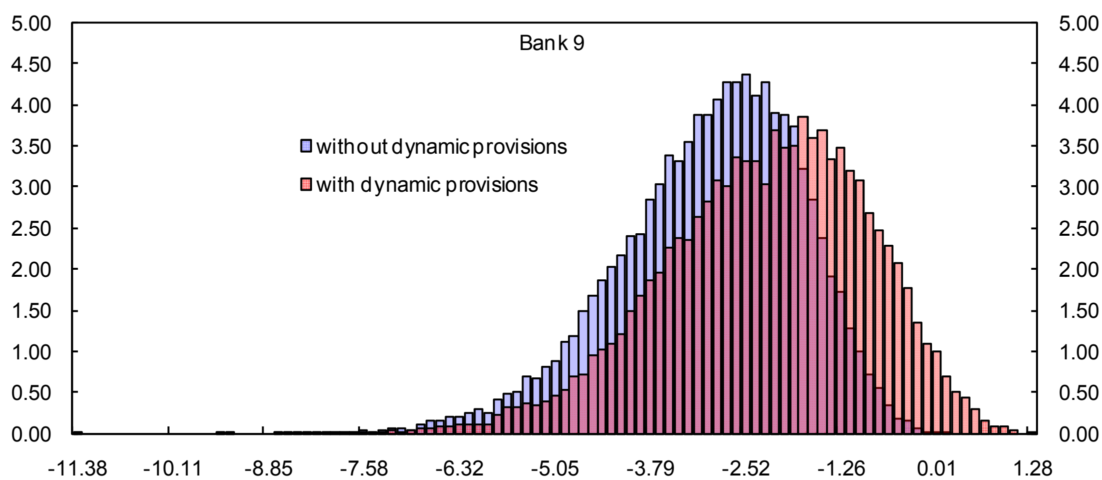


Source: SBIF and staff calculations.
1/ Horizontal axis: provisions in percent of total loans; vertical axis; probability, in percent.
2/ A negative number indicates that provisions are insufficient to cover loan losses.

Figure 1. (cont.) Minimum Provision Buffer, Probability Distributions 1/2/

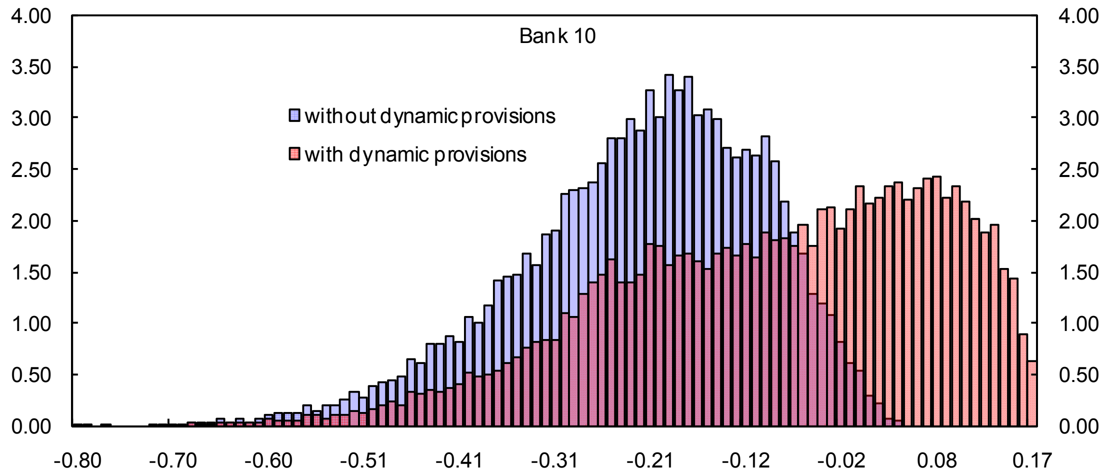


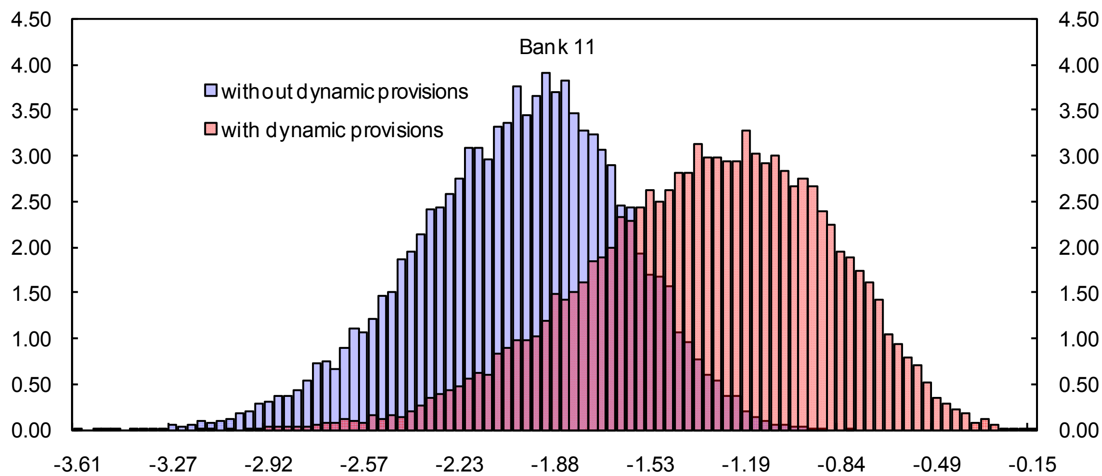


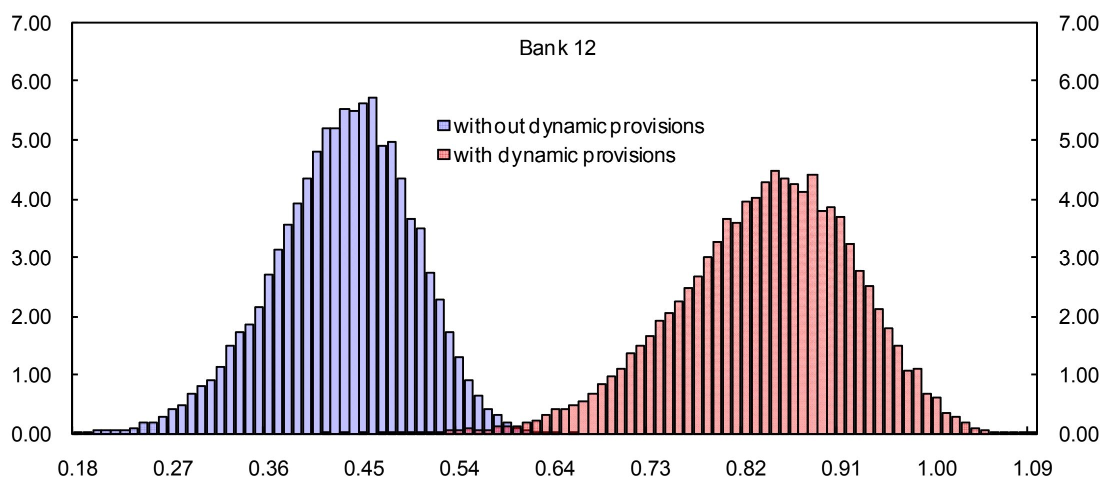


Source: SBIF and staff calculations.
1/ Horizontal axis: provisions in percent of total loans; vertical axis; probability, in percent.
2/ A negative number indicates that provisions are insufficient to cover loan losses.

Figure 1. (cont.) Minimum Provision Buffer, Probability Distributions 1/2/

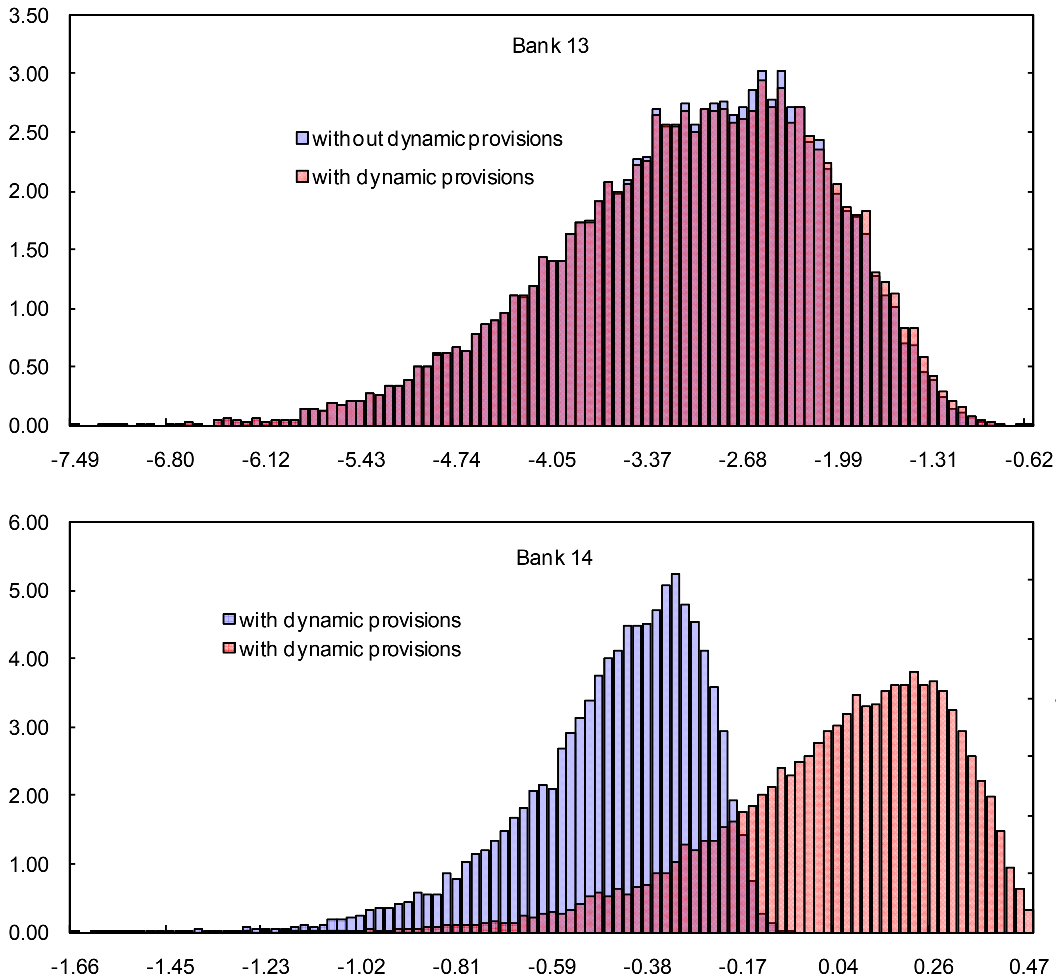






Source: SBIF and staff calculations.
1/ Horizontal axis: provisions in percent of total loans; vertical axis; probability, in percent.
2/ A negative number indicates that provisions are insufficient to cover loan losses.

Figure 1. (cont.) Minimum Provision Buffer, Probability Distributions 1/2/



Source: SBIF and staff calculations.
1/ Horizontal axis: provisions in percent of total loans; vertical axis; probability, in percent.
2/ A negative number indicates that provisions are insufficient to cover loan losses.

18. **Dynamic provisions do not make a substantial difference in the case of Bank 13**. This is likely owing to the fact that losses are extremely large relative to the initial stock of total provisions. Nevertheless, this particular case shows that calibration based in historical data, i.e.the 1.5 percent initial provision stock, could be misleading when loan losses exhibit fat-tail behavior.

19. **The descriptive statistics of the minimum provision buffer distributions also illustrate how dynamic provisions could contribute to enhance bank solvency**. (Table 2). For almost every bank, the mean and median of buffers in regime with dynamic provisions are higher than in a regime without them. The kurtosis in the dynamic provisions regime tends to be higher but since the mean is also higher, the left-tail minimum buffers are smaller.

Table 2. Minimum Provision Buffers, Descriptive Statistics

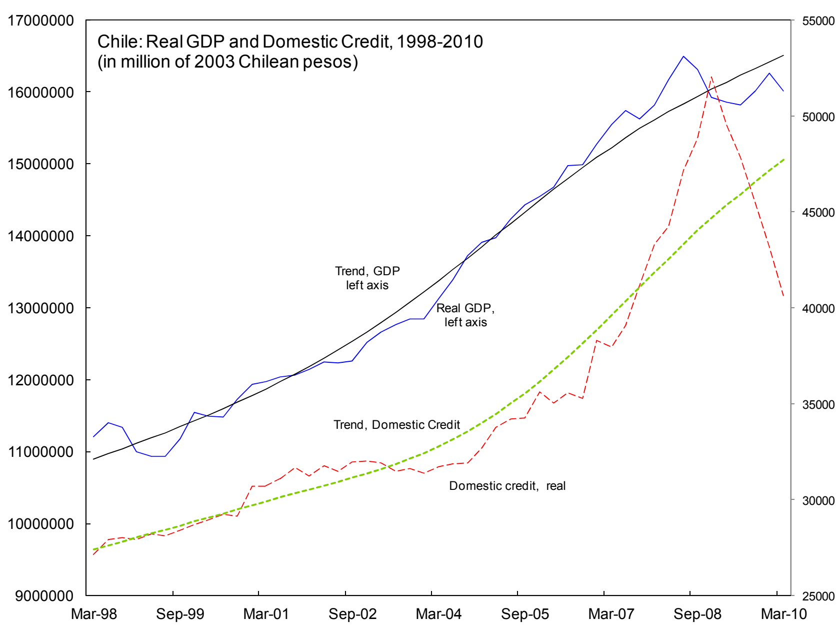
Bank	Without dynamic provisions						With dynamic provisions					
	Mean	Median	Standard deviation	Skewness	Kurtosis	VaR 95	Mean	Median	Standard deviation	Skewness	Kurtosis	VaR 95
1	-0.21	-0.21	0.06	-0.37	3.40	-0.33	0.12	0.13	0.07	-0.35	3.06	0.00
2	-0.36	-0.32	0.19	-0.94	3.83	-0.72	0.39	0.44	0.29	-1.06	4.26	-0.18
3	0.48	0.48	0.06	-0.29	3.06	0.38	0.98	0.99	0.06	-0.31	3.09	0.88
4	-0.32	-0.31	0.11	-0.77	3.67	-0.53	0.35	0.38	0.21	-0.72	3.15	-0.05
5	-0.18	-0.15	0.21	-0.61	2.90	-0.55	0.23	0.29	0.20	-1.31	4.67	-0.17
6	0.01	0.05	0.19	-0.75	2.97	-0.36	0.56	0.59	0.17	-0.95	3.87	0.23
7	-1.00	-0.87	0.71	-0.73	3.18	-2.34	-0.54	-0.46	0.53	-0.86	3.73	-1.54
8	-1.18	-1.16	0.25	-0.42	3.08	-1.62	-0.63	-0.61	0.39	-0.39	2.82	-1.32
9	-3.00	-2.86	1.22	-0.63	3.56	-5.20	-2.26	-2.14	1.37	-0.51	3.36	-4.66
10	-0.22	-0.21	0.12	-0.62	3.26	-0.45	-0.09	-0.07	0.17	-0.56	2.72	-0.39
11	-2.01	-1.99	0.38	-0.35	3.03	-2.68	-1.33	-1.30	0.44	-0.40	2.96	-2.11
12	0.43	0.44	0.07	-0.35	3.08	0.32	0.84	0.84	0.08	-0.43	3.20	0.69
13	-3.07	-2.96	0.96	-0.57	3.14	-4.83	-3.05	-2.95	0.98	-0.55	3.09	-4.83
14	-0.46	-0.42	0.20	-1.11	4.65	-0.85	0.04	0.09	0.26	-0.96	3.99	-0.46

Source: SBIF and staff calculations.

E. Do Provisions Help Reduce Procyclicality? Provisions and the Credit Cycle in Chile

20. **Chile likely experienced a credit bubble – credit growing well above trend – in 2007–08, prior to the global financial crisis**. From early 1998 until mid-2007, domestic credit grew roughly in line with real GDP at an average annual pace of 3½ percent (Figure 2).

Figure 2. Chile: Real GDP and Domestic Credit, 1998-2010



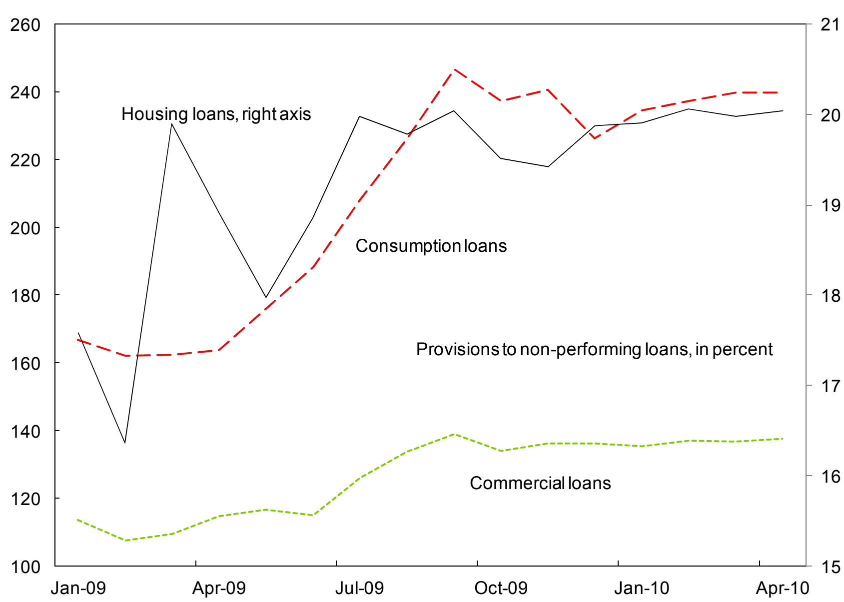
Source: Haver Analytics and author's calculations.

21. **From 2007Q3 to 2008Q3, however, domestic credit accelerated rapidly, growing by 14½ percent on an annual basis**. In contrast, real GDP grew only by 5½ percent during the same period. The rapid credit expansion was partly responsible for an overheating of the

economy and high inflation, the later compounded by external price shocks. After peaking in December 2008, real credit dropped abruptly below trend as the economy slowed down due to the global financial crisis.

22. **Notwithstanding the rapid credit expansion, the ratio of non-performing loans only increased slightly despite the severity of the financial crisis in 2008–09 and the earthquake in 2010**. Banks, nevertheless, started to increase their provisions in the second half of 2009, especially for consumption loans. The short-lived nature of the impact of the earthquake on the ongoing economic recovery may explain why provisions did not increase in March-April 2010 (Figure 3). In addition, a simple trend decomposition based on the use of a Hodrick-Prescott filter indicates that real credit cycle is highly correlated with real GDP cycle. These two variables also appear to lead the provision cycle, implying that provisions lag rather than lead the credit cycle

Figure 3. Provisions to Non-Performing Loans

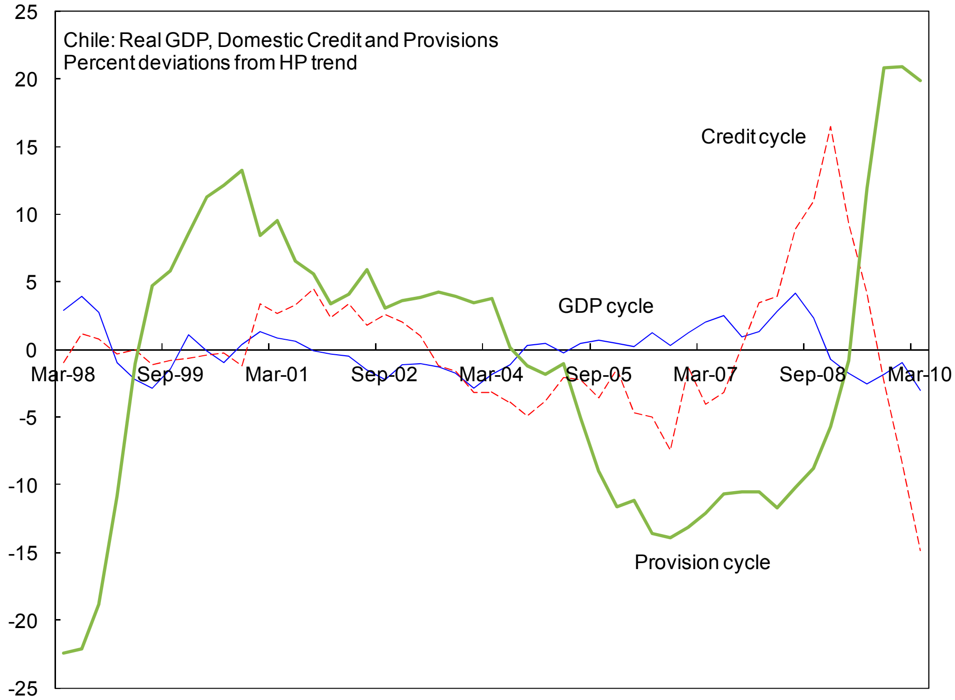


Source: SBIF and author's calculations.

23. **A more rigurous analysis using an vector error correction model (VECM) reinforces the results of the simple filter analysis (Table 1)**. The VECM analysis was performed using quarterly data on real GDP, domestic credit, and provisions for the period March 1998 – June 2010. In the long run, real GDP exhibits contemporaneous positive correlation with real credit and negative correlation with provisions. In the short-run, however, changes in provisions have a negligible role for explaining real GDP and credit growth. In contrast, provisions are mainly driven by past credit growth. Since provisions do not appear to drive the credit cycle, smoothing them by imposing dynamic provisions may not have a major impact on procyclicality. This conclusion appears supported by the failure of dynamic provisions to reduce procyclicality in the few countries that have implemented

them. Spain experienced rapid credit growth and a housing price bubble since provisions play only a marginal impact on credit growth (Wood, 2009, and Fernandez de Lis and García-Herrero, 2010).

Figure 4. Chile: Real GDP, Domestic Credit and Provisions, Percent Deviations from HP trend



Source: SBIF and author’s calculations.

Table 3. Vector Error Correction Model for Real GDP, Real Credit Growth, and Provisions

Cointegrating equation				
Real GDP, 1 lag		1	n.a.	
Real credit, 1 lag		-0.646499	[-30.2600]	
Provisions, 1 lag		0.18645	[10.4800]	
Constant		-9.803183	n.a.	
Error correction equations		Real GDP	Real Credit	Provisions
Cointegrating equation		0.430*	0.902*	-0.999*
		[3.247]	[2.708]	[-3.478]
First Difference				
Log of real GDP,	lag1	-0.442	-0.784	0.778
		[-1.749]	[-1.234]	[1.421]
	lag 2	-0.898*	0.141	0.742
		[-4.201]	[0.262]	[1.598]
	lag 3	-0.445*	-0.583	0.248
		[-2.373]	[-1.236]	[0.609]
	lag 4	-0.556*	-0.161	0.437
		[-2.805]	[-0.322]	[1.017]
Log of real credit,	lag1	0.250*	0.563*	-0.484*
		[2.773]	[2.484]	[-2.476]
	lag 2	0.29388*	0.834054*	-0.349
		[3.034]	[3.424]	[-1.663]
	lag 3	0.083	0.554*	-0.017
		[0.868]	[2.292]	[-0.083]
	lag 4	0.069	0.431	-0.005
		[0.805]	[1.996]	[-0.027]
Log of provisions,	lag1	-0.025	0.059	0.201
		[-0.366]	[0.350]	[1.370]
	lag 2	-0.006	0.069	0.026
		[-0.082]	[0.386]	[0.169]
	lag 3	-0.009	0.106	-0.047
		[-0.129]	[0.609]	[-0.312]
	lag 4	0.022	0.049	0.154
		[0.329]	[0.295]	[1.081]
Constant		0.020	-0.009	-0.010
		[4.887]	[-0.865]	[-1.111]
R-squared		0.502	0.555	0.823
Adj. R-squared		0.287	0.362	0.746
F-statistic		2.330	2.877	10.699
Log likelihood		149.604	109.025	115.537
Akaike AIC		-6.164	-4.319	-4.615
Schwarz SC		-5.596	-3.752	-4.048

* indicates coefficient is statistically significant at the 5 percent confidence level.
Source: Central Bank of Chile and staff calculations.

F. Conclusions

24. **At the policy level, the case for regulatory dynamic provisions have been advanced on the grounds that they help reducing the risk of bank insolvency and dampening credit procyclicality**. In the case of the Chile the data appears to partly validate these claims.

25. **A simulation analysis suggests that under the Spanish dynamic provisions rule provision buffers against losses would be higher compared to those accumulated under current practices**. The analysis also suggests that calibration based on historical data may not be adequate to deal with the presence of fat-tails in realized loan losses. Implementing dynamic provisions, therefore, requires a careful calibration of the regulatory model and stress testing loan-loss internal models.[4]

26. **Dynamic provision rules appear not to dampen procyclicality in Chile**. Results from a VECM analysis indicate that the credit cycle does not respond to the level of or changes in aggregate provisions. In light of this result, it may be worth exploring other measures to address procyclicality. Two examples of these measures include countercyclical capital requirements, as proposed by the Basel Committee on Banking Supervision (2010a and b), or the countercyclical provision rule introduced in Peru in 2008. The Basel countercyclical capital requirements suggest that the build up and release of additional capital buffers should be conditioned on deviations of credit to GDP ratio from its long-run trend. The Peruvian rule, contrary to standard dynamic provision rules, requires banks to accumulate countercyclical provisions when GDP growth exceeds potential. Both measures, by tying up capital or provision accumulations to cyclical indicators, could be more effective for reducing procyclicality.[5]

[4] Besides parameter calibration, the successful implementation of a dynamic provisions scheme requires addressing several issues like the estimation of long-run expected losses and the tax and accounting treatment of reserves (Mann and Michael, 2000).

[5] See Chan-Lau, (2011) for a discussion of how different tools can reduce procyclicality in Latin America.

References

Basel Committee on Banking Supervision, 2010a, *Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems* (Basel: BIS).

_____, 2010b, *Guidance for National Authorities Operating the Countercyclical Capital Buffer* (Basel: BIS).

Bikker, J.A., and P.A.J. Metzemakers, 2005, "Bank Provisioning Behaviour and Procyclicality," *Journal of International Financial Markets, Institutions and Money*, Vol. 15, No. 2, pp. 141–157.

Balla, E., and A. McKenna, 2009, "Dynamic Provisioning: A Countercyclical Tool for Loan Loss Reserves," *Economic Quarterly*, Vol. 95, No. 4, pp. 383–418.

Burroni, M., M. Quagliariello, E. Sabatini, and V. Tola, 2009, "Dynamic Provisioning: Rationale, Functioning, and Prudential Treatment," Occasional Paper No. 57, Banca D'Italia (Rome).

Brunnermeier, M., A. Crockett,C. Goodhart, A. Persaud, and H.-S. Shin, 2009, *The Fundamental Principles of Financial Regulation*, Geneva Report on the World Economy, Vol. 11.

Borio, C., C. Furfine, and P. Lowe, 2001, "Procyclicality of the Financial System and Financial Stability: Issues and Policy Options," in *Marrying the Macro- and Micro-Prudential Dimensions of Financial Stability*, BIS Papers No.1, pp. 1–57. (Basel).

Chan-Lau, J.A., 2008, "The Globalization of Finance and its Implications for Financial Stability: An Overview of the Issues," *International Journal of Banking, Accounting, and Finance*, Vol. 1, No. 1, pp. 3–29.

Chan-Lau, J.A., 2011, "Leaning against the Wind in Latin America: Capital Requirements, Leverage Ratios, Countercyclical Capital Buffers and Dynamic Provisions," mimeo, Washington, DC.

FASB and IASB, 2009, "Spanish Provisions Under IFRS," Information for Observers, IASB/FASB Meeting, March (London).

Fernández de Lis, S., J. Martínez Pagés, and J. Saurina, 2000, "Credit Growth, Problem Loans and Credit Risk Provisioning in Spain," Banco de España, Documento de Trabajo No. 0018 (Madrid).

Fernandez de Lis, S. and A. Garcia-Herrero, 2010, "Dynamic Provisioning: Some Lessons from Existing Experiences," Working Paper No. 218, Asian Development Bank Institute (Manila).

Fillat, J.L., and J. Montoriol-Garriga, 2010, "Addressing the Pro-Cyclicality of Capital Requirements with a Dynamic Loan Loss Provision System," Working Paper No. QAU10-4, Federal Reserve Bank of Boston.

Gordy, M., and B. Howells, 2006, "Procyclicality in Basel II: Can We Treat the Disease Without Killing the Patient?" *Journal of Financial Intermediation*, vol. 15, No. 2, pp. 397– 417.

Mann, F., and I. Michael, 2002, "Dynamic Provisioning: Issues and Application," *Financial Stability Review*, pp. 128–136, December (London: Bank of England).

Plantin, G., H. Sapra, and H. Shin, 2008, "Marking to market: Panacea or Pandora's Box?" *Journal of Accounting Research*, Vol. 46, No. 2, pp. 435–60.

Poveda, R., 2000, "La Reforma del Sistema de Provisiones de Insolvencia," *Boletín Económico*, pp. 73–91, Banco de España, Enero (Madrid).

Ryan, S. G., 2007, *Financial Instruments and Institutions. Accounting and Disclosure Rules*, 2nd edition (New York: John Wiley).

Saurina, J., 2009, "Loan Loss Provisions in Spain. A Working MacroPrudential Tool," *Revista de Estabilidad Financiera*, No. 17, pp. 9– 26 (Madrid: Bank of Spain).

Sunley, E., 2003, "Corporate Income Tax Treatment of Loan-Loss Reserves, " chapter 9 in P. Honohan, editor, *Taxation of Financial Intermediation: Theory and Practice for Emerging Economies* (Washington, D.C.: International Bank for Reconstruction and Development and Oxford University Press).

Wezel, T., 2010, "Dynamic Loan Loss Provisions in Uruguay: Properties, Shock Absorption Capacity and Simulations Using Alternative Formulas," IMF Working Paper No. 10/125 (Washington, DC).

Wood, D., 2009, "Critics Attack Dynamic Provisioning Following Spanish Bank Results," *Risk*, October.