Coping with Chile's External Vulnerability:

A Financial Problem

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Abstract

With traditional domestic imbalances long under control, the Chilean business cycle is driven by external shocks. Most importantly, Chile's external vulnerability is primarily a financial problem. A decline in the Chilean terms-of-trade, for example, is associated to a decline in real GDP that is many times larger than one would predict in the presence of perfect financial markets. The financial nature of this excess-sensitivity has two central dimensions: a sharp contraction in Chile's access to international financial markets when it needs it the most; and an inefficient reallocation of this scarce access across domestic borrowers during external crises. In this paper I characterize this financial mechanism and argue that Chile's aggregate volatility can be reduced significantly by fostering the private sector's development of financial instruments that are contingent on Chile's main external shocks. As a first step, the Central Bank or IFIs could issue a benchmark instrument contingent on these shocks. I also advocate a countercyclical monetary policy but mainly for incentive ---that is, as a substitute for taxes on capital inflows and equivalent measures--- rather than for ex-post liquidity purposes.

I.   Introduction and Overview

With traditional domestic imbalances long under control, the Chilean business cycle is driven by external shocks. Most importantly, Chile's external vulnerability is primarily a financial problem. A decline in the Chilean terms-of-trade, for example, is associated to a decline in real GDP that is many times larger than one would predict in the presence of perfect financial markets. The financial nature of this excess-sensitivity has two central dimensions: a sharp contraction in Chile's access to international financial markets when it needs it the most; and an inefficient reallocation of this scarce access across borrowers during external crises. I argue that Chile's aggregate volatility can be reduced significantly by fostering the private sector's development of financial instruments that are contingent on the main external shocks faced by Chile. As a first step, the Central Bank or IFIs could issue a benchmark instrument contingent on these shocks. I also advocate a countercyclical monetary policy (also contingent on these shocks) but mainly for incentive ---that is, as a substitute for taxes on capital inflows and equivalent--- rather than for ex-post liquidity purposes.

The essence of the mechanism through which external shocks affect the Chilean economy can be characterized as follows: First, there is a deterioration of terms-of-trade that raises the need for external resources if the real economy is to continue unaffected, but this triggers exactly the opposite reaction from international financiers, who pull back capital inflows. Occasionally, the latter occurs directly as part of "contagion" effects. Second, once external financial markets fail to accommodate the needs of domestic firms and households, these agents turn to domestic financial markets, and to commercial banks in particular. Again, this increase in demand is not matched by an increase in supply as banks -- particularly resident foreign institutions – tighten domestic credit, opting instead to increase their net foreign asset positions. Third, there is significant "flight-to-quality" within the domestic financial system, which reinforces the above effects as large firms find it more attractive to seek financing in domestic markets, in circumstances that the displaced small and medium size firms cannot access international financial markets at any price.

The costs of this mechanism are high. Widespread financial constraints are binding during the crisis, when major forced adjustments are needed. The sharp decline in domestic asset prices, and corresponding rise in expected returns, is driven by the extreme scarcity in financial resources and their high opportunity cost.   Even the praised rise in FDI that occurred during the most recent crisis is a symptom of these fire sales. The fact that this investment takes the form of control-purchases rather than portfolio or credit flows simply reflects some of the underlying problems that limit Chile's integration to international financial markets: weak corporate governance and other "transparency" standards. Finally, the costs do not end with the crisis, as financially distressed firms are ill equipped to mount a speedy recovery. The latter often comes not only with the costs of a slow recovery in employment and activity, but also with a slowdown in the process of creative destruction and productivity growth. In the U.S., the latter may account for about 30% of the costs of an average recession (see Caballero and Hammour, 1998), which is

probably a very optimistic lower bound for the Chilean economy.

The distributional impact of this type of crisis is significant as well. On one end, large firms are directly affected by external shocks but can substitute most of their financial needs domestically. They are affected primarily by demand factors. On the other, small and medium sized firms (henceforth, PYMES) are crowded out and are severely constrained on the financial side. They are the residual claimants of the financial crunch.

This diagnosis points in the direction of a structural solution based on two building blocks. The first one deals with the institutions required to foster Chile's integration to international financial markets and the development of domestic financial markets. Chile is making significant progress along this margin through its capital markets reform program. The second one, necessary during the unavoidable slow nature of the above process, is to design an appropriate international liquidity management strategy. The latter must be understood in terms broader than just the management of international reserves by the central bank, and include the development of financial instruments that facilitate the delegation of this task to the private sector.

I focus on the latter type of solutions in this paper.[2] I view the policy problem as one of remedying a chronic private sector underinsurance with respect to external crises.[3] After outlining the main sources of such problem and the corresponding solutions, I focus on two of them. The first one, which I develop in greater detail, seeks to develop a key missing market. I propose the creation of a benchmark "bond" that is made contingent on the main external shocks faced by Chile. This instrument should facilitate the private sector's pricing and creation of similar and derivative contingent financial instruments.

In the second one, I discuss optimal monetary policy and international reserve management from an insurance perspective. Provided that the Central Bank of Chile has achieved a high degree of inflation-target credibility, the optimal response to an external shock is with a moderate injection of reserves and an expansionary monetary policy. The latter, however, is unlikely to have a large real impact and indeed will imply a sharp short-lived exchange rate depreciation. The main benefit of such policy is in the incentives it provides. Its main problem is that it is time-inconsistent.

Section II describes the essence of the external shocks and the financial mechanism at work. Section III follows with a discussion of the impact of this mechanism on the real side of the economy and the different economic agents. Section IV discusses policy options and Section V concludes.

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[2] See Caballero (1999, 2001) for a discussion of the structural reforms aimed at improving integration and the development of financial markets. More importantly, Chile is in the process of enacting a major capital markets reform.

[3] See Caballero and Krishnamurthy (2001a) for a formal discussion of this perspective.

II.   The Shock and the Financial System

In this section I illustrate the mechanism though which external shocks affect the Chilean economy. I organize the discussion of the role played by these shocks and their amplification mechanisms around demand and supply factors affecting the domestic banking system – the backbone of the Chilean financial system. An overview of the Chilean financial institutions is presented in Box 1.

I focus on the most recent cyclical episode, as the changing nature of the Chilean financial system makes older data less relevant.

II.1 The External Shock and its Impact on Domestic Financial Needs

The trigger of the mechanism is illustrated in Figure 1. Panel (a) shows the path of Chile's terms-of-trade and the spread paid by prime Chilean instruments over the equivalent U.S. Treasury instrument. It is apparent that Chile was severely affected by both at the end of the 1990s. Panel (b) offers a better metric to gauge the magnitude of these shocks. Taking the quantities from the 1996 current account as representative of those that would have occurred in the economy absent any real adjustment, it translates them into the dollar losses associated to the deterioration in terms-of-trade and interest rates. In 1998, these losses amounted to about 2% of GDP, with similar magnitudes for 1999 and 2000.

Box 1: The Chilean Banking Sector

Banks are an important source of financing for Chilean firms. The composition of financing (table A.1) is similar to that of advanced European economies. Unlike the latter, and much like the US, the maturity structure of Chilean bank loans is more concentrated on the short end: 57% of total loans, and 60% of commercial loans, have a maturity of less than 1 year.[4] In summary, Chilean banks look like European banks in terms of their relative importance but like US banks in terms of their focus on short maturities.[5]

Relative importance: Loans versus other instruments.

Table A.1: The relative importance of bank loans.

Source of financing	Stock	Flows
Loans	43%	51%
Equity	54%	33%
Bonds	3%	16%

Note: Participations built using the stocks at December 2000. Flows were computed as the difference in stocks between December 1999 and December 2000 except for the flow of new equity, which was built using information on equity placement during the period.

Composition of Loans.

Chilean banks concentrate most of their activity on firms. Commercial loans represent around 60% of total bank loans (see Table A.2). Adding trade loans, about 70% of total bank credit supply is directed to firms.

Table A.2: Composition of loans by use.

Type of loan	Fraction of total loans
Commercial	60%
Residential	15%
Consumption	10%
Trade	10%
Other	5%

Source: Superintendencia de Bancos e Instituciones Financieras.

Composition of commercial loans by firm size.

Chilean banks concentrate their lending activity on large firms, at least when firm size is approximated by loan size. Around 65% of the volume of commercial loans is allocated to loans above US$ 1. The relative importance of different loan sizes is summarized in Table A.3.

Table A.3: The relative importance of different loan sizes.

Loan size	Fraction of the volume of commercial loans
Large	64%
Medium	14%
Micro	22%

Note: Large: all loans above 50,000 UF (around US$ 1.4 millions (end of 1999 dollars)); Medium: loans between 10,000 and 50,000 UF (US$ 280,000 and US$ 1,400,000); Micro: loans below 10,000 UF (US$ 280,000).
Source: Superintendencia de Bancos e Instituciones Financieras.

Banks versus other financial institutions.

Banks in Chile are important when compared with other financial institutions as well. Table A.4 compares the total assets of banks, pension funds, and insurance companies.[6] Banks' assets represent 60% of total assets.

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[4] Computed using the stock of loans in December 1999. Source *Superintendencia de Bancos e Instituciones Financieras.*
[5] In Germany, for example, more that 70% of the commercial loans are long term. In contrast, in the US short term loans account for about 60% of non-residential loans.

[6] Total assets is the sum of financial and fixed assets. Fixed assets are not included for insurance companies. Nevertheless, fixed assets represent a very small fraction of financial institutions' assets.

Table A.4: Banks and other financial institutions.

	Banks	Pension Funds	Insurance companies
Relative asset level	60%	30%	10%

Note: Ratios based on the stock of assets at December 2000.
Sources: Superintendencia de Bancos e Instituciones Financieras, Superintendencia de Valores y Seguros.

Domestic and Foreign banks.

Foreign banks presence is very significant. Table A.5 shows that loans by foreign banks represented around 40% of total loans in 1999. It is important to note that Chilean Banking Law does not recognize subsidiaries of foreign banks as part of their main headquarters.
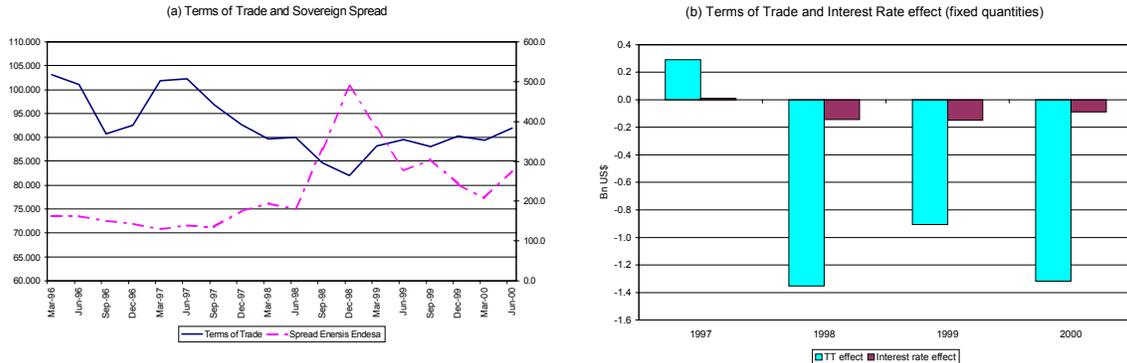
Table A.5: Domestic and Foreign Banks

	Domestic	Foreign
Relative importance (% total loans)	58%	42%
Portfolio composition		
Loans	80%	67%
Securities	11%	14%
Foreign assets	6%	15%
Reserves	3%	4%

Note: Ratios based on December 1999 values.
Source: Superintendencia de Bancos e Instituciones Financieras.

Figure 1: External Shocks

How should Chile have reacted to this sharp decline in national income, absent any significant financial friction (aside from the temporary increase in the spread)? Figure 2 hints the answer. The thin line depicts the path of actual consumption growth, while the thick line illustrates the hypothetical path of Chile's consumption growth if it were perfectly integrated to international financial markets and terms-of-trade the only source of shocks.[7] There are two interesting features in the figure. First, there is a very high correlation between Chile's business cycle and shocks to its terms-of-trade. Second, and more importantly for the argument in this paper, the actual response of the economy is being measured on the left axis while that of the hypothetical is being measured on the right axis. Since the scale in the former is *ten* times larger than that of the latter, it is apparent that the economy over-reacts to these shocks by a significant margin. In practice shocks to the terms-of-trade are simply too transitory, especially when they are driven by demand as in the recent crisis, to justify a large response of the real side of the economy.[8]

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[7] Consumption growth is very similar to GDP growth for this comparison. Adding the income effect of interest rate shocks would not change things too much as these were very short-lived. I neglect the presence of substitution effects because there is no evidence of a consumption overshooting once international spreads come down.

[8] The price of copper has trends and cycles at different frequencies, some of which are persistent (see Marshall and Silva, 1998). But there seems to be no doubt that the sharp decline in the price of copper during the late 1990s crisis was mostly the result of a transitory demand shock brought about by the Asian and Russian crises. I would argue that conditional on the information that the current shock was a transitory demand shock, the univariate process used to estimate the present value impact of the decline in the price of copper in Figure 2, overestimates the extent of this decline. The lower decline in future prices is consistent with this view. The variance of the spot price is 6 times the variance of 15-months-ahead future prices. Moreover, the expectations computed from the AR process track reasonably well the expectations implicit in future markets but for the very end of the sample, when liquidity premia considerations may have come into play.

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The income effect that is measured in panel (b) of Figure 1 should in principle, but it does not in practice, translate almost entirely in increased borrowing from abroad.

**Figure 2: Excess Sensitivity of Real Consumption
Growth to Terms-of-Trade Shocks**
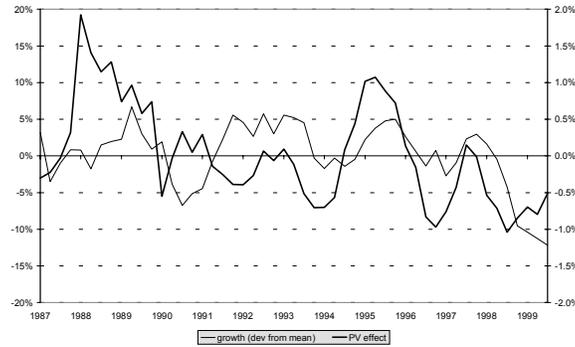
Notes: consumption growth from IFS, copper prices (London Metal Exchange) from Datastream, copper exports from Min. de Hacienda.

Returning to the late 1990s crisis, panel (a) of Figure 3 illustrates that international financial markets not only did not accommodate the (potential) increase in demand for foreign resources but actually capital inflows declined rapidly over the period. Panel (b) documents that while the central bank offset part of this decline by injecting back some of its international reserves, it clearly was not nearly enough to offset both the decline in capital inflows and the rise in external needs. For example, the figure shows that in 1998, the injection of reserves amounted to approximately US$2 billion dollars. This is comparable to the direct income effect of the decline in terms of trades and rise in interest rates, but it does not compensate for the decline in capital inflows that came with these shocks.

**Figure 3: Capital Flows and Reserves**
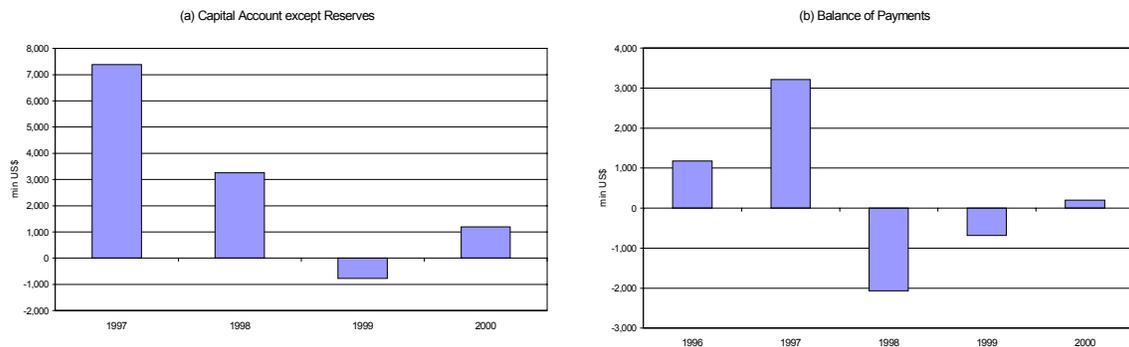
Source: Banco Central de Chile

How severe was the mismatch between the increase in needs and the availability of external financial resources? Figure 4a has a back-of-the-envelope answer. It graphs the

actual current account (light bars) and the current account with quantities fixed at 1996 levels (dark bars). At the trough, in 1999, the actual current account deficit was around US$4 billion smaller than what one would have predicted using only the actual change in terms-of-trade. Moreover, this dollar adjustment underestimates the quantity adjustment behind it, as the deterioration of terms-of-trade typically worsens the current account deficit for any path of quantities. The importance of this price-correction can be seen in panel (b), which graphs the actual current account (light bars), and the current account at 1996 prices (dark bars). Clearly, the latter shows a significantly larger adjustment than the former.

Figure 4: The Current Account
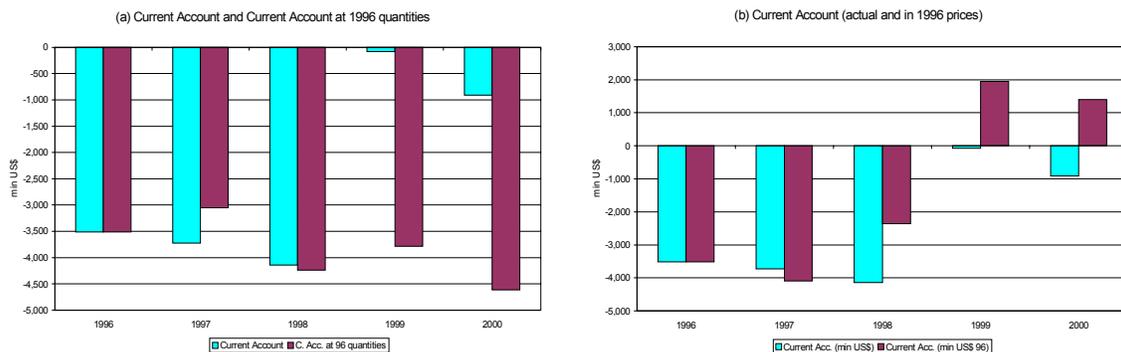
Notes: (a) The current account at 1996 quantities was computed by multiplying the 1996 quantities by each year's price indices for exports, imports and interest payments . The other components of the current account were kept at current values. (b) The current account in 1996 prices was computed by multiplying the 1996 prices by each year's quantities. Source: Banco Central de Chile

Figure 5 reinforces the mismatch conclusion by reporting increasingly conservative estimates of the shortage of external financial resources by the non-banking sector. Panel (a) describes the path of the change in potential financial needs stemming from the decline in terms-of-trade and capital inflows, and the increase in spreads. Panel (b) subtracts from (a) the injection of reserves by the central bank, while panel (c) subtracts from (b) the decline in capital inflows to the banking sector. We can see from this figure that the increase in financial needs for 1999 ranges from about $2 billions to just above $7 billions. Regardless of the concept used, the mismatch is large, creating a potentially large surge in the demand for resources from the domestic financial system. The difference between panel (b) and (c), as well as the next section more extensively, show that the latter sector not only did not accommodate this increase in demand, but also exacerbated the financial crunch.

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Figure 5: The Increase in Potential Financial Needs

(a) Comprehensive

(b) (a) minus reserves accumulation
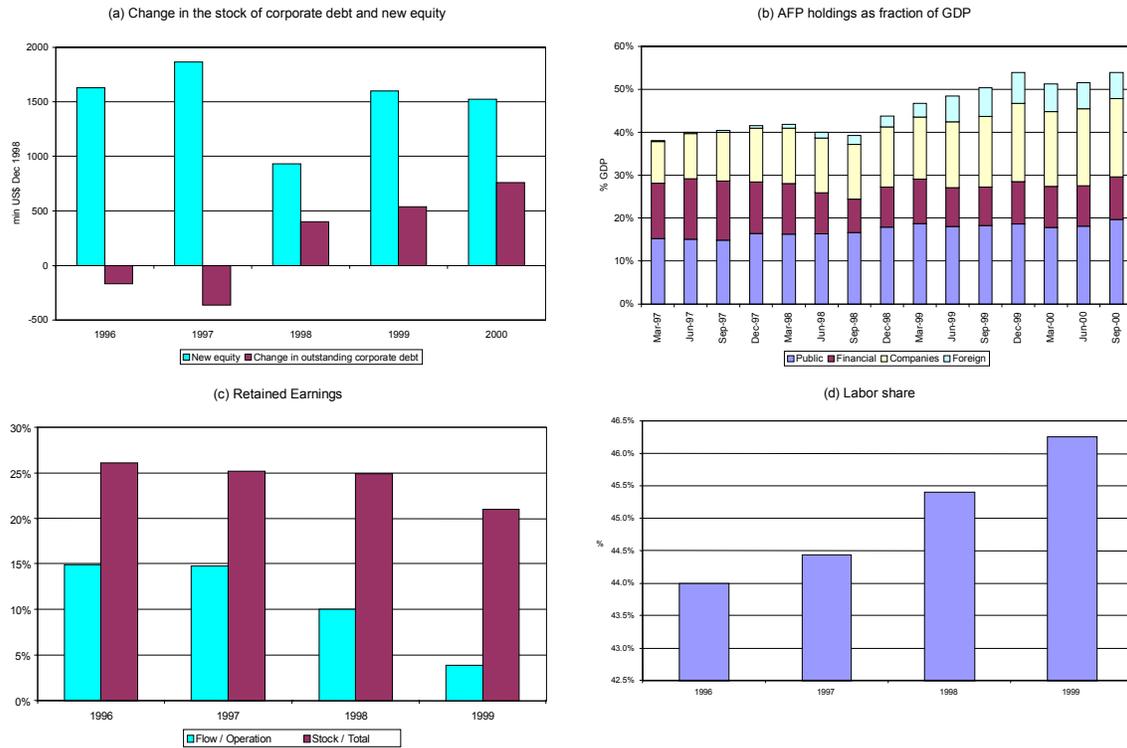
(c) (b) minus flows to banking sector
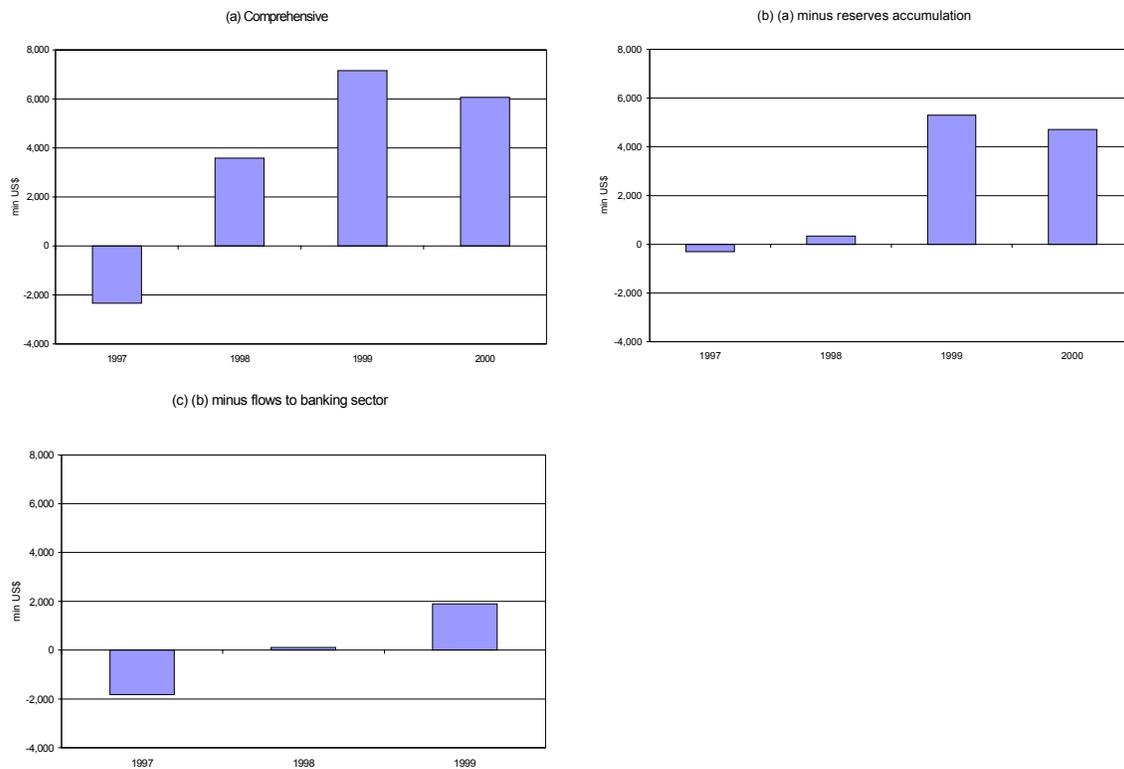
Notes: Panel (a) corresponds to the sum of the terms-of-trade effect, the interest rate effect, and the decline in capital inflows. Both the terms-of-trade and the interest rate effects are measured at 1996 quantities. The decline in capital flows corresponds to the difference of the capital account except reserves with respect to its 1996 value. Panel (b) subtracts from (a) the net change in Central Bank reserves. Panel (c) subtracts from panel (b) the net increase in flows to the banking sector. Source: Banco Central de Chile

To conclude this section, Figure 6 illustrates other dimensions that could have, but did not, smooth the demand for resources from resident banks. Panel (a) and (b) carry the relatively "good" news. The former panel shows that issues of new equity and corporate bonds did not decline very sharply, although they hide the fact that the required return on these instruments rose significantly. The latter panel illustrates that while the AFPs increased their allocation of funds to foreign assets during the period, this portfolio shift occurred mostly against public instruments. However, this decline probably translated into a large placement of public bonds on some other market or institution that competes with the private sector, like banks (see the discussion below). Panel (c), on the other hand, indicates that retained earnings, a significant source of investment financing to Chilean firms, declined significantly over the period.[9] Finally, panel (d) illustrates that

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[9] Before the crises, in 1996, the stock of retained earnings represented 20% of total assets for the median firm. The difference between profits and dividend payments, a measure of the flow of retained earnings, represented around a 50% of total capital expenditures for the median firm in 1996.

workers did not help accommodating the financial bottleneck either, as the labor share rose steadily throughout the period.

Figure 6: Other Factors

(a) Change in the stock of corporate debt and new equity

(b) AFP holdings as fraction of GDP

(c) Retained Earnings

(d) Labor share

Notes: (a) Source: Bolsa de Comercio de Santiago and Superintendencia de Valores y Seguros. New equity valued at issuance price, and deflated using CPI. The stock of corporate debt outstanding was also deflated by CPI. The December 1998 exchange rate was 432 pesos per dollar. (b) Source: Superintendencia de AFP. The values are expressed as a fraction of the year's GDP. (c) The data on retained earnings are from Bolsa de Comercio de Santiago (Santiago Stock Exchange) and correspond to the stocks of retained earning reported in the balance sheets of all the societies traded in that exchange. They exclude investment societies, pension funds, and insurance companies. The flow value was computed as the difference in the (deflated) stocks at t and t-1. (d) Source: Banco Central de Chile.

The bottom line of this section is clear: during external crunches, firms need substantial additional financial resources from resident banks.

II.2 The (Supply) Response by Resident Banks

How did resident banks respond to increased demand? The short answer is that they exacerbated rather than smooth the external shock.

Panel (a) in Figure 7 shows that domestic loan growth actually slowed down sharply during the late 90s, even as deposits kept growing. This tightening can also be seen in prices in panel (b), through the sharp rise in the loan-deposit spread during the early phase

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of the recent crisis. While spreads started to fall by 1999, there was a strong substitution toward prime firms that makes it difficult to interpret this decline as a loosening in credit standards (see below).
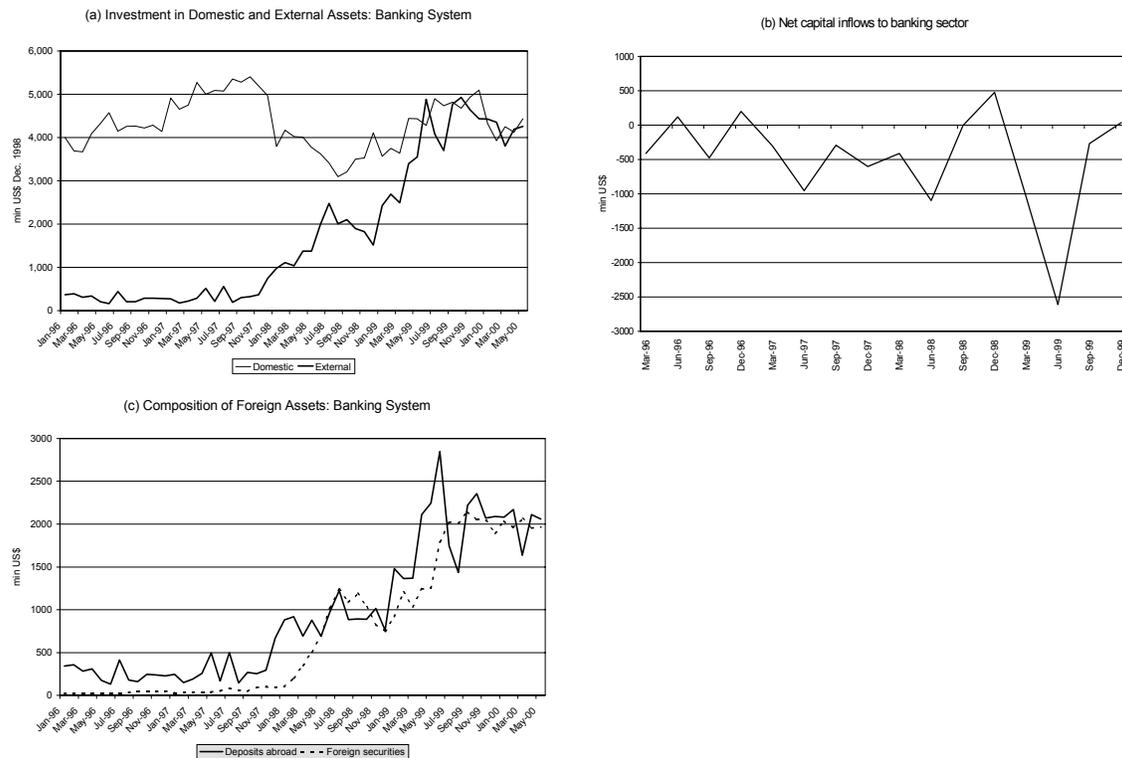
Figure 7: The Credit Crunch
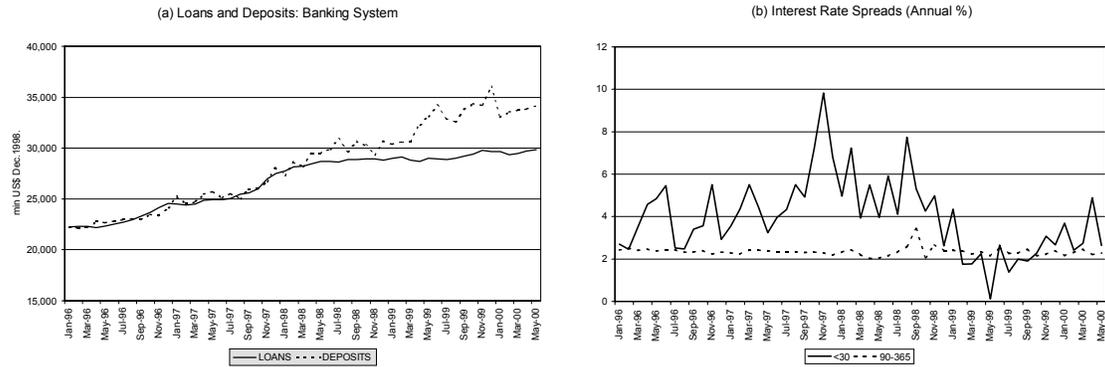
Notes: (a) Loans: commercial, consumption, trade, and mortgages. Deposits: sight deposits and time deposits. The values were expressed in dollars of December 1998 using the average December 1998 exchange rate (472 pesos/dollar). (b) The 30-day interest rates are nominal while the 90-365 are real (to a first order, this distinction should not matter for spreads calculations). Sources: Banco Central, and Superintendencia de Valores y Seguros.

The main substitutes for loans in banks' portfolios are public debt and external assets. These alternatives are shown in Figure 8a, with the clear conclusion that banks moved their assets toward external assets. Interestingly, the central bank policy of fighting capital outflows with high domestic interest rates was only temporarily successful (see the reversal during the last quarter of 1998). Instead, the rise in interest rates during the Russian phase of the crisis seems to have succeeded mostly in slowing down the decline in banks' investment in public instrument, and encouraged substitution away from loans. Banks, rather than smooth the loss of external funding, exacerbated it by becoming part of the capital outflows. In fact, while panel (b) illustrates that the banking sector also experienced a large capital outflow during this episode, panel (c) reveals that much of the net outflow was not due to a decline in their international credit lines or inflows, but rather due to an outflow toward foreign deposits and securities.

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Figure 8: Capital Outflows by the Banking System

(a) Investment in Domestic and External Assets: Banking System

(b) Net capital inflows to banking sector

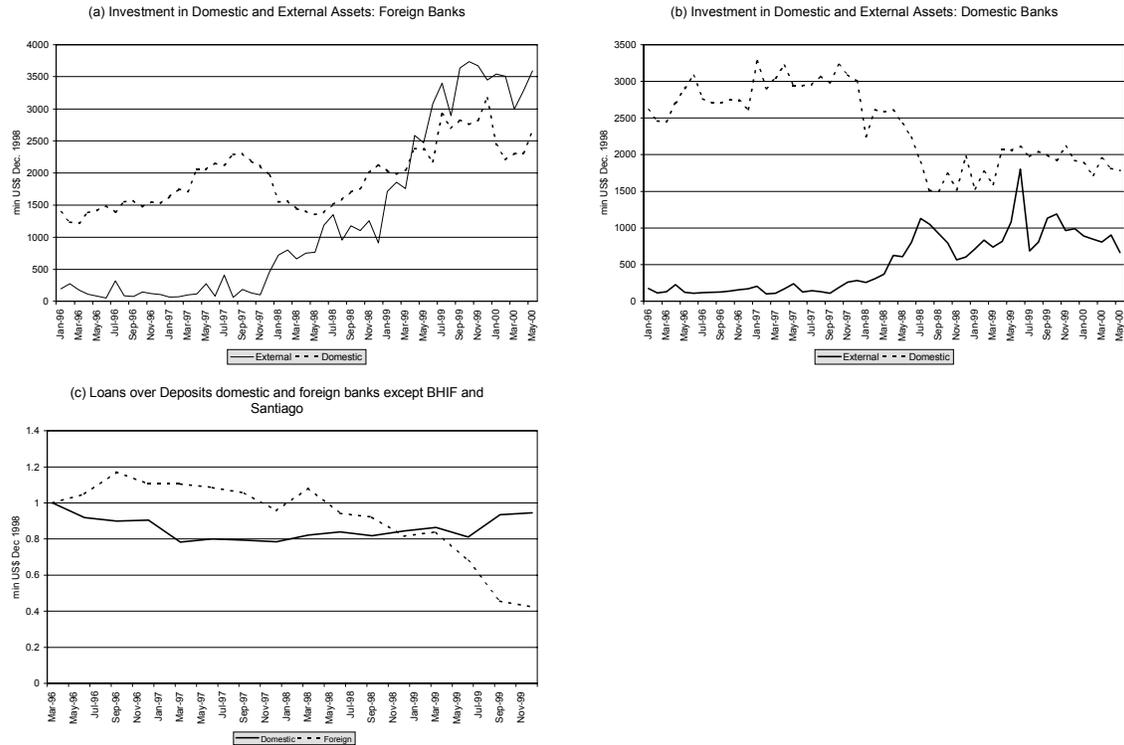(c) Composition of Foreign Assets: Banking System

Notes: (a) Domestic assets include Central Bank securities with secondary market and intermediated securities. External assets are the sum of deposits abroad and foreign securities. Deposits abroad are mostly sight deposits in foreign (non-resident) banks. Foreign securities are mostly foreign bonds.
Sources: Banco Central and Superintendencia de Bancos.

While most resident banks exhibited this pattern to some degree, it is resident foreign banks that had the most pronounced portfolio shift towards foreign assets. This is apparent in panels (a) and (b) in Figure 9, which present the investment in domestic and foreign assets by foreign and domestic (private) banks, respectively. While all banks increased their positions in foreign assets, foreign banks' trend was substantially more pronounced. Moreover, domestic banks "financed" a larger fraction of their portfolio shift by reducing other investments rather than loans. This conclusion is confirmed by panel (c), which shows the paths of loans-to-deposit ratios for foreign (dashes) and domestic (solid) banks.[10]

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[10] This figure excludes two banks (BHIF and Banco de Santiago) that changed from domestic to foreign ownership during the period. The change in statistical classification took place in November 1998 for Banco BHIF, and in July 1999 for Banco de Santiago. In the case of Banco de Santiago, the takeover operation took place in May 1999 by Banco Santander (the largest foreign bank in Chile). Assuming that the two banks were going to merge, the Chilean banks regulatory agency (Superintendencia de Bancos) ordered Banco de Santiago to reduce its market presence (the two banks had a joint presence equivalent to 29% of total loans). The banks finally decided not to merge and therefore their joint market presence has remained unaltered so far. Most likely the confusion created by the potential participation limits did not help the severe credit crunch that Chile was experiencing at the time.
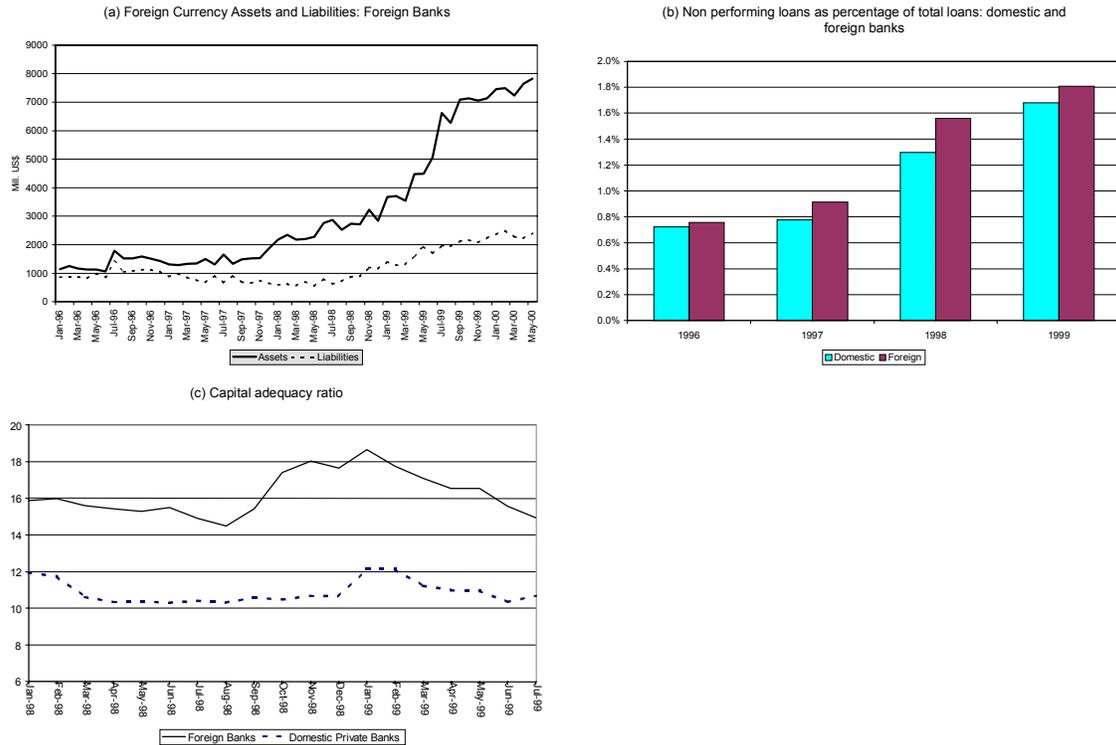
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Figure 9: Comparing Foreign and Domestic Bank Behavior

(a) Investment in Domestic and External Assets: Foreign Banks

(b) Investment in Domestic and External Assets: Domestic Banks

(c) Loans over Deposits domestic and foreign banks except BHIF and Santiago

Notes: Domestic banks do not include Banco del Estado. (a), (b) Domestic assets include Central Bank securities with secondary market and intermediated securities. External assets are the sum of deposits abroad and foreign securities.
All constant 1998-peso series were converted to dollars using the average exchange rate during December 1998 (472 pesos/dollar). (c) Loans-to- deposits ratios are normalized to one in March 1996. Deposit: sight and time deposits. Loans: commercial, consumption, and trade loans, and mortgages. Banco BHIF and Banco de Santiago, which changed from domestic to foreign during the period, were excluded from the sample. The information used to separate these two banks is from the Bolsa de Valores de Santiago (Santiago Stock Exchange).

The question arises whether it is not the nationality but other factors (e.g., risk characteristics) of the banks that determined the differential response. While this is certainly a theme to be explored more thoroughly, the evidence in Figure 10 suggests that this is not the case. Panel (a) shows that foreign banks did not experience a rise in net foreign currency liabilities that could account for additional hedging. When compared with domestic banks, they did not experience a significantly sharper rise in non-performing loans as is indicated by panel (b), or were affected by a tighter capital-adequacy constraint in panel (c).

Figure 10: Risk Characteristics of Foreign and Domestic Banks

(a) Foreign Currency Assets and Liabilities: Foreign Banks

(b) Non performing loans as percentage of total loans: domestic and foreign banks

(c) Capital adequacy ratio

Notes: (a) Foreign assets: foreign loans, deposits abroad and foreign securities. Foreign liabilities: funds borrowed from abroad and deposits in foreign currency. (b) ROE: ratio of total profits over capital and reserves (as a percentage). Domestic private banks do not include Banco del Estado.
Source: Superintendencia de Bancos e Instituciones Financieras.

Foreign banks usually play many useful roles in emerging economies but they do not seem to be helping to smooth external shocks (at least in the most recent crisis). It is probably the case that these banks' credit and risk strategies are being dictated from abroad, and there is no particular reason to expect them to behave too differently from other foreign investors during these times.

In summary, during 1999 –perhaps the worst full year during the crisis--- banks reduced loan growth by approximately US$2 billions,[11] while the increase in financial needs by the non-banking private sector was about US$2 billions as well (see figure 5c). Although there are many general equilibrium issues ignored in these simple calculations, it is probably not too far-fetched to add them up and conclude that the financial crunch was extremely large, perhaps around US$4 billions (about 5-6% of GDP) in that single year.

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[11] A number close to two billion dollars is obtained from the difference between the flow of loans during 1999 (computed as the change in the stock of loans between December 1999 and December 1998) and the flow of loans in 1996 (computed in a similar manner).

III. The Costs

The impact of the financial crunch on the economy is correspondingly large, especially on small and medium size firms.

III.1 The Aggregates

Figure 2 already summarized the first-order impact of the financial mechanism, with a domestic business cycle that is many times more volatile than it would be if financial markets were perfect. This "excess volatility" was particularly pronounced in the recent slowdown, as is illustrated by panel (a) in Figure 11.   The paths of national income (solid) and domestic demand (dashes) not only appear to move together, but the latter adjusts more than the former, implying that the largely transitory terms-of-trade shock is not being smoothed over time. Panel (b) illustrates a sharp rise in the unemployment rate that has yet to be undone.

Figure 11: Output, Demand, and Unemployment
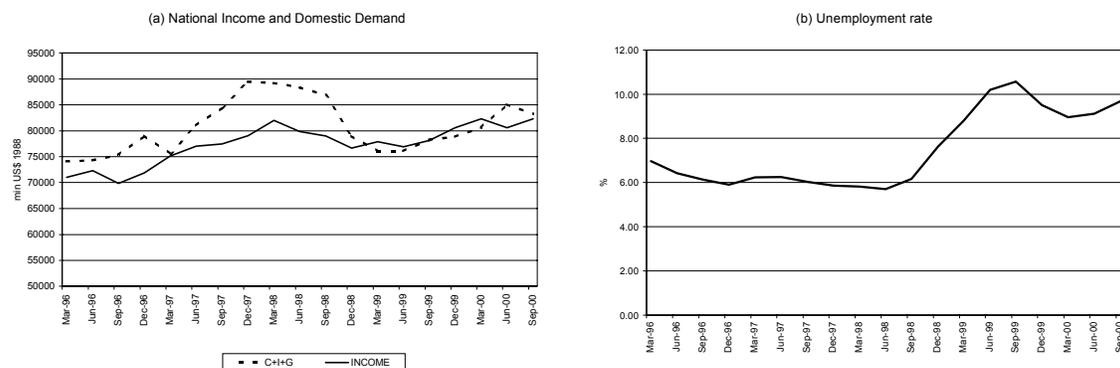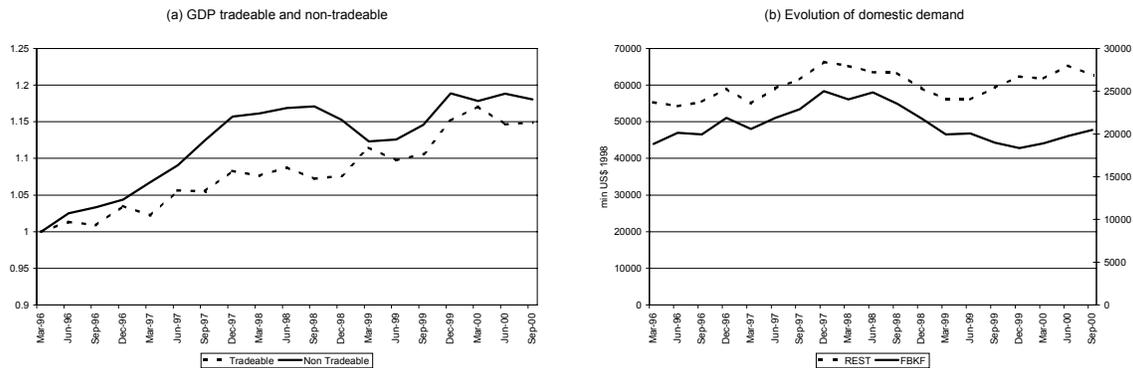

Notes: (a) Series are seasonally adjusted and annualized. Source: Banco Central de Chile. (b) Source: INE.

Aside from the direct negative impact of the slowdown and any additional uncertainty that may have been created by the untimely discussion of a new labor code, the build up in unemployment and its persistence can be linked to two additional aspects of the financial mechanism described above. First, in the presence of an external financial constraint the real exchange rate needs a larger adjustment for any given decline in terms-of-trade.[12] As a result of this, a big share of the adjustment falls on the labor-intensive non-tradable sector, as illustrated in panel (a) of Figure 12. Second, going beyond the crisis and into the recovery, the lack of financial resources hampers job creation, a phenomenon that is particularly acute in the PYMES (see below). While I do not have job creation numbers, panel (b) shows that investment (solid line) suffered a deeper and more prolonged recession than the rest of domestic aggregate demand (dashed line). This is

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[12] The larger real exchange rate adjustment corresponds to the dual of the financial constraint. See Caballero and Krishnamurthy (2001a).

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important beyond its impact on unemployment, as it also hints at the slowdown of one the main engines of productivity growth: the restructuring process. If the U.S. is any indication of the costs associated to this slowdown in restructuring -- possibly a very optimistic lower bound for the Chilean costs -- this mechanism may add a significant productivity loss that amounts to over 30% of the employment cost of the recession.[13]

**Figure 12: Forced and Depressed Restructuring**

Notes: (a) Series are seasonally adjusted and normalized to one in March 1996. Tradable sector: agriculture, fishing, mining, and manufacturing. Non-tradable sector: electricity, gas and water, construction, trade, transport and telecommunications, and other services. (b) Series are seasonally adjusted, and annualized. Source: Banco Central de Chile.

As the external constraint tightens, all domestic assets that are not part of international liquidity must lose value sharply in order to offer significant excess returns to the few agents with the will and liquidity to buy them. Figure 13a shows a clear trace of this v-pattern in the Chilean stock market. Panel (b) is perhaps more interesting, as it illustrates that foreign direct investment (FDI) increased by almost $4.5 billion during 1999, and created a bottom to the fire sale of domestic assets.   However, while FDI is very useful since it provides external resources when they are most scarce, its presence during the crisis also reflects the severe costs of the external financial constraint as valuable assets are sold at heavy discounts.

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[13] See Caballero and Hammour (1998).

Figure 13: Fire Sales

(a) Value of Chilean stocks (index)

(b) Foreign Direct Investment (FDI)
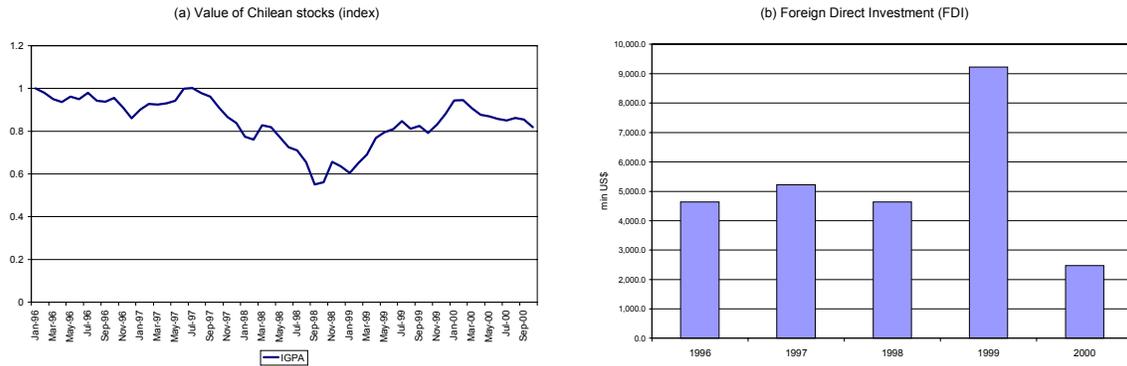
Notes: (a) IGPA is the general stock price index of the Santiago Stock Exchange. Sources: Bloomberg and Banco Central de Chile
(b) Gross FDI inflows. Source: Banco Central de Chile.

III.2 The Asymmetries

The real consequences of the external shocks and the financial amplification mechanism are felt differently across firms of different sizes. Large firms are directly affected by the external shock but can substitute their financial needs domestically. They are affected primarily by price and demand factors. The PYMES, on the other hand, are crowded out from domestic financial markets and become severely constrained on the financial side. They are the residual claimants -- and to a lesser extent, so are indebted consumers -- of the financial dimension of the mechanism described above.

Figure 14 illustrates some aspects of this asymmetry, starting with panel (a) that shows the path of the share of "large" loans as an imperfect proxy for resident bank loans going to large firms. Together with panel (b), which shows a sharp increase in the relative size of large loans, it hints at a substantial reallocation of domestic loans toward relatively large firms. In the policy section I will argue that some of this reallocation is likely to be socially inefficient.

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Figure 14: Flight-to-Quality

(a) Share of large loans in total loans

(b) Average size of small and large loans
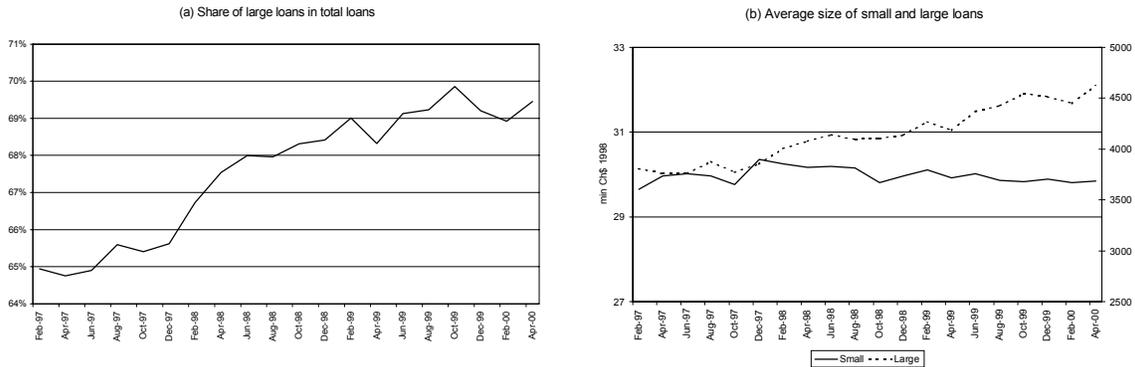
Notes: (a) Large loans: larger than 50000 UF; Small loan: greater than 400UF but less than 10000 UF. (b) The average size corresponds to the stock of loans in each class divided by the number of debtors.
Source: Superintendencia de Bancos e Instituciones Financieras.

The next figure looks at continuing firms from the FECUs.[14] Despite all of these firms being relatively large publicly traded companies, one can already see important differences between the largest of them and "medium" size ones. Figure 15 shows the path of medium and large firms' bank-liabilities (normalized by initial assets) during the recent slowdown. It is apparent that larger firms fared better as medium-sized firms saw their level of loans frozen throughout 1999. Perhaps more importantly, since the sum of loans to medium and large firms rose during this period, while total loans declined throughout the crisis, the contraction must have been particularly significant in smaller firms (those not in the FECUs).

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[14] FECU is the acronym for *Ficha Estadistica Codificada Uniforme*, which is the name of the standardized balance sheet that every public firm in Chile is required to report to the supervisor authority (*Superintendencia de Valores y Seguros*) on a quarterly basis. Our database contains the information on those standardized balance sheets for every public firm reporting to the authority between the first quarter of 1996 and the first quarter of 2000.

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Figure 15: Bank Debt of Publicly Traded Firms By Size

(a) Bank liabilities of medium and large firms
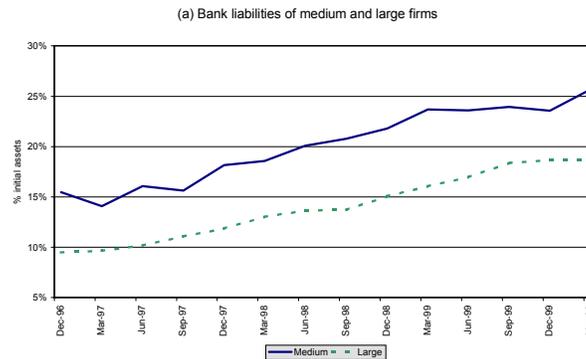
Notes: (a) Data source: FECU reported by all listed firms to the Superintendencia de Valores y Seguros. The sample includes all firms that continuously reported information between December 1996 and March 2000. Within this sample, the medium (since they are larger than firms outside the sample) size firms are those with total assets below the median level of total assets in December 1996. The series correspond to the total stock of bank liabilities at all maturities expressed in 1996 pesos, divided by the total level of assets in December 1996). The nominal values were deflated using the CPI. The total level of assets in December 1996 was US$788 millions for the group of medium size firms, and US$59,300 millions for the group of large firms.

In summary, despite significant institutional development over the last two decades, the Chilean economy is still very vulnerable to external shocks. The main reason for this vulnerability appears to be a double-edged financial mechanism, which includes a sharp tightening of Chile's access to international financial markets, and a significant reallocation of resources from the domestic financial system toward larger corporations, public bonds and, most significantly, foreign assets.

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IV.   Policy Considerations and a Proposal

The previous diagnostic points at the occasional tightening of an external financial constraint -- especially when terms-of-trade deteriorate -- as the trigger for the costly *financial* mechanism.

IV.1   General Policy Considerations

If this assessment is correct, it calls for a structural solution based on two building blocks:

a) Measures aimed at improving Chile's integration to international financial markets and the development of domestic financial markets.
b) Measures aimed at improving the allocation of financial resources during times of external distress and across states of nature.

While in practice most structural policies contain elements of both building blocks, I focus on (b) as the guiding principle of the policy discussion below because (a), at least as an objective, is already broadly understood and Chile is already making significant progress along this dimension through its capital markets reform program. That is, I focus primarily on the *international liquidity management* problem raised by the analysis above.[15]

International liquidity management is primarily an "insurance" problem with respect to those (aggregate) shocks that trigger external crises. Of course solutions to this problem must have a contingent nature. The first step is to identify a -- hopefully small -- set of shocks that capture a large share of the triggers to the mechanism described above. In the case of Chile, terms-of-trade, the EMBI+, and perhaps weather variables, represent a good starting point, but the particular index chosen is a central aspect of the design that needs to be extensively explored before it is implemented.

The second step is to identify the ex-post transfers (perhaps temporary loans rather than outright transfers) that are desirable. At a broad level these are simply:
i)   From foreigners to domestic agents.
ii)   From less constrained domestic agents to more constrained ones.

At a generic level these transfers are clear, but in practice there is great heterogeneity in agents' needs and availability, raising the information requirements greatly. It is thus highly desirable to let the private sector take over the bulk of the solution, which begs the question of why is it that this sector is not already doing as much as is needed. The answer to this question most likely identifies the policy goals with the highest returns.

The main suspects can be grouped into two types: supply and demand factors.

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[15] See Caballero (1999, 2001) for general policy recommendations for the Chilean economy, including measures type (a). My objective in the current paper is instead to focus and deepen the discussion of a subset of those policies, adding an implementation dimension as well.

Among the supply factors, there are at least three prominent ones:
a) *Coordination problems*. The absence of a well-defined benchmark around which the market can be organized.
b) *Limited "insurance" capital*. These may be due to structural shortages or due to a financial constraint (in the sense that what is missing is assets that can be credibly pledged by the "insurer," rather than actual funds during crises). A closely related problem, but with coordination aspects as well, is that an insufficient number of participants in the market raises the liquidity and collateral risk faced by the "insurers*."*
c) *Sovereign (dual-agency) problems*. While contracts are signed by private parties, government actions affect the payoffs of these contracts.[16]

Among the demand problems, one should consider at least three sources of underinsurance:
a) *Financial underdevelopment*. This leads to a private undervaluation of insurance with respect to aggregate shocks. The latter depresses effective competition for domestically available external liquidity at times of crises, reducing the private (but not the social) valuation of international liquidity during these times.[17]
b) *Sovereign problems*. Implicit (free) insurance.
c) *Behavioral problems*. Over-optimism.

In my view, domestic financial underdevelopment is still a problem in Chile, which gives relevance to demand factor (a) and to supply factor (b) as it reduces the size of the effective market. The bulk of the solution to this problem should be pursued through financial market reforms. In the meantime, however, an adequate use of monetary and reserves management policy may remedy some of the underinsurance implications of this deficiency. I briefly discuss the general features of this policy in the next section. A more extensive discussion can be found in Caballero and Krishnamurthy (2001c).

Similarly, demand factor (c) seems to be a pervasive human phenomenon (see for example Shiller 1999), whose macroeconomic implications can also be partly remedied with the above policy. The latter must be done with great care not to generate a sizeable demand-(b) type problem, which is otherwise not likely to be present in any significant amount in the case of Chile and neither is supply-(c).

This leaves us with supply-(a) as the main focus of the policy proposal, which I discuss extensively in section IV.3.

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[16] See, e.g., Tirole (2000).
[17] See Caballero and Krishnamurthy (2001a,b).

IV.2 Monetary Policy as a Solution to the Underinsurance Problem

Figure 16 provides a stylized characterization of an external crises of the sort that I have described up to now. The main problem during an emerging market crisis is well captured by the presence of a "vertical" external constraint. That is, external crises are times when, at the margin, it becomes very difficult for most domestic agents to gain any access to international financial markets at *any* price. As a result of this, international liquidity becomes scarce and domestic competition for these resources bid up the "dollar"-cost of capital, i^d, above the international interest rate faced by prime (international) Chilean assets, i^*. The dual of this crunch is a sharp fall in investment.

Figure 16: External Crisis
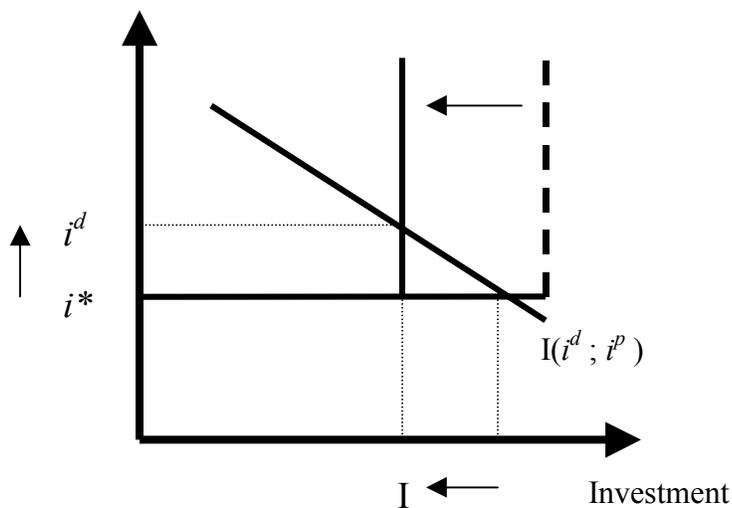
Ex-post-Optimal Monetary and reserves policy during crisis

Before discussing optimal policy from an insurance perspective, it is worth highlighting the incentives that a central bank faces during an external crisis.

The main shortage experienced by the country is one of international liquidity (or "collateral," broadly understood). Thus, an injection of international reserves into the market is a very powerful tool: it directly relaxes the "vertical" constraint on investment in Figure 16, and it stabilizes the exchange rate.

To see the latter, note that during an external crisis international arbitrage does not hold since there is an external credit constraint. Domestic arbitrage, on the other hand, must hold. Peso and dollar instruments backed by domestic collateral must yield the same expected return (risk aversion aside). Thus the *domestic* arbitrage condition is:

(1) $$i^d = i^p + (e - Ee),$$

where i^p denotes de peso interest rate, e the current exchange rate, and Ee the expected interest rate for next period. In what follows, I take the latter as given, although interesting interactions arise when this expectation is affected by policy as well (see Caballero and Krishnamurthy 2001c).

Rearranging (1) yields and expression for the exchange rate:

(2) $$e - Ee = i^d - i^p,$$

which shows that as i^d falls with the reserves' injection, the exchange rate appreciates for any given peso interest rate.

The effectiveness of reserves' injections in boosting investment and protecting the exchange rate contrasts sharply with the impact of an expansionary monetary policy. The reason for this is that the main problem during an external crisis is the lack of international not domestic liquidity.

Domestic liquidity facilitates domestic loans and hence the role of i^p in the investment function in Figure 16 (given i^d, lower peso interest rates raise investment demand) but, to a first order, it does not relax the binding international financial constraint. As a result, an expansionary monetary policy is not effective in boosting real investment in equilibrium. Instead, its main impact is to raise domestic competition for the limited international liquidity, and hence i^d. By equation (2), the latter means that the exchange rate depreciates sharply, as it must not only offset the reduction in i^p (the standard channel) but also absorb the rise in i^d.

In conclusion, a central bank that has an inflation target and is concerned with the impact that the exchange rate may have on it, will rather tighten monetary policy. Doing otherwise does not have much real benefits during the crisis and can lead to a sharp exchange rate depreciation.

Ex-ante-Optimal Monetary and reserves policy during crisis

But if the central bank could commit ex-ante to a monetary policy, would it still choose to tighten during a crisis. The answer is no. The reason for this is that the primitive problem is the private sector's underinsurance with respect to aggregate external shocks. The amount of international liquidity that the country has during an external crisis may be exogenous at the time of the crisis but it is not ex-ante. It depends on how much international borrowing occurred during the boom years, on the maturity structure and denomination of that debt, on the contingent credit lines contracted, on the sectoral allocation of investment, and so on. Underinsurance means that these decisions did not fully internalize the social cost of sacrificing a unit of international liquidity. Figure 17 captures this gap by adding a social valuation curve to Figure 16. The gap Δ-i^d captures

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the undervaluation problem. In other words, had the private sector expected value of a unit of liquidity being Δ as opposed to i^d, they would have hoarded more international liquidity and the vertical constraint during the crisis would have shifted to the right.

Figure 17: Underinsurance
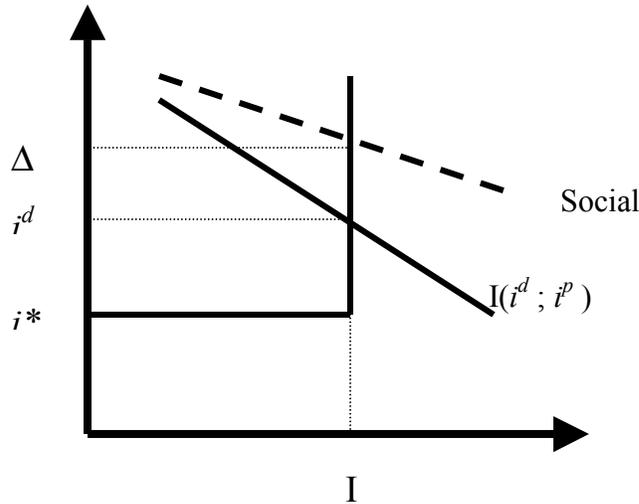
Thus, while an expansionary monetary policy during a crisis is unable to boost investment, its anticipation *is*. If private agents anticipate such policy, they will expect a higher i^d and hence will make ex-ante decision more in line with those of the social planner. In this context, the main role of monetary policy is one of incentives rather than one of liquidity provision, for the main scarcity during an external crisis is international rather than domestic liquidity.

What about international reserves' injections? They are still optimal ex-ante, however the fall in i^d they bring about have a perverse incentive effect that also needs to be offset by the expansionary monetary policy.

To conclude, I shall remind the reader that I have taken *Ee* as given throughout. If this is not warranted, in the sense that the commitment to a post-crisis inflation target is not sufficiently credible and is seriously compromised by policies during the external crunch, then monetary policy may not be an available incentive mechanism. Having lost the latter, the authorities may have to resort to much costlier incentive mechanisms such as capital controls. I do not believe this is the case of Chile today.

IV.3 Creating a market: Issuing a benchmark-contingent-instrument

As I mentioned before, I suspect another key aspect behind underinsurance is simply a coordination problem. While there are many ways to hoard international liquidity, they tend to be more cumbersome than they need to be. The basic proposal here is extremely simple: The Central Bank or, preferably, one of the IFIs should issue a financial instrument –a "bond" for now-- contingent on the shocks identified in step one in section IV.1. Ideally, and hence the role played by a reputable first issuer, this bond should be free of other risks. The issue should be significant enough to attract the participation of international institutional investors and hence generate its liquidity. While some of the desired insurance may be achieved directly by this bond, its main purpose is simply to create the market. With the basic contingency well priced, it should be substantially simpler for the private sector to engineer its own contingent instruments.

It is important to realize that the contingency generated via this mechanism addresses only the expected differential impact of the aggregate shocks contained in the index. Individual agents will generate heterogeneity in their effective hedging through their net positions rather than through a change in the specific contingency.[18] Other, more idiosyncratic underinsurance problems are also welfare reducing but are less connected with aggregate stabilization, which is the concern in this paper.[19]

While in principle the question of how responsive should be the contingency to the underlying insurance factors or indices is irrelevant since the private sector should be able to develop the derivative markets that can generate any slope they may need, financial constraints and liquidity considerations suggest otherwise. With the latter considerations in mind, it is desirable to make the bond contingency very "steep," so as to minimize the leverage and derivative instruments required to generate an appropriate amount of insurance for large crises. The counterpart will probably be a very limited insurance of small and intermediate shocks, which should be fine since these shocks seldom trigger the financial amplification mechanism highlighted in this paper.

How much insurance does the country need? This question is not easy to answer as it involves many general equilibrium considerations, but a very conservative answer for a full-insurance upper bound should not be very far from the partial equilibrium answer. Crises deep enough to trigger the complex scenarios experienced by Chile recently are probably once in a decade events, and according to our estimates earlier on the shortfall of resources is about 5 billion dollars a year, lasting for at most two years (recessions

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[18] See Shiller's (1993) seminal work on promoting the creation of macro-markets as a mechanism for insuring microeconomic risks. While much of his reasoning applies in the context I have discussed as well, my ultimate focus is on the equilibrium (macro)-benefits of microeconomic insurance with respect to macroeconomic shocks, rather than on the direct microeconomic welfare enhancing features of such insurance.

[19] Also, insurance against aggregate shocks is more likely to support a market instrument as its solution, as opposed to more expensive (less liquid) individually tailored insurance contracts.

longer than this are most likely the result of the damage created by the lack of insurance, rather than the direct effect of the external shocks). But the required insurance is only a fraction of this shortfall since all that is needed is that these resources be lent, not transferred. If we conservatively assume that the average (shadow) spread on Chilean external debt rises by 600 basis points, the required insurance is effectively 300 millions per crisis year (with the loan commitment or credit line). Gathering all these factors puts the fair price of full-insurance at around 60 millions a year. Of course prices for this type of insurance are never fair, but the point of this "back-of-the-envelope" calculation is that the amounts involved are not large.

The mapping from the above to the size of the contingent bond issues required depends on the slope of the contingency, amount of insurance required (full insurance is highly unlikely to be optimal), and other design issues. Of course, the benchmark bond should represent only a small fraction of the total amount, as hopefully the private sector will follow behind. But it cannot be too small either, since it needs to be liquid enough from the outset.

All of the above refers to the insurance between foreigners and domestics, but there is also a need to create a substantial amount of domestic insurance. Large corporations with better access to international financial markets should be able to profit from arbitraging their access to smaller domestic firms, rather than move inward to borrow in the domestic markets during time of distress, as it happened in the recent episode. Probably the domestic banking system is the natural institution to administer this side of the contingent strategy, which would probably require regulatory changes to accommodate this new role without causing undesirable domestic credit crunches as the index moves around.

The question arises on whether the development of such contingency has any obvious advantage over the admittedly simpler strategy of "internationalizing the peso;" that is, of placing abroad bonds denominated in Chilean pesos. This is the strategy currently being pursued, with the support of a recent World Bank issuance for US$ 105 million.[20] In my view, while the shocks indexing the contingency will in all likelihood put pressure on the exchange rate, and hence the peso-bonds serve a role similar to the contingent instruments I have proposed, there is a clear disadvantage in them: The Chilean authorities largely control the value of the peso, and therefore this contingency is unlikely to appeal the insurers (or bond holders) as much as an exogenous contingency. Moreover, and somewhat paradoxically, a peso-denominated bond may not only be subjected to a higher premium due to the risk of Central Bank's manipulation of the exchange rate, but it may also not prove a very effective insurance mechanism if, for example, the authorities decide to dampen an exchange rate depreciation that is risking an inflation target (see previous section).[21]

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[20] The bond was floated in May 31, 2000, for an amount of $55,000 million of Chilean pesos. The bonds have 5 years of maturity (to be repaid on June 4th, 2005), a coupon of 6.6%, and are indexed to Chilean inflation. Most of the issue was acquired by Chilean institutional investors (75%), while the rest was placed among international investors. Chase Manhattan International Ltd, New York, acted as director bank.

[21] The so called "fear of floating" (Calvo and Reinhart 2000). In principle, one could think of an optimal

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The disadvantage of the contingent bond, on the other hand, is that it is more difficult to implement and hence the risk of not finding the market for it is non-negligible. It will require careful planning not to design an instrument that it is difficult to comprehend, or whose contingencies are not fully transparent. The experiences of previous placements of commodity-indexed bonds should be studied carefully, and a few references to these experiences are summarized in Box 2 below. Several firms experimented with commodity-indexed bonds in the 1980s, but most seem to hedge commodity price volatility using the options markets. Commodity producers generally have focused on minimizing downside risk and have been reluctant to hedge away the benefits of price increases.[22]

There are also plenty of lessons to learn from the recent securitization of catastrophe-insurance contracts in the US. Box 3 describes the instruments employed by the insurance industry in recently attempting to hedge catastrophe risk through capital markets. The obstacles faced by the first placements of these instruments were plentiful, ranging from investor's lack of understanding of their contingencies to the legal obstacles to overcome due to, for example, the great confusion on whether to classify these instruments as bonds or insurance, and hence on deciding which institution should regulate them. Another lesson from the catastrophe risk experience is that these bonds will probably pay a significant premium early on, but this premium should come down rapidly as well.[23] Since this declining path creates a natural incentive for a "war-of-

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amount of external peso debt so that the moral hazard problem is exactly offset by the fear of floating effect. In practice, such mechanism may introduce significant policy uncertainty to investors.

[22] Magma Copper exercised an option to call its copper-indexed junk bonds in late 1991 as the price of copper increased in order to eliminate higher coupon rates. Since then, the company has focused exclusively on setting a price floor with put options. See Appendix A.I below for more detail. In the case study on United Copper Industries, the company appeared reluctant to hedge in a manner that it would later regret if copper prices increased markedly. See Appendix A.II for an extended discussion. Sunshine Precious Metals ultimately defaulted on its silver-indexed bonds in 1991, converted them into another series of silver-indexed bonds, and then retired them in 1993 as silver prices started to rebound. This final case is described in Appendix A.III.

[23] The first cat-bonds were placed in 1997 and initially paid a premium over nine times the expected loss.

attrition" in the private placement of these bonds, it reinforces the conclusion that the process needs to be started by the Chilean authorities or an IFI.[24]

V. Final Remarks

There is no reason to stop at financial markets. Once the contingent index has been created, many contracts can naturally arise indexed to it. As the U.F. (unidad de fomento – an inflation index) once removed much of the uncertainty created by high and unstable inflation to microeconomic agents, the new contingency may be institutionalized to do something similar with the uncertainty that financially amplified external shocks generate. For example, labor markets -- minimum wages and temporary contracts -- could be indexed to the contingent index to ease firms' financial difficulties during external crises. The structural fiscal surplus could similarly be indexed to free financial resources to the private sector during those times.

Finally, it is important to consider regional interactions. It may well be worth giving up some of the specific tailoring of the instrument to the Chilean needs, for a much more liquid contingent bond that includes other advanced emerging economies of the region, such as Argentina, Brazil and Mexico. Or perhaps even search for other co-issuers beyond Latin America, with contingency needs not too distant from those of Chile.

By 1999, that premium had steadily declined by nearly forty percent.
[24] There is also some evidence that CAT-Options paid a lower initial excess-premium than CAT-Bonds. See Cummins, Lalonde and Phillips (2000).

Box 2: Examples of Commodity-Indexed Bonds

Bonds with warrants on the issuer's shares have become fairly common financial instruments, while bonds embedded with options on commodity prices are relatively rare. These commodity-indexed bonds have generally been attractive to investors that would like to participate in commodity options but cannot for regulatory or other reasons purchase directly. While these instruments can be quite complex, in all cases they can be broken down (and thus valued) as the sum of fairly standard securities. Some recent examples include:

Oil.

In 1986 **Standard Oil of Ohio** created an issue of *Oil Indexed Notes* where the principal payment was a function of oil prices at maturity. The holder of a 1990 note received -- in addition to a guaranteed principal amount – the value of 170 barrels of Light Sweet Oklahoma Crude Oil with a price floor at $25 and price ceiling at $40. Investors essentially held standard four-year bond while being long in a call option with exercise price of $25 and short in a call option with exercise price at $40. The Mexican state oil company **PEMEX** also issued bonds in 1973 including a forward contract on oil

Copper.

In 1988, **Magma Copper** issued $200 million of 10-year junk bonds with quarterly coupon rate was indexed to the average copper price. While the coupon rate was fixed at 18% for the first six months, it was indexed thereafter to average copper prices in the preceding quarter. This rate had both a ceiling at $2 of 21% and a floor at $.80 of 12%. Magma president J. Burgess Winter said "I don't mind expensive money if the copper price stays high." Embedded in this 10 year bond are 40 options on the copper price with maturities staggered from 3 months to 10 years. **United Copper Industries** also issued copper- indexed bonds. See the boxes below for more detail.

Silver.

Sunshine Mining issued bonds in 1980 due in 1995 and 2004 incorporating an option on silver. At maturity or redemption, each bond was payable at the greater of $1000 and between 50 and 58 ounces of silver. If the indexed principal amount is greater than $1000, the company had the right to deliver silver to bondholders in satisfaction of the indexed principal amount. The coupon rates on these bonds varied from 8 percent to 9.75 percent. These bonds also had sinking fund covenants requiring the company to call a fraction of the original indenture and an option of recall by the company.

Natural Gas.

In July 1988 **Forest Oil** proposed a 12-year issue of *Natural Gas Interest Indexed Debentures*. This note was intended to pay a base coupon rate every 6 months plus 4 basis points for every $0.01 by which average gas spot price exceeds $1.76 per million BTUs.

Oil and Currency.

Smith (1995) discusses the feasibility of issuing an oil interest-indexed dual currency bond. A five-year bond would pay a semiannual coupon of two barrels of Sweet Light Crude with a price floor of $34 and principal of 140,000 yen at maturity. This is simply a standard five-year coupon bond plus 20 call options having an exercise price of $17 with staggered maturity and a five-year forward contract on yen with an exercise price of 140 Yen/$.

Source: Smith and Smithson (1990), Smith (1995) and SEC 10K filings of **Magma Copper** and **Sunshine Mining**

Box 3: The Catastrophe (CAT) Securities Market Experience

The pooling of catastrophe risk is still in the early stages of development despite the marked increase in catastrophe insurance over the last two decades. While prospective event losses could easily exceed $50 billion, the total capital and surplus of the U.S. insurers is only about $240 billion. The insurance industry has historically tried to reduce exposure to such risk through reinsurance contracts with separately capitalized firms, but reinsurance capital has been extremely limited and is largely insufficient to finance exposures in the US, let alone the rest of the world. This has prompted insurers to look to other investors in order to finance catastrophe risk. Capital markets plausibly represent a solution as the $50-$100 billion in industry exposures that could be financed are about equal to a normal day's fluctuation in equity markets. As these risks are "zero-beta" events, they potentially provide a new source of diversification for investors.

CAT Bonds and Notes.

Guy Carpenter, **J.P. Morgan** and other institutions have recently issued "act-of-God" bonds as a source of financing for insurance companies. These instruments are subject to reductions in principal in the event of a catastrophe loss to the insurer. As these types of risks are acts-of-God not subject to manipulation, they do not suffer from severe adverse selection or moral hazard problems. These bonds traded at substantial spreads, however, almost 10%, above Treasuries of similar maturity.

In 1997-98 **USAA** issued $400 million of these bonds contingent on losses exceeding $1 billion over the next 12-18 months.

Investors were liable for 80 percent of the first $500 million in losses, with USAA taking a 20 percent stake to reduce any remaining agency problems. These bonds have yielded between 275-575 basis points over LIBOR depending on the principal protection purchased.

This issue has been a remarkable success and was actually oversubscribed, and demonstrated a willingness by investors to bear risk equivalent to industry losses exceeding $25 billion. The success of this issue set the stage for later issues covering earthquake exposure in California and Japan. Approximately $1 billion of catastrophe bonds was issued in each of 1997 and 1998.

Nationwide Mutual recently issued $400 million in contingent surplus notes. Investors purchase US Treasury bonds but the company has the right to liquidate these bonds in exchange company notes in event of catastrophe. This instrument infuses the company with cash when times are bad and pays investors a premium over a normal Treasury.

Overall, there have been about 20 catastrophe bond issues with proceeds totaling about $3 billion, compared to about $120 billion in annual volume on the international reinsurance market. There is evidence that they are gaining acceptance by the investment community. The first cat-bonds placed in 1997 initially paid a premium over nine times the expected loss, but two year later that premium had steadily declined by nearly forty percent.

One important issue with CAT bonds is that investors are not only taking on catastrophe risk but also credit risk when buying these instruments, implying that adverse selection and moral hazard problems could limit their usefulness to companies seeking to hedge by significantly raising their cost.

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CAT Options.

The **Chicago Board of Trade** (CBOT) introduced catastrophic loss futures in 1992, but withdrew these contracts in 1995 due to a lack of interest by investors. Currently the exchange trades call option spreads on nine catastrophe indices constructed by Property Claims Services (one national, five regional and three state). However, these options trade less frequently than other options at the CBOT and less than $100 million has been placed in any quarter in these instruments. While agency issues mentioned above are ameliorated through the use industry index (in contrast to CAT bonds), this creates basis risk for the company making these options less useful as a hedging instrument.

Despite this recent success, there remains a great deal of uncertainty about the assessment of catastrophe risk, the lack of standardization in measuring losses, and the absence of an institutional structure for disaster securities. These markets are generally not very liquid and investors demand compensation for this risk. Competition from the reinsurance market as well as the tax and accounting advantage of reinsurance are hurdles for further development of CAT securities markets.

Source: Froot (1999); Cummings Lalonde, and Phillips (2000)

Appendix A.I: Hedging at Magma Copper

Magma Copper Company was a fully-integrated producer of electrolyctic copper and was one of the largest US producers in the later 1980s and early 1990s.[25] The company owned and operated copper mines at San Manuel, Superior, and Pinto Valley and owned a mine in Peru through its Tintaya subsidiary.

The copper prices established on the two major metals exchanges - The Commodity Exchange, Inc. (Comex) in New York and the London Metal Exchange (LME) - broadly reflect the worldwide balance of copper supply and demand. The profitability of **Magma**'s operations was obviously largely dependent upon the worldwide market price for copper. A $0.01 per pound change in the average price realized for the company's 1994 output would have affected pre-tax income by an estimated $6.0 million.

As illustrated in the table below, copper prices have historically been subject to wide fluctuations and are affected by numerous factors, including international economic and political conditions, levels of supply and demand, the availability and cost of copper substitutes, inventory levels maintained by copper producers and others and, to a lesser degree, inventory carrying costs (primarily interest charges) and international exchange rates.[26]

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[25] **BHP Minerals** acquired the company in 1996.

[26] The table of pertinent copper industry data contains Comex high, low and average copper prices per pound and illustrates the historic volatility of copper prices. Price data are given for the Comex standard-grade copper contract for the years 1985-1989. Thereafter, prices are given for contracts for delivery of high-grade copper cathode, which replaced the standard-grade contract effective January 1, 1990.

Magma had instituted a copper price protection program to ensure, regardless of the copper price, adequate cash flow for the completion of several major capital projects that are important to its future. These projects, Tintaya, Kalamazoo and Robinson, were intended to increase Magma's production and ore reserves and reduce overall cost per pound. The program included hedging using either the purchase of copper price put options or forward sales of copper at a fixed price depending on copper market conditions including price and volatility.

Copper Price (1 lb.)			
	High	**Low**	**Average**
1985	$0.66	$0.56	$0.61
1986	$0.69	$0.57	$0.62
1987	$1.46	$0.60	$0.78
1988	$1.63	$0.88	$1.15
1989	$1.59	$1.00	$1.25
1990	$1.38	$0.96	$1.19
1991	$1.20	$0.96	$1.05
1992	$1.16	$0.94	$1.03
1993	$1.07	$0.72	$0.85
1994	$1.40	$0.78	$1.07

Due to these hedging strategies, **Magma**'s average copper price realized was nine cents per pound greater (94 cents versus 85 cents) than the average Comex price for 1993 and was nine cents per pound lower (98 cents versus $1.07) than the market price in 1994. With the recent purchase of Tintaya, and construction of the Kalamazoo and Robinson mines, the copper price protection program was extended into early 1997. In contrast to 1994, which included a significant amount of forward sales entered into at the end of 1993, the program for 1995 and 1996 consists almost entirely of copper price put options which lock in a copper price floor and operating cash flow while retaining the upside potential of higher copper prices.

As a result of this program, which created a copper price floor of 87 cents and 93 cents for 1995 and 1996 respectively, **Magma** felt confident that is would be able to complete its strategic growth opportunities with moderate outside financing and maintain its strong financial position and flexibility.

In the 1980s, the company had experimented with commodity-indexed bonds as a means of hedging risk created by volatility in copper prices. **Magma** issued $210,000,000 of 10 year *Copper Interest-Indexed Senior Subordinated Notes* in 1988 – junk bonds underwritten by Drexel Burnham Lambert. The *Copper Notes* paid an 18 percent quarterly coupon rate for the first six months and then had the coupon indexed to the average copper price according to the table below.

When the average copper price applicable to an interest payment was $ .80 per pound or less, and the company's interest coverage ratio was less than 1.5 to 1 for the most recent fiscal quarter ending, **Magma** had the option to pay 50% of such interest by delivery of additional *Copper Notes* ("Pay-in-Kind Notes") in principal amount equal to the amount of such interest.

Quarterly Coupon Rate	Average Copper Price (1 lb.)
21%	$2.00 or above
20%	$1.80
19%	$1.60
18%	$1.40
17%	$1.30
16%	$1.20
15%	$1.10
14%	$1.00
13%	$0.90
12%	$0.80 or below

The *Copper Notes* were redeemable at the option of the Company at any time or from time to time on or after November 15, 1991, but only in increments described in the indenture.

Commencing on November 15, 1992 and on each November 15 thereafter, the holders of the *Copper Notes* had the option of requiring the company to repurchase, for cash, or in certain circumstances, for new debt securities, *Copper Notes* in principal amount equal to 15% of the principal sum at 100% of the principal amount plus accrued interest.

If the average copper price for the preceding eleven-month period is $ .80 or below per pound the **Magma** had the right to offer to holders in lieu of cash an equal principal amount of *Senior Subordinated Notes* due 1998 with a fixed interest rate such that in the opinion of two nationally recognized investment banks chosen by the company the new notes would have a bid value of 101% of their principal amount.

The indenture pursuant to which the *Copper Notes* were issued contained, among other limitations, limitations on the payment of cash dividends and distribution on, and repurchases of the company's capital stock.

Moody's initially rated these bonds as "B1" but raised the rating to "Ba3" in December 1991 as the company lowered its costs and reduced its debt levels.

As copper prices rebounded from their low levels of the 1980s, the interest rate on these bonds steadily climbed. As **Magma** became confident that prices would remain steady through the 1990s, the company eventually decided to retire the bonds in to lower interest expense.

In December 1991, there was a defeasance of the **Magma**'s *Copper Notes*. The company gave notice of the redemption to the holders of the *Copper Notes* on December 31, 1991. The company sold $200,000,000 of 12% *Senior Subordinated Notes* (12% Notes) due 2001, and irrevocably deposited the proceeds and

additional funds into a trust. As provided for under the *Copper Notes* indenture agreement, the notes were redeemed at 108% of the principal amount thereof plus accrued interest on January 31, 1992.

Appendix A.II: Hedging Commodity Price Risk at United Copper Industries (UCI)

United Copper Industries Inc. was formed in a merger from two smaller copper companies: **Mesa Copper Industries** and **Canyon Copper Corporation** in 1976. Following this merger a number of other copper mines that were in poor shape were acquired in the USA and Canada, mostly financed via small equity issues. However, following a proposal from the group's lead investment bank, the company also entered into a number of limited partnerships in the early 1980s for its more mature mines. Limited partnerships were a tax-efficient way of passing income to investors. Exploration and development had not been ignored either, and the company formed a joint venture with a Vancouver-based exploration company to develop the find it had discovered in the Yukon. To finance its share of the partnership, **UCI** issued a 4.5 per cent copper-index note, together with a placing of common shares and a warrant issue.

Following these developments, **UCI** was now in the top five copper producers in North America. Its shares were now actively traded on the American Stock Exchange and it sought to realize its potential. The company had set itself a set of clear strategic goals to be realized over the next five years.

It aimed to become the third largest producer of copper in North America. This probably would entail a number of significant acquisitions in mining, in the US, Canada, but above all in Mexico, given the high potential of that market. **UCI** considered a presence in that market would facilitate sales and the negotiation of long term contracts with users. In this regard, the

Upland project was an important plank in the firm's strategy.

To be successful, the Board considered that sound financial practice and protection from a downturn in copper prices were essential. As a rider, the company considered it was not in the business of speculating on copper prices and hence, taking a view on short-term demand.

The primary business of **UCI** was copper mining and the production of refined copper cathodes or wirebars. The company also had an exploration division that had bought licenses to seek out reserves in promising geological areas. As mentioned earlier, the company was not against using its expertise in joining with other companies to exploit discoveries. At the moment, the company operated five mines, the two that came from the initial merger and three, smaller mines acquired thereafter. One of these was due to close in the near term, having nearly exhausted the deposit. Only if copper prices rose significantly would it pay the company to continue to exploit the poor quality ore and a decision to close was probably imminent. As a result, **UCI**'s output was likely to fall in the near term. The Canadian joint venture was not expected to start producing significant quantities of copper in the coming financial year. The company also had yet to decide whether to proceed with its Upland project, which would more than replace the closure. Upland had great potential, but would require a significant investment and it would be three to four years before the first revenues were generated from the project. It would also only be viable if copper prices remained reasonably buoyant and above the US$1400/ton level.

The volatility of the copper price meant that **UCI** had over the years favored hedging some of its output. Since introducing the decision to hedge, the firm had expanded the ways and means it had used to eliminate the commodity price risk from its

production. The company produced just over 400 000 tonnes per annum. The firm had initially just hedged the immediate production when the outlook seemed to justify it. However, it had gradually extended its approach to having rolling, five-year output targets and a long-term view on the copper price.

Equity analysts who followed the stock considered the company's hedging program to be one of the prime reasons for investing in its shares. The company was often compared favorably with other mining companies for the relative stability of its earnings and cash flow. In 1997, however, due to the increase in share capital the previous year (1996) and the downturn in the industry that started in year (1995), the company had been forced to reduce its dividend from the long-run 60 cents a share to 48 cents - a reduction that had led to much adverse analytical comment and a dive in the share price. Senior management was keen to avoid a repetition of the problem in the future.

The current tools used by the firm to hedge its price risks mostly involved forward and futures contracts. The firm had hedged a very small quantity of its output using options and had also received a number of proposals to use commodity swaps for a part of its production, but had not - as yet - undertaken any transactions of this type. On the liability side, as mentioned earlier, it had issued a copper-indexed note at a time when these were fashionable.

The company particularly liked forward contracts and used these as the basic means by which its price risks were being hedged. The forward market was attractive in two respects. First, the company could lock in buyers to their output up to two years hence and could plan where the delivery was going to take place. Second, although the company knew it was taking counterparty risk in entering the agreement, it was in a position to modify the standard terms and conditions

by mutual agreement. Nevertheless, because of the problem of counterparty risk, less than 10 percent of its annual production was hedged this way. However, because of the attractions, the company was always looking at opportunities to increase its hedging via fixed-price supply agreements.

The company also had a number of long-term contracts with users out to a maximum maturity of seven years, which amounted to 2 per cent of annual capacity in 1997.

UCI was an active hedger with copper futures traded on the London Metal Exchange (LME) and the New York Commodity Exchange (Comex). The firm regularly sold futures against production. Because of the market structure where liquidity was concentrated in the nearby months, selling contracts beyond six to nine months was usually not feasible. To hedge a given exposure, the company had to resort to stack hedges and rolling hedging positions forward - with all the basis risk problems this entailed. The firm was, as was to be expected, an active user of the market and had large structural positions. This required the company to post considerable amounts in margin, both involving internal cash resources and tying up borrowing lines. To manage this activity, the central treasury unit employed two dealers, plus three back-up staff. Positions were monitored daily and adjustments, based on market view and the evolving production and demand outlook were factored into any adjustments. Currently, about 45 per cent of **UCI**'s output was hedged this way.

Whereas futures were used to manage the bulk of the firm's price risks, both forwards and futures fulfilled the same economic function for the company. One of the aspects **UCI** was keenest to examine in any changes that might be contemplated was ways to improve the firm's approach to hedging. The Upland project offered just the opportunity to re-examine the hedging strategy. Furthermore, a number of banks

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were keen to promote a copper-linked commodity swap as a solution. Others, such as Phibro-Salomon, were interested in selling the company long-dated over-the-counter puts on the copper price.

The Upland mine project was situated in Utah, in the Rockies in a find that offered the prospect of recovering about 10 million tons of copper over a 20-year period by means of open-cast mining.

To bring the project on line, **UCI** would be investing about US$100 million in site clearing and preparation, mining equipment and copper refining. As part of the project analysis, **UCI** had prepared a series of long-term forecasts on the copper price. These are based on three scenarios: a bullish increased demand forecast which the company considered the most likely (assigning it to a 0.6 probability in the analysis) where the project had a NPV of $39.3 million; a neutral forecast where demand remained largely constant (given a 0.25 probability) with a NPV of $21.8 million; the bearish forecast (0.15 probability) with a NPV of $10.2 million, envisaging a long-term decline in copper demand.

For the three scenarios given above, the Upland project would be profitable - as measured by its net present value (NPV). However, at prices just below US$1400/ton, the project would be unprofitable.

The questions facing **UCI**'s Board were, first, whether the project's sensitivity to copper and the break-even price were acceptable in terms of future copper price behavior. The Board was also concerned to maintain the company's standing with investors as a mining stock with a stable profit record and a good dividend record (particularly following the previous year's debacle). The second issue was whether the price volatility to an acceptable variability in cash flow from the project. Copper price had been quite volatile and that relying on the spot market might lead the company to experience losses and suffer considerable variations in cash flow from the project - and hence profits - making it less attractive to the firm, and to investors. An examination of the forecasts showed that the impact of the copper price on the annual after-tax cash flow during the maximum extraction phase.

The president felt that the Board would take the view that there were definite attractions in reducing the downside risk on the investment, especially since a fall in the copper price would also affect other parts of the firm at the same time. Other alternatives that were available for operational or financial hedging of the Upland project had already been proposed. As mentioned earlier, some of these had already been used by **UCI** but the company was exploring other, as yet untried, methods which might be more appropriate in the context of the firm's expansion. The alternatives under consideration were:

Enter into a *long-term supply contract* at a fixed price with a consumer;

Sell forward the copper for an agreed period. One investment bank's proprietary product that is available to **UCI** is known as a flat-rate forward where the contango (or the difference between the spot and forward price) was fixed regardless of maturity. Another product, known as a spot deferred, is a forward contract with a floating copper price and no fixed delivery date. It provides more flexibility than a conventional forward contract but without the upfront cost of using an option;

Enter into a commodity swap where **UCI** would receive a fixed price for a given quantity of copper against paying a variable price. The effect would be to synthetically create a fixed selling price;

Hedge the position by using copper futures. This would require the setting up of a stack hedge since futures prices do not extend

beyond about three years. However, lack of liquidity in the longer contracts means that only the shorter-dated contracts would prove practical;

buy a series of copper puts. These would need to cover output over a given period and - as a way of saving money - these could be Asian-style (that is, average rate options over the exercise period).

All the above measures could be used to hedge its exposure fully or partially and could be used in tandem. So **UCI** could both use a commodity swap and buy copper puts if this provided the best alternatives.

The company knew that any hedging decision potentially meant giving up on the upside for the copper price and he was concerned that, given the firm's long-run bullish assessment for copper, hedging - despite its temporary weakness - might prove to be the wrong decision. A decision to hedge might then be something **UCI** would regret.

The market uncertainty surrounding copper, with the price see-sawing daily on the commodities exchanges, did not make this decision any easier. This unsettled behavior made any `no action´ recommendation to the Board even more problematical. The company also wanted to be cautious and not add to the problem of the dividend that had already caused so much external and internal comment. However, locking in the price now might leave the company exposed to the charge that they had inappropriately and unwisely hedged.

As part of the hedging strategy, the Board had to consider how the new hedges should be integrated with existing positions, the use of new instruments (in particular the advantages of options), and extending the hedging period for some of the group's output with a commodity hedge.

The **UCI** case has looked at the issues surrounding the hedging or insuring of a strategic business decision and some of the concerns that managers might have when deciding whether to hedge - or not. As with most business problems there are no hard-and-fast rules for deciding when, what or how to hedge. The issues are more complex than in the first case where the benefit/cost trade-off from the hedge-not hedge decision for a single receivable is more straightforward.

For **UCI** to hedge means guaranteeing a price on the new project's output - and hence profitability - but also means most likely giving up some or all of the opportunity to gain from future price increases. There are also questions as to the risk appetite of the firm and its shareholders and what they would want **UCI**'s managers to do. The instruments available also seem less well adapted to **UCI**'s needs, or are costly. The firm really requires a very long-term hedging instrument. This is not readily available and is likely to involve the company in paying a premium for protection. Providers are likely to impose a significant premium if **UCI** seeks to trade beyond the market's norm for risk management products. Do-it-yourself approaches, such as stacking hedges in futures or dynamic replication, impose significant costs in skill and management time and, in the final analysis, may not deliver the promised outcome.

Source: Moles (1988)

Appendix A.III: Hedging Silver Price Risk at Sunshine Mining Company

Starting in 1985, silver, oil and natural gas suffered a prolonged period of low prices, and, in February 1991, silver prices reached a 17-year low. At December 31, 1991, silver prices were still depressed, with a spot settlement price per ounce of silver as reported by COMEX of $3.88. As a result, the **Sunshine Mining Company** reported consolidated net losses for each of 1985-1991. For the year ended 1991, the company reported a net loss of approximately $40.1 million. The company's operating losses and cash flow deficiencies were likely to continue until silver prices recover. Accordingly, the company began a financial restructuring plan to reduce its debt burden and ensure its future viability.

Pursuant to the restructuring plan, the company sold substantially all of the domestic oil and natural gas properties of its other subsidiaries. The net proceeds received from this sale, after discharge of all of outstanding indebtedness and payment of the related costs of disposal, were approximately $60.0 million. **Sunshine Mining Company** discontinued its remaining oil and natural gas operations and attempted to sell those assets.

On April 9, 1991, **Sunshine Mining Company** completed a tender offer for its *Convertible Subordinated Reset Debentures* due 2008 (the Debentures). Approximately $51.8 million aggregate principal face amount of the Debentures was tendered to the Company in consideration of $600 cash and 200 shares of its common stock, plus accrued interest, per $1,000 aggregate principal amount of each Debenture for a total aggregate purchase price of approximately $32.2 million cash and

10 million shares of common stock. The repurchased Debentures were utilized to satisfy all future sinking fund obligations on the Debentures.

Other than the Debentures the only other outstanding consolidated indebtedness consisted of the silver-indexed bonds issued from 1980 to 1986. These bonds were obligations of its subsidiary, **Sunshine Precious Metals,** and were not assumed or guaranteed by its parent company.[27] Due to the continued depressed price of silver, the operations of the subsidiary and the payments of interest and principal on the *Silver Indexed Bonds* were funded from 1988, primarily by the advancement of funds from its parent company.

As of April 1991, the parent company determined not to advance any additional funds to its subsidiary for the payment of future interest or sinking fund obligations with respect to the *Silver Indexed Bonds*. The non-payment by **Sunshine Precious Metals** of interest or sinking fund obligations with respect to any series of represented an event of default under such series. As a result, payment defaults occurred on all series of *Silver Indexed Bonds*. The aggregate amount of accrued and unpaid interest along with unpaid sinking fund obligations as of December 31, 1991, was approximately $15.6 million for all such series.

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[27] Exploring a new strategy in diversifying commodity price risk, subsidiary issued in 1980 four series of bonds due in 1995 and 2004 that incorporated an option on future silver prices. At maturity or redemption, each bond was payable at the maximum of $1,000 or the market price of between 50 and 58 ounces of silver. These bonds had stated interest rates ranging from 8% to 9.75%, sinking fund requirements, an option of recall by the company, and were collateralized by an interest in the annual mining production of the Sunshine Mine. The bond indentures contained certain restrictive covenants applicable to **Sunshine Precious Metals** including minimum net worth requirements and limitations on the payment of dividends or other distributions on its capital stock, purchases of treasury stock and the issuance of additional silver-backed securities.

The parent and subsidiary believed that a restructuring of the *Silver Indexed Bonds* represented **Sunshine Precious Metals** only viable plan for continuing operations unless there is a significant rise in the price of silver in the near term. Accordingly, in December 1991, the parent company proposed an exchange offer whereby the holders of the *Silver Indexed Bonds* would receive $800 principal amount of a new issue of silver indexed bonds of **Sunshine Precious Metals** bearing interest at an annual rate of 8% (the 8% Silver Indexed Bonds), and shares of which have a market value of $200 for each outstanding $1,000 face amount of *Silver Indexed Bonds* tendered. In addition, each tendering holder would receive additional shares of **Sunshine Mining**'s common stock in satisfaction of a portion of accrued and unpaid interest. Each $1,000 face amount of 8% *Silver Indexed Bond* would be payable at maturity or redemption at the greater of $1,000 or the specified average market price of 85 ounces of silver. Interest on the *8% Silver Indexed Bond* would be payable semi-

annually in cash or, at the option of **Sunshine Precious Metal** and subject to availability if certain conditions are met, in shares of the parent company's common stock. The *8% Silver Indexed Bonds* were redeemable in whole or in part at the option of **Sunshine Precious Metals** at any time in cash or shares of the parent company's common stock at the indexed principal amount together with accrued and unpaid interest.

During 1993, the principal amount of outstanding 8% *Silver Indexed Bonds* was reduced from $57.2 million to $7.6 million through various redemption transactions for **Sunshine Mining's** common stock. As a result of these transactions, the parent company recorded a charge of $12.5 million, representing the loss on an induced conversion, and an extraordinary charge of $13.6 million relating to the redemption of the remaining outstanding bonds.

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Source: SEC 10K Reports of **Sunshine Mining.**

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