DISCUSSION PAPER SERIES

No. 4889

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INTERNATIONAL MACROECONOMICS

Centre for Economic Policy Research

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Available online at: **www.cepr.org/pubs/dps/DP4889.asp**

ISSN 0265-8003

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Discussion Paper No. 4889
January 2005

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CEPR Discussion Paper No. 4889

January 2005

ABSTRACT

Credit Crunch and Keynesian Contraction: Argentina in Crisis*

The Argentine convertibility regime, where the peso was fixed at parity with the US dollar, ended with a 'twin crisis' – a tripling in the price of a dollar and a protracted closure of the entire banking system – accompanied by an economic contraction so severe that it is often referred to as *'Nuestra gran depresión'*. But the government's attempt to imitate President Roosevelt by pesifying dollar loan contracts (while simultaneously protecting dollar depositors) had the effect of destroying bank net worth in the absence of credible compensation. To analyse the macroeconomic effects of credit crunch and currency collapse (and of policies to mitigate them), we turn to a model of crisis, specifically that of Aghion, Bacchetta & Banerjee (2000). Our account, however, combines the supply contraction cause by balance sheet effect with a Keynesian demand contraction due to a domestic credit crunch, exacerbated by unsuccessful resolution of the banking crisis. The latter is analysed as a game of political economy played between government and banks about who pays for the banking crisis induced by default and asymmetric pesification.

JEL Classification: E12, E51, F34 and G18
Keywords: Argentina debt crisis, asymmetric pesification, conflicting beliefs, Keynesian recession and twin crisis

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*We are grateful to the ESRC for financial support supplied to the research project RES-051-27- 0125 ‘Debt and Development’ and to Elba Roo for research assistance funded in part by the CSGR. We thank Lisandro Barry, Mario Blejer, Luis Céspedes, Guillermo Escude, Matthew Fisher, Daniel Heymann, Daniel Laskar, Santiago Acosta Ormaechea, Andrew Powell and Klaus Schmidt-Hebbel for helpful suggestions; but responsibility for views expressed is our own.

Submitted 19 January 2005

Non-technical Summary

Introduction

For emerging market economies, the initial impact of sharp devaluations is often contractionary; and the most likely causal mechanism is currency mismatch in corporate balance sheets, (Frankel, 2004). Economies which are relatively closed with substantial borrowing denominated in dollars are particularly vulnerable to a sudden stop in capital flows: dollar loans to the nontraded sector will be mismatched and the exchange rate adjustment needed to service dollar debts will be large. Moreover, the vulnerability can itself trigger sudden stops in capital flows, as pointed out by IADB in its 2005 Report on Economic and Social Progress in Latin America.

Balance sheet effects hit non-financial companies directly; but banks can also act as a potent transmission mechanism if they suffer from adverse balance sheet effects, for the knock-on effects of the credit crunch can spread widely throughout the economy. This is especially true in Latin America, where banks play a central role in corporate financing (IADB Report, 2005, Introduction).

Recent events in Argentina have provided stark evidence of these risks and vulnerabilities. The economy was relatively closed, there was widespread currency mis-match (about two thirds of corporate borrowing in dollars) and the currency was tied to a dollar that rose strongly against key markets for Argentine exports. The 'convertibility' regime, where the peso was fixed at parity with the US dollar, ended with a 'twin crisis', involving a tripling in the price of a dollar and a protracted closure of the entire banking system, and an economic contraction so severe that it is referred to locally as "Nuestra gran depresion".

Even before the convertibility regime ended, the economy had been badly weakened. A decade of pegging to a strong dollar had squeezed profits and ended growth; and the government itself, with large dollar debts secured on a narrow tax base of largely domestic producers, was a major source of currency mismatch. The failure to banish the spectre of fiscal insolvency had eroded market confidence, raising sovereign spreads and weakening investment; and the vulnerability of both government and banks led to draining capital flight and deposit withdrawals.

When the peg finally collapsed, President Duhalde's bold attempt to imitate Franklin Roosevelt by pesifying dollar loan contracts, while simultaneously protecting dollar depositors, had the effect of destroying bank net worth as government promises to recapitalise lacked credibility. So the banking system closed down and the economy was thrown into a depression.

Gerchunoff and Llach (2003) provide a graphic history of these events and a balanced account of conflicting interpretations of the crisis is provided by Sgard (2004). The aim of this paper is not, however, to debate why convertibility ended; it is rather see how, i.e. to study the process of collapse and the proximate events that threw the country into depression when the end came.

Using an explicit model

A dynamic analysis of balance sheet effects is included within the comprehensive two-sector New Keynesian framework developed by Escude (2004), where exports are sold in euros while debts are contracted in dollars. With sticky wages and service prices, dollar appreciation causes unemployment and leads to a sudden stop in capital flows, followed by devaluation and default. This inter-temporally optimising two-sector approach has its attractions, but the continuous-time dynamic system is complex even without taking account of the investment demand and their capacity effects.

Aghion, Bacchetta and Banerjee (2000) (hereafter ABB) provide a framework which offers a neat characterisation of output and exchange rate determination in a small open economy producing a traded good. One-period of price stickiness for the traded good is enough to yield adverse balance sheet effects where a fall in the exchange rate induces a supply-side contraction as investment is cut back, reducing productive potential in the next period. There is goods market clearing and international asset arbitrage; but the multiplicity of equilibria opens up the possibility of sudden shifts in the exchange rate (an effect analogous to that of a Sudden Stop).

While the authors have subsequently gone on to include more detail on the role of banks, they explicitly assume that "...banks have enough assets not to fall into insolvency in case a currency crisis occurs." (Aghion, Bacchetta and Banerjee 2004, p15). That this is not appropriate for Argentina in 2002, we show by calculating the

adverse effect of default, devaluation and asymmetric pesification on banks' balance sheets. It is suggested that an interesting extension would be to incorporate bank currency exposure, where currency depreciation can results in disruption of lending so that "... the credit multiplier μ may be reduced ..." (Aghion, Bacchetta and Banerjee, 2004, p28). In this paper we use the basic model of ABB, modified to allow for changes in the credit multiplier.

Another modification is to allow for a Keynesian demand-side recession. In the ABB framework output is essentially supply determined: it is a small open economy model where net exports always bring demand into line with supply. So a fall in investment, for example, leaves current period output unchanged but reduces output in the next period. But when investment collapsed in Argentina after devaluation and default in 2001/02, output also fell sharply. Allowing for the demand-determination of output in the period of collapse provides a richer framework for studying open economy crises in general — a blend of the demand-side approach of Krugman (1999), Céspedes *et al* (2003,2004) and the dynamic supply-side account of ABB. It also allows one to capture more realistically what happened in Argentina. We show, for example, that, when it causes a demand side recession, tight monetary policy is less likely to strengthen the currency.*

This eclectic approach is used to show first how pesification can, in principle, mitigate adverse balance sheet effects; but how, mishandled, it can plunge the economy into chaos. For when debt relief for corporations is achieved by making banks bankrupt, the outcome can well be counter-productive, as the collapse of the banking system leads to a reduction in the credit multiplier, less investment and less output.

Unfortunately, the prompt action taken by the Duhalde government to recapitalise the banking system lacked credibility, and led to paralysis of the banking system, leaving the country without credit for one year and a half. How could this outcome have been avoided? One possible strategy was asymmetric pesification at a rate of 1.2. Under this policy, depositors would be given some help and so too would producers: and the hits on bank net worth would be smaller.But whether this was politically feasible is debatable.

*Technically, if output in crisis period is demand-determined, an increase in the interest rate will lead to a currency depreciation relative to that predicted by the ABB model.

The policy approach recommended by the IADB, on the other hand, would imply a more selective debtor bail-out; and a greater political commitment by the government to meeting the costs of recapitalisation. The IADB Report of 2005 cites with approval the actions taken later by Uruguay when it faced a similar crisis. (In due course Argentine banks have reopened, the economy is recovering and the government is paying compensation.)

Conflicting Beliefs and Asymmetric Pesification

To address the question posed by Gerchunoff and Llach (2003) "Why the catastrophic collapse of a financial system that had attracted great praise and enjoyed popular support until the last moment?", we use a game theoretic approach involving differences of belief.

For historical reasons outlined by della Paolera and Taylor (2003), the government could well have believed that actions which render banks technically insolvent would be acceptable if accompanied by the promises of future compensation: but branches and subsidiaries of multinational banks answerable to overseas managers would not be able or willing to accept such promises. The IADB Report (2005), for example, observes that "the combination of all the measures taken by the government implied a breach of existing contracts and significant legal uncertainty, which prompted the headquarters of foreign banks to deny financial support to their branches and subsidiaries. By mid-2002 the banking system was completely inoperative..." (p80).

In a sequential game between government and banks, we show how differences of belief about the nature of the banks (and of the acceptability of government promises) can lead to catastrophic errors of policy.

Capital flight

Before concluding, the paper contains a brief discussion of capital flight. It is widely agreed that Argentina should have devalued earlier, but the then government was desperate that the peg should not fail. In these circumstances it should have been warned of the need to limit capital outflows — advice inconsistent with the IMF's commitment to financial liberalisation. The result was open capital account, with bank runs and the flight of reserves supplied by IMF lending, now being repaid

at a much higher resource cost than had been anticipated.

Conclusion

As Francoise Sgard (2004) notes in an elegant survey of opinions, the case of Argentina — where a currency peg came to such a spectacular end — will doubtless be debated for years to come. Here we try to show how existing models of crisis in emerging markets can — with modifications — help to throw some light on the issue.

¿Por qué cayó la Argentina en la mayor crisis económica de su historia? ¿ Por qué acabó tan catastróficamente un sistema monetario que en el algún momento había despertado los mayores elogios y un apoyo popular que se prolongó hasta su final?[1]

Gerchunoff & Llach (2003)

I Introduction

In one key respect the currency board system implemented in Argentina in 1990 proved extraordinarily successful: hyperinflation was promptly replaced by price stability. But it proved to be unsustainable.

In an empirical study of the end of Convertibility, Powell (2003) indicates four reason for this. He cites growing doubts about long-run *fiscal sustainability*[2]; the progressive *loss of competitiveness* of the Argentine economy over the decade that its currency was tied to the US dollar; *political risk* stemming from the split in the Peronist party in Menem's second term and the weakness of Alianza; and, finally, a *shift between multiple equilibria.*Econometric evidence leads him to the conclusion that "political risk, playing together with the mild level of required adjustment in the fiscal accounts, put Argentina into a bad equilibrium from which it did not escape without eventual devaluation and default" Powell (2003).

Gerchunoff & Llach (2003) provide a graphic history of these events; and balanced account of conflicting interpretations of the crisis is provided by Sgard (2004). The aim of this paper is not, however, to debate *why* convertibility ended [3]; it is rather to see how; i.e. to study the process of collapse and its economic consequences for the end of the dollar peg did not simply involve delayed devaluation and debt restructuring; it took the form of a full- blown financial crisis where the collapse of the exchange rate and the paralysis of the banking system precipitated an Argentine Great Depression, Blejer (2003) and Sturzenegger (2003).As Krueger & Fisher (2003) ruefully observe,

[1]Why has Argentina collapsed in the worst economic crisis in its history? What brought to such a catastrophic end a monetary system that had attracted great praise and enjoyed popular support until the last moment?

[2]See also Mussa (2002).

[3]A subject we examine in a parallel paper, Fronti, Miller & Zhang (2002)

"the combination of a highly dollarised banking system and a rigid exchange rate regime can result in vulnerabilities that are difficult to manage".

Frankel (2004) reports that, for emerging markets, it is common for a sharp economic contraction to follow on the heels of devaluation, a result that he attributes to the adverse balance sheet effects of dollarised liabilities. In a Keynesian model of open economy with sticky prices Céspedes, Chang & Velasco (2004) discuss the balance between increased competitiveness and adverse balance effect following devaluation: and suggest that a highly dollarised economy will be subject to contraction. In their analysis of Sudden-Stops, Calvo, Izquierdo & Talvi (2003) emphasise the destabilizing role of dollar borrowing in the non-traded goods sector in achieving sustainability. (Where liability dollarisation is high and export shares are low, the real exchange rate which rebalances the current account assuming internal balance is maintained implies a large devaluation.)

A dynamic analysis of such balance sheet effects is included within the comprehensive two-sector New Keynesian framework developed by Escude (2004), where exports are sold in euros while debts are contracted in dollars. With sticky wages and service prices, dollar appreciation causes unemployment and leads to a sudden stop in capital flows, followed by devaluation and default. This inter-temporally optimising, two-sector approach has its attractions: but the continuous-time dynamic system is complex even without taking account of the investment demand and their capacity effects.

Aghion, Bacchetta & Banerjee (2000), hereafter ABB, provide a framework which offers a neat characterization of output and exchange rate determination in a small open economy producing a traded good. [4] One-period of price stickiness for the traded good . is enough to yield adverse balance sheet effects where a fall in the exchange rate induces a supply- side contraction as investment is cut back, reducing productive potential in the next period. There is goods market clearing and international asset arbitrage; but the multiplicity of equilibria opens up the possibility of sudden shifts in the exchange rate (an effect analogous to that of a Sudden Stop). While the authors have gone on to include more detail on the role of banks, they explicitly assume that "...banks have enough assets not to fall into insolvency in case a cur-

[4]This device is one way of capturing price stickiness achieved in Escude in a two sector model.

rency crisis occurs." (Aghion, Bacchetta & Banerjee (2004, p15)). That this is not appropriate for Argentina in 2002, we show in section II by calculating the adverse effect of default, devaluation and asymmetric pesification on banks' balance sheets. It is suggested that an interesting extension would be to incorporate bank currency exposure, where currency depreciation can result in disruption of lending so that "... the credit multiplier μ may be reduced..." (Aghion, Bacchetta & Banerjee (2004, p28)). In this paper we use the basic ABB model, modified to allow for changes in the credit multiplier.

Another modification made here is to allow for a Keynesian demand-side recession. In the ABB framework output is essentially supply determined: it is a small open economy model where net exports always bring demand into line with supply. So a fall in investment, for example, leaves current period output unchanged but reduces output in the next period. But when investment collapsed in Argentina after devaluation and default in 2001/02, output also fell sharply. This can be seen from the data for Argentine GDP and its components during the 2001/02 crisis shown in Table 1 measured in billion pesos at both 1993 prices (upper panel) and at current prices (lower panel).

It is clear from the table that the recession in Argentina began before the crisis of 2001/02 (see upper panel column two): from the peak in 1998 output fell by some 2% or 3% per annum over the next three years. With devaluation and default in 2001/2, however, output collapsed by more than 12% in one year, with private consumption falling by 14%, investment by more than a third but exports remaining more or less constant[5](see upper panel).

Allowing for the demand-determination of output in period of collapse, see section III, allows one to capture more realistically what happened in Argentina; it also provides a richer framework for studying open economy crises in general — a blend of the demand-side approach of Krugman (1999) or Céspedes *et al* (2003, 2004) and the dynamic supply-side account of ABB.

[5]As imports volumes halved, exports-net-of-imports rose by about 16 bn pesos at constant prices and by 42 bn pesos at current prices, indicating a substantial real exchange rate effect between traded and non-traded goods which we discuss further below.

Table 1: GDP in Argentina from 1997 to 2003.

GDP in constant prices (bn peso)[a, b]							
Year	GDP	Consumption (private)	Consumption (public)	Investment	Exports	Imports	Statistical error
1997	277.4	190.9	34.1	57.0	27.9	35.9	3.4
1998	288.1	197.6	35.2	60.8	30.8	38.9	2.6
1999	278.4	193.6	36.2	53.1	30.4	34.5	-0.5
2000	276.2	192.3	36.4	49.5	31.3	34.5	1.2
2001	264.0	181.3	35.6	41.7	32.1	29.7	2.9
2002	**235.2**	**155.3**	**33.8**	**26.5**	**33.1**	**14.8**	**1.3**
2003	256.0	168.0	34.3	36.7	35.1	20.4	2.4
GDP in current prices (bn peso)[c]							
1997	292.9	203.0	35.3	56.7	30.8	37.4	4.4
1998	298.9	206.4	37.4	59.6	31.0	38.7	3.2
1999	283.5	198.9	38.9	51.1	27.8	32.7	-0.4
2000	284.2	197.0	39.2	46.0	30.9	32.7	3.8
2001	268.7	185.2	38.0	38.1	31.0	27.4	3.9
2002	**312.6**	**193.5**	**38.2**	**37.4**	**86.6**	**40.0**	**-3.1**
2003	375.9	237.6	43.0	56.9	93.9	53.4	-2.0

[a, c] Source: Ministerio de Economía Argentina.

[b] All quantities reported are in 1993 prices.

In section IV this eclectic approach is used to show first how pesification can, in principle, mitigate adverse balance sheet effects[6]; but how, mishandled, it can plunge the economy into chaos. In section V, to help to understand the genesis of the financial crisis, we employ a game of conflicting beliefs, where the government misunderstands the response of the banks to asymmetric pesification. Before concluding, there is a brief discussion of capital flight in section VI.

[6]Some argue, however, that the contractual structure was so dollarised that this mitigating effect could be small, see Galiani, Heymann & Tommasi (2002).

II Bankrupting the banks

After Mr de la Rua's resignation, the country was plunged into political chaos as Congress elected three successive presidents in two months. A degree of political stability was regained at the beginning of January 2002 when Eduardo Duhalde was appointed president. Among its first economic measures, the government he headed devalued the peso and started the process of '*pesification*' of the whole economy. Unexpectedly, the government adopted a differential conversion rate which effectively destroyed banks solvency. According to Sturzenegger (2003, p49) this was a political decision to privilege companies that had dollar loans in the local market, without imposing the full costs on those with dollar deposits in local banks. We argue that the choice of the asymmetric pesification can be explained by the government's desire to protect producers with dollar loans *together with* mistaken beliefs about bank behaviour (i.e., there was a policy error).

The specific plan of asymmetric pesification (AP) was outlined in the Government decree on February 3rd, 2002 (Decreto No 214/2002). Articles 2 and 3 mandate the pesification of dollar deposits at a rate of 1:1.4 and dollar loans at a rate of 1:1. Article 7 decrees that the hole in bank balance sheets caused by the asymmetric pesification be financed by issuing government bonds. Our calculation of the losses to the banks as result of asymmetric pesification, together with the write-down of sovereign bonds held by banks, to be about $17bn. The finance minister pointed out reassuringly that, by pesifying existing sovereign debt held by pension funds and as well as banks, the government could reduce its liabilites by the equivalent of $16bn: so, it was argued, *bank recapitalisation was affordable for the government* (Remes Lenicov *et al* in Diez, 2003). But there is a clear "time consistency" problem here: how credible are promises of a government which offers new bonds "financed" by default on existing bonds?

II.1 Pesification and Banks' Net Worth

In examining how a collapse of the peso could lead to banking collapse, we look at the impact of the rising price of the dollar on the net worth of the banking sector, ignoring, for the present, promises of compensation. As a baseline, we note that if

there is no interference with bank portfolios — which were long in the US dollar in 2001 — bank net worth rises as the peso falls. Second, we consider the case of *asymmetric pesification* (AP) with a conversion rate for loans of one dollar to one peso and for deposits of one dollar to 1.4 pesos, then there is a loss of net worth: at the dollar/peso exchange rate of 1.4 for example, banks will lose the 0.4/1.4 of the value of their dollar lending to the private sector. Thirdly, we assume that — in addition to the asymmetric pesification — bank's holdings of government debt are also pesified at the rate of one to 1.4 (so the government partially defaults on its dollar obligations). The impact on balance sheet totals for December 2001 are reported in Appendix A: the broad effects can be seen with the aid of Figure 1 below.

Formally, under the first assumption that there is no interference to banks' portfolios, the net worth of banks measured in pesos is given by

$$N \quad = \quad E(B + X + L - D) + P, \tag{II.1}$$

where N denotes the net worth of banks, E the dollar/peso exchange rate, B the level of dollar-denominated sovereign bonds held by banks, X the net external dollar balance for the banks (negative in this case), L the dollar-denominated loans and P the net peso balance for banks. With asymmetric pesification, banks' net worth becomes

$$N' \quad = \quad E(B + X) + L - \bar{E}D + P, \tag{II.2}$$

where $\bar{E} > 1$ is the rate at which dollar deposits are converted into pesos. Introducing partial default by the government further worsens the banks' net worth as banks' holdings of government guaranteed dollar debt are also converted into peso at the rate $\bar{E}$:

$$N'' \quad = \quad \bar{E}B + EX + L - \bar{E}D + P. \tag{II.3}$$

These three outcomes are shown as schedules in Figure 1, with the dollar value of the peso plotted on the horizontal axis. In the figure we assume $L = D = 40$, $B = 25$, $X = -10$ and $P = 0$ (as an approximation to the consolidated financial statements shown in the appendix). With the peso at one-to-one with the dollar, bank net worth is shown initially at 15 on the vertical axis; and, with banks long in the dollar, this increases with the price of the dollar as shown by the schedule N. The effect of AP is to cut the banks net worth by $0.4L = 16$, so the net worth schedule moves down

to N' in the figure. If, in addition, the Government pesifies the banks holdings of its own dollar debt, then the banks are exposed to losses as the dollar rises in value and their net worth is shown as the downward-sloping schedule N'' (which intersects with N' at $E = 1.4$).

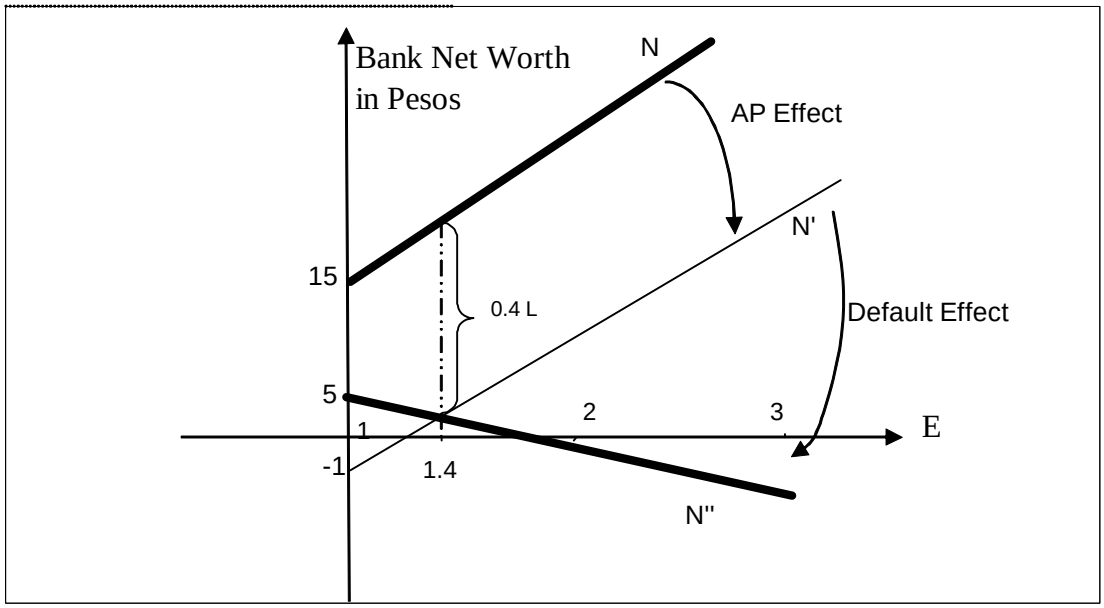

Figure 1: Effects of asymmetric pesification and default on banks' net worth.

The potentially devastating impact that these measures can have is shown in Figure 1 where asymmetric pesification and the write-down of bonds reduces net worth below zero as the dollar moves above 2 pesos.

As noted above, the government did mandate the prompt recapitalisation of banks balance sheets.[7] The issue of how credible the promised compensation might have appeared is discussed further in Section IV in a policy game with two types of banks — one which trusts the government and the other which does not. In the next section we analyse the macroeconomic effects of devaluation and a credit crunch.

[7] Assuming fully credible recapitalisation of the AP of loans and deposits, net worth would amount to about \$6bn as opposed to \$16bn before devaluation and default.

III An eclectic model accompanied by crisis

III.1 ABB's supply-side model: a brief outline

The macroeconomic model of ABB is designed to capture the balance sheet effect on private sector investment of an exchange rate collapse in a small open economy. Before indicating the modifications we introduce to take account of developments in Argentina, we briefly outline the central elements of this popular two-period model.

During period 1 prices are preset but other variables such as the nominal interest rates and the nominal exchange rate adjust at unanticipated shock which leads to a ex-post deviation of PPP. There is full capital mobility and uncovered interest parity holds. The actual timing of the events in period 1 is: first the price is preset according to ex ante PPP condition and firms invest; then there is an unanticipated shock followed by the adjustment of interest rates and the exchange rate; subsequently, output and profits are generated, and a fraction or retained earnings after debt repayment is saved for investment in period 2, which determines the level of production. In the second period, there are no shocks and prices are flexible so PPP prevails.

The equilibrium in this model can be summarised by the intersection of two schedules, called the IPLM curve and the W curve. As the name suggests, the former is a combination of the Uncovered Interest Parity, money market equilibrium and the PPP condition for the second period. Formally, it is written as:

$$E_1 \quad = \quad \frac{1+i^*}{1+i_1}\frac{M_2^S}{L(Y_2,\bar{i_2})} \tag{III.1}$$

where E_1 is the exchange rate for the first period, i^* is the foreign interest rate, i_1 and $\bar{i_2}$ are domestic interest rates for periods 1 and 2, M_2^S and Y_2 are money supply and output in period 2, and $L(Y_2,\bar{i_2})$ is the money demand function. This IPLM curve is downward sloping in the E_1 and Y_2 space because higher output in the second period increases money demand (i.e., higher L given interest rate in period 2) and so strengthens the exchange rate (note M_2^S is given).

The W-curve characterises the supply of output on the assumption that entrepreneurs are credit-constrained. (The production function is assumed to be linear in capital stock, which depreciates completely at the end of the period.) The total

investment for a given firm consists of last period retained earnings and borrowing (in terms of domestic and foreign currencies and with their fractions given exogenously) which is limited to a given fraction $\mu_t(i_{t-1})$ of the retained earnings. The introduction of $\mu_t(i_{t-1})$, the credit multiplier (with $\mu_t^{'} < 0$), captures credit market imperfection. The W-curve is specifically given by

$$Y_2 = \sigma[1 + \mu_2(i_1)](1 - \alpha)\left[Y_1 - (1 + r_0)D^C - (1 + i^*)\frac{E_1}{P_1}(D_1 - D^C)\right] \qquad \text{(III.2)}$$

where σ is the productivity parameter, α is the fraction of output consumed in each period, D_1 is the total borrowing in period 1, and D^C is its domestic currency component. The so constructed W-curve is a downward sloping straight line in E_1 and Y_2 space because currency depreciation increases firm's debt burden and reduces output. The above formulation also captures explicitly the balance sheet effect of the exchange rate. (Note that Y_2 is set to zero if the right hand side of (III.2) turns out to be negative.)

In the ABB model, tight monetary policy in period 1 has an ambiguous effect on E_1 since both IPLM and W curves shift to the left after an increase in i_1, but the effect of tight money on the exchange rate depends on the *relative* sensitivity of Y_2 to i_1 in (III.1) and (III.2). In what follows, we show that tight money in period 1 is more likely to lead currency depreciation when period 1 income is demand-determined.

For period zero, we indicate in Appendix B how to incorporate the high ex-ante country spread on sovereign debt and the "crowding out" of public expending under policies of zero deficit and the contractionary effect of the asymmetric pesification. In addition, we introduce a proportional corporate tax and country risk premium. Here we discuss the two major modifications proposed in this paper: first the fall of demand below supply in response to the financial crisis, and second the contraction of the credit multiplier as banks' balance sheets suffer from devaluation.

III.2 Demand-determined output and credit crunch

In the ABB model, an unexpected currency collapse in period 1 lowers output in period 2: but it leaves output in period 1 unchanged. The Argentine data presented in Table 1, however, show that GDP collapsed at the same time as the currency, with

investment showing the largest percentage fall.

The simplest way to capture this while retaining other features of the model is to assume what is shown in Table 1, namely that export volumes remain unchanged. A key justification for this is discussed in Kohlscheen & O'Connell (2004), namely the restriction of the trade credit as punishment strategy by external creditors faced with Argentinean default on sovereign debt. It was in their strategic interest to limit the expansion of exports.[8] As a consequence output in period 1 maybe is demand-determined, i.e., the fall of investment can cut current output and consumption.

Specifically, let output in period 1 be determined as follows:

$$Y_t^D = \gamma\alpha[Y_t - D_t^* + f(E_t/P_t)] + (1+\mu_{t+1})(1-\alpha)[Y_t - D_t^* + f(E_t/P_t)] + \bar{X} - mY_t, \quad \text{(III.3)}$$

where Y_t is aggregate demand measured in constant prices. In defence of this specification, note that, in the midst of a credit crunch and bank closures, both consumers and producers were effectively denied access to new credit. The first term on the right hand side of (III.3) indicates consumption demand where $\alpha < 1$ is the labour share of income and $\gamma < 1$ is its fraction spent on consumption. The second term is demand for investment with $Y_t - D_t^* + f(E_t/P_t)$ representing corporate profits (here, Y_t is the output measured in constant prices not corrected for the real exchange rate effect, D_t^* is the debt repayment for the borrowing, and $f(E_t/P_t)$ is the terms of trade effect on net exports[9]), and μ is the credit multiplier. The last two terms represent net exports, where we assume export volumes are fixed in the current period while imports vary proportionally with current income, as the data above suggest is appropriate. The failure of export volumes to rise means that a collapse of investment (due to balance sheet effects, for example) can reduce realised output in the current period as well as supply potential in the next period.

To simplify the treatment, we follow ABB by letting $D_1^* = (1 + r_0)D^C + (1 +$

[8]Other factors include contract lags and physical capacity constraints: the export response to the spectacular fall of the Indonesian currency in 1997/98 was considerably hampered by lack of container shipping capacity, for example.

[9]As is clear from Table 1, both export and import prices moved in sympathy with the price of the dollar in 2002, and exchange rate "pass through" which is assume to be zero in the ABB model.

$i^*)(E_1/P_1)(D_1 - D^C)$ and treating f as a constant. Solving (III.3) for period 1 yields

$$\begin{aligned} Y_1^D &= \frac{[\gamma\alpha + (1+\mu_{t+1})(1-\alpha)][-D_1^* + f(E_1/P_1)] + \bar{X}}{1 + m - [\gamma\alpha + (1+\mu_{t+1})(1-\alpha)]}, \\ &= \frac{\xi[-D_1^* + f(E_1/P_1)] + \bar{X}}{1 - \xi + m} < Y_1^S, \end{aligned} \tag{III.4}$$

where $\xi = \gamma\alpha + (1+\mu_{t+1})(1-\alpha)$ and $1 > 1 - \xi + m > 0$, Y_1^S is the aggregate supply in the same period. The Keynesian style multiplier on exports is simply $1/(1-\xi+m)$, where ξ is the marginal propensity to spend and $1-\xi$ the marginal propensity to save. Note that

$$-D_1^* + f(E_1/P_1) = -(1+r_0)D^C - (1+i^*)(E_1/P_1)(D_1 - D^C) + f(E_1/P_1). \tag{III.5}$$

So as long as foreign currency borrowing is relatively large, i.e., $(1+i^*)(D_1 - D^C) > f$, a devaluation will reduce aggregate demand. In Chile, where only 20% of debt in traded sector is dollarised — and none in the non-traded sector — the terms of trade effect could well dominate the balance sheet effect; but in Argentina, with wide-spread dollarisation and around 2/3 of debt in dollars in both sectors IADB (2004, p.53), it is reasonable to assume that this condition is satisfied.[10]

Figure 2 illustrates aggregate demand and supply in period 1 where the horizontal axis represents output and the vertical the exchange rate. Period 1 aggregate supply appears as a vertical line Y_1^S since it depends on output and interest rate in the previous period. Given relatively large foreign currency borrowing, (III.4) traces a downward sloping aggregate demand schedule Y_1^D. An increase in the period 1 interest rate will shift Y_1^D leftwards and rotate it anti-clock-wise as high interest rates reduce the credit multiplier and investment demand.

Table 2 compares and contrasts the determination of output in our specification with that of the standard ABB model, where output is supply determined as indicated in the first column. For the latter, an adverse devaluation-induced shock to the balance sheet in period 1 has no effect on period 1 output (which is determined by previous period investment), but reduces period 2 output through reduced capital accumulation. Unlike the ABB model, we assume that the quantity of exports cannot

[10] See Céspedes, Chang & Velasco (2003) for discussion of the tradeoff between competitiveness and balance sheet effects in emerging market economies.

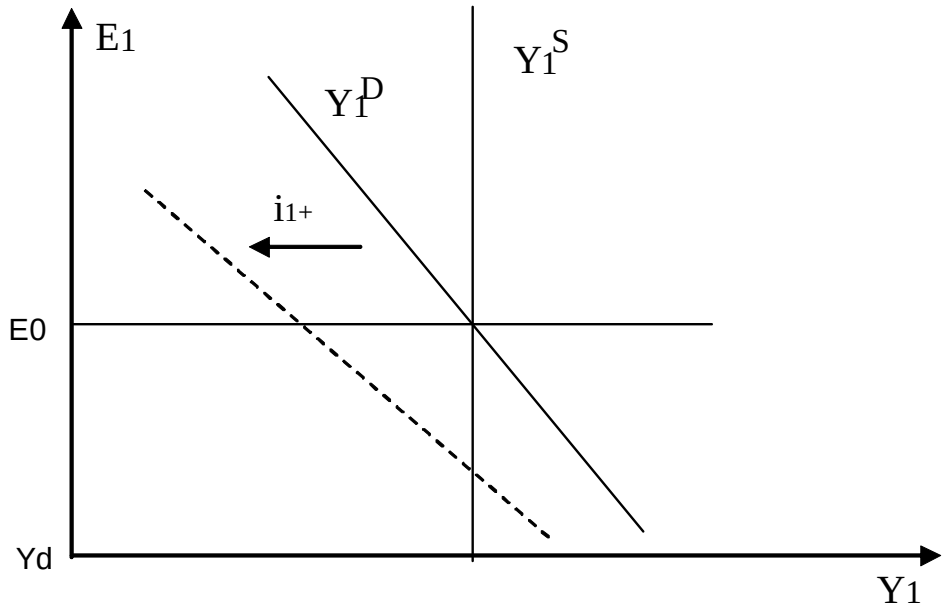

Figure 2: Aggregate demand and supply in period 1.

adjust within period to maintain the balance of demand with supply. If the positive real exchange rate effect coming from the revaluation of the net exports is not large enough to compensate for the balance sheet effect (as assumed above), then aggregate demand contracts with devaluation, leading to a fall in period 1 output (see the upper entry in column 2).

The table can also be used to show how the credit crunch may have an impact on current period output. Consider, for example, a contraction in the credit multiplier μ_2 due to asymmetric pesification leading to bank closures in period 1. In the ABB

Table 2: Comparison with the ABB model.

	ABB model	MFZ modification
Y_1	$Y_1^s = \sigma[1+\mu_1(i_0)](1-\alpha)[Y_0 - D_0^*]$	$Y_1^D = [\gamma\alpha+(1+\mu_2)(1-\alpha)]\times[Y_1 - D_1^* + f(E_1/P_1)] + \bar{X} - mY_1$
	$Y_1 = Y_1^s = Y_1^D$	$Y_1 = Y_1^D < Y_1^s = Y_1^s(ABB)$
Y_2	$Y_2^s = \sigma[1+\mu_2(i_1)](1-\alpha)[Y_1 - D_1^*]$	$Y_2^D = Y_2^s < Y_2^s(ABB)$

model, the impact on output is delayed until period 2 as can be seen from column 1 (which is presumably why the credit multiplier carries the label 2). With Keynesian demand determination, however, the effects are more immediate and more damaging. The tightening corporate credit constraints reduces investment in period 1 directly. But this exogenous fall in demand triggers a contraction of income in period 1, which in turn leads to even less investment as profits fall. The knock-on effect on period 2 supply is consequently greater than in the ABB model.[11] Note that the effects of the contraction of μ will in part be offset by the pesification of some corporate dollar debt. On balance, however, we take net effect to be contractionary.

To see how adding Keynesian demand in period 1 alters a key policy implication of the ABB model, we introduce the following proposition:

Proposition 1 *If output in period 1 is demand-determined, as specified in (III.4), an increase in period 1 interest rate will lead to a currency depreciation relative to that predicted by the ABB model, i.e., when it causes a recession, tight monetary policy is less likely to strengthen the currency.*

Proof: As noted above, the equilibrium of (Y_2, E_1) is given by the intersection of (III.1) and (III.2) with Y_1 in (III.2) being replaced by Keynesian demand given in (III.4). The proposition is true if an increase in i_1 induces more leftward shift to Y_2 in our specification than that in the ABB's, i.e.,

$$\left.\frac{\partial Y_2}{\partial i_1}\right|_{MFZ} < \left.\frac{\partial Y_2}{\partial i_1}\right|_{ABB}. \tag{III.6}$$

Differentiating Y_2 in (III.2) with respect to i_1 (with Y_1 replaced by Y_1^D from (III.4)) yields

$$\left.\frac{\partial Y_2}{\partial i_1}\right|_{MFZ} = \frac{\mu_2'(i_1)}{1+\mu_2(i_1)} Y_2 + \sigma(1+\mu_2)(1-\alpha)\frac{\partial Y_1^D}{\partial i_1}.$$

where the first term on the left hand side is what we would have obtained if we use ABB specification, and the second term gives the additional effect because the output in period 1 is demand determined. As is clear from (III.4) that $\partial Y_1^D/\partial i_1 < 0$, so (III.6) must hold.

[11] Cutting μ_1, credit multiplier corresponding to period 0, would, however, have same effects on period 1 supply in both models.

In the table and in the analysis that follows, we assume for convenience that output in period 2 is supply-determined as the volume of exports can adjust freely from period 1 to period 2 because, say, external creditors relax the constraint on trade credit, see lower entry in column 2. Although it might appear that output in period 2 would match that of the ABB model, this is not true: the contraction in period 2 supply is greater because of the reduced investment period 1 associated with the fall in aggregate demand. (The simplifying assumption made by ABB that capital depreciates completely within one period dramatically highlights this effect, but is surely an exaggeration.) Of course, if exports fail to respond sufficiently promptly, output may also fall below supply in period 2 as well.

IV Analysing the Argentine crisis

In using the modified ABB model to help explain how "Argentina passed from being one of the world's fastest growing economies in the 1990s to suffering one of the sharpest recessions of any peace-time capitalist economy since the Second World War" (Gerchunoff & Llach 2003, p456), it is convenient to identify three separate periods: Pre-collapse (approximately 2001); Currency Collapse and Depression (approximately 2002); Continued Depression (2003), which are referred to as Period 0, 1 and 2 respectively.

Inter-bank interest rates from begining of 2000 to September 2004 are shown in Figure 3 (monthly average of the BAIBOR 30 days in pesos: data for Dec 2001, Jan 2002 are not available).

IV.1 Currency collapse and Keynesian Depression

The proximate trigger for economic collapse was probably the IMF announcement in December 2001 that the country would not receive the $1.3 bn of financial support that the government had requested to cover debt payments (Financial Times, Dec. 2001; (Diez 2003, p126)). The lack of financial support was followed by restrictions on the withdrawal of bank deposits. This led to a rapid spread of street demonstrations, lootings of supermarkets and a general strike with "country risk" rising substantially to 50%. The domestic turmoil forced de la Rua to resign the presidency on the 20th of

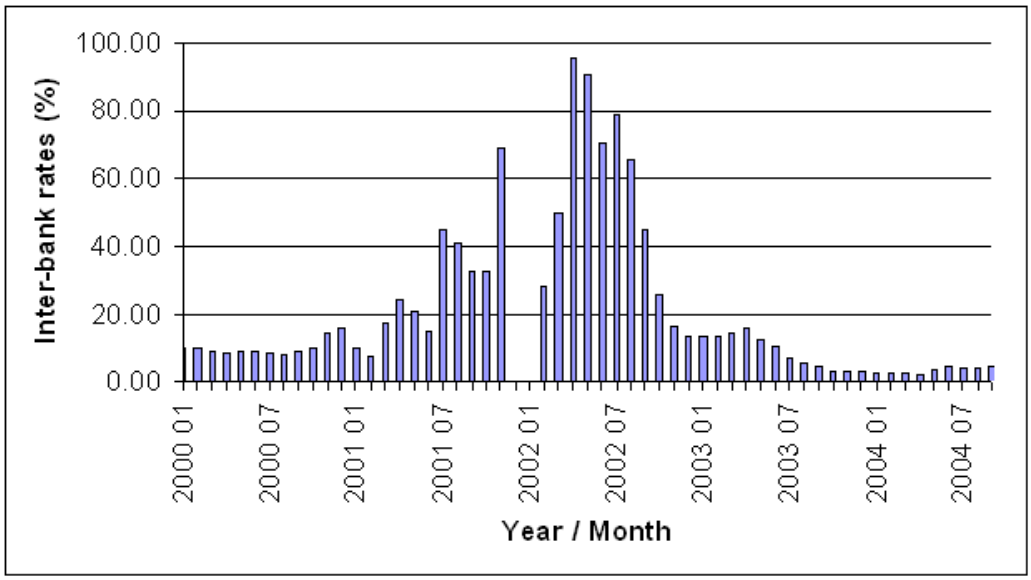

Figure 3: Inter-bank rates in Argentina from Jan 2001 to Sep 2004

(Source: Banco Central de la República Argentina.)

December, leaving the country in constitutional chaos with three successive presidents elected by the Congress in quick succession. Political stability was partially regained at the beginning of January 2002 when Eduardo Duhalde was appointed as the new president. One of his first economic measures was the devaluation of the peso: but it fell far more than anticipated as currency colapse to a spectacular increase in the price of a dollar, which rose from 1 peso to over 3.

Why should this lead to a contemporaneous recession? Equation (III.4), provides an answer as follows. With substantial liability dollarisation, devaluation leads to an increase in corporate indebtedness, measured by D_1^*. Although this is offset in part by a favourable real exchange rate effect $f(E_1/P_1)$, a net reduction in corporate net wealth will squeeze investment. In the absence of an offsetting rise in exports, however, this will lead to a fall in current output, as Keynes emphasized at the time of the Great Depression.

[The collapse of investment described above clearly has adverse effect on the supply

potential of the economy in the subsequent period. This effect is exaggerated by the ABB specification, however: with 100% depreciation in each period, the one-third fall of investment observed from 2001 to 2002, would imply a 1/3 fall in potential GDP in the next period].

In Figure 4 we indicate how the combination of low investment beforehand and a Keynesian demand contraction trigged by tight money could lead to depression levels of output in period 2. We start with the former in period 0, where Cavallo's last-ditch attempts to maintain the dollar peg were associated with punishingly high interest rates. With the peg still in place, the IPLM curve is not relevant, its place being taken by the parity peg. But, the high interest rates shift the W-curve leftwards, decreasing the output in period 2 from A to B.

Appendix B indicates how the rise in sovereign risk premium has a direct effect on investment by the rise of the peso interest rate showed in Figure 3 . In addition, it shows the indirect effect which arises when the sovereign risk premium attached to government debt is recovered by higher corporate taxation - as when the government pursued a balanced budget policy ("déficit zero").

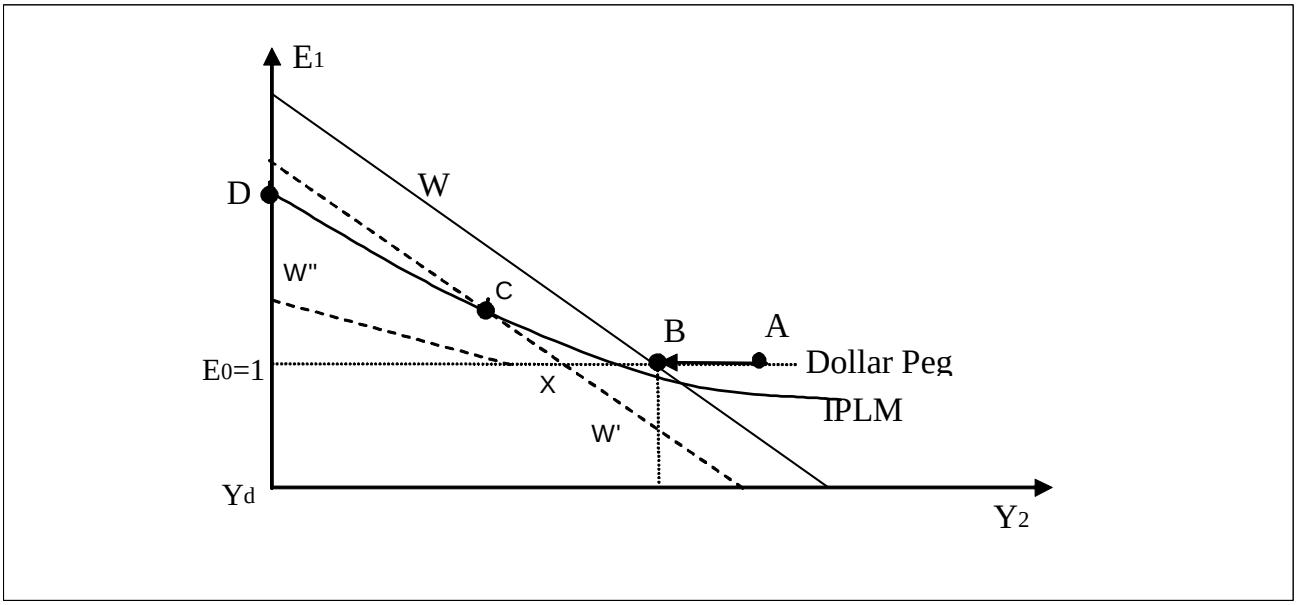

Figure 4: Demand failure and depression.

We move on to period 1 (see the 2002 peak of interest rate in Figure 3) when the peso was floated and monetary policy was tightened to support the currency. Assuming however that the W curve moves more than the IPLM when interest rates rise in period 1, the prediction of the ABB model would be the equilibrium at point C. But this prediction implicitly assumes that export volumes rise sufficiently to keep aggregate demand equal to supply. If exports are slow to react, the multiplier effect both shifts the W' schedule further to the left and flattens it, see W'' in the figure. The figure shows the case where there is no intersection with the IPLM curve until output falls to depression level Y_d and the price of the dollar rises to the value shown at point D.

To mitigate or avoid this depression, the government attempted to follow the example of President Roosevelt[12] The potential effect of so doing is indicated in Figure 5. Consider first the pesification of corporate borrowing which has no negative effect on banking system (e.g., a symmetric pesification when loans and deposits are *both* pesified at a rate of 1.4). In this case, beyond for values of the dollar greater than 1.4, the W'' curve rotates right-ward to become W''_{SP}. The new equilibrium is given by the intersection of the W''_{SP} with the IPLM curve, at point C'. This Rooseveltian policy of pesification prevents output from collapsing because it gives relief to corporations with dollar debts.

But when debt relief for corporations involves bankrupting the banks , the outcome could well be counter-productive, as the collapse of the banking system leads to a reduction in the credit multiplier (μ), less investment and less output. This is shown in Figure 5 where the new W''_{SP}-curve is replaced by W''_{AP}. If the reduction in μ is large enough, there may be no intersection with the IPLM curve, so the equilibrium is economic depression and currency collapse at point D (as before).

How could this outcome have been avoided? One possible strategy was asymmetric pesification at a rate of 1.2[13]. The effect of such as policy in Figure 4 would be

[12]FDR persuaded Congress to cancel the Gold Clause in debt contracts when the US left to Gold Standard in 1933. The devaluation of the dollar raised the gold price — and the dollar value of gold-denominated debt — by about 70%; but cancelling the Gold Clause kept dollar values unchanged. See Diez (2003).

[13]As proposed by the team of Remes Lenicov, Diez (2003).

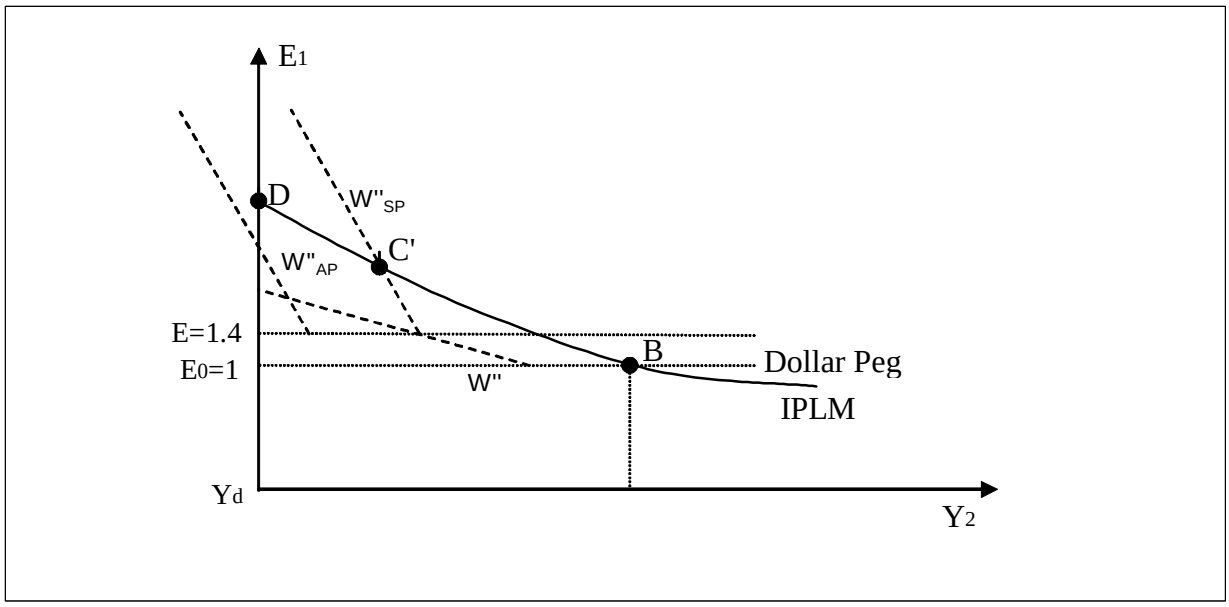

Figure 5: "Nuestra gran depresión"?

to shift W''_{SP}-curve and the intersection of IPLM to the right. Under this policy, depositors would be given some help and so too would producers: but whether this was politically feasible is debatable. (It might appear from the figure that a tightening of monetary policy to check a rise in the dollar would help to reduce recession: but tighter monetary policy could shift the W'' curve further to the left.)

Given devaluation and the policy of AP, the obvious strategy for government is to restore bank solvency by paying credible compensation. This would increase the credit multiplier and move the equilibrium back to point C in Figure 5. Unfortunately, the prompt action taken by the Duhalde government to recapitalize the banking system lacked credibility, and led to paralysis of the banking system, leaving the country without credit for a year and a half.

The policy approach recommended by the IADB, on the other hand, would imply a more selective debtor bail-out; and a greater political commitment by the government to meeting the costs of recapitalisation. The IADB Report of 2005 cites with approval the actions taken later by Uruguay when it faced a similar crisis. (In due course Argentine banks have reopened, the economy is recovering and the government is

paying compensation.)

V Conflicting Beliefs and Asymmetric Pesification

How and why was the policy of asymmetric pesification combination chosen? Here we pursue the notion that the government and the banks were accustomed to working hand in glove as testified by della Paolera & Taylor (2003) ,hereafter DT, who interpret the financial history of Argentina since the nineteenth century as evidence of enduring collusion. In the penultimate section of their paper entitled 'The Political Economy of Gaucho Banking in 2001', DT [pp16-19], the authors ask: 'were the banks coerced or did they collude with political forces?'. By way of answer, they observe that "The initial switch by banks in April 2001 and May 2002 towards investing in high-yield sovereign bonds was the start of an extremely risky policy — one that we think can be transparently seen as a collusive outcome between most banks and the government. The implicit agreement was simple: *you help me now and I will help you in the immediate future*" [italics added]. They continue: "We know that the banks were also subject to 'moral suasion' to take the "megaswap" in the summer [of 2001] and, by then, we believe,they were quite convinced that if the high returns did not materialize *they would (somehow) be bailed out by the government* [italics added]. It is beyond the scope of this paper to speculate as to where they thought *ex ante* these resources would come from — and if this would involve pesification. By the end, however, they surely saw pesification as a potential answer if the scheme were to fail."

It seems clear from this account that so-called Gaucho Banks would be willing to accept the enforced pesification of *both* dollar deposits and dollar loans — as an arrangement which helps loan customers by violating contracts made with depositors (who effectively pay for the transfer), leaving bank balance sheets unscathed. More than that, as part of a collusive agreement with the government, they could take the same view of *asymmetric* pesification of loans and deposits, even though their balance sheets are adversely affected by the transfer to loan customers. So AP without immediate compensation should have been viable.

There is however a crucial aspect of Argentine finance in 1990s that is not discussed in DT's account, namely the extraordinary extent of financial liberalisation

under the peg regime, as a result of which the banking system became dominated by multinational banks, with branches/subsidiaries of well-known names such as Banco Frances, Banco Santander, Bank of Boston, BNP, Banca Nazionale del Lavoro, Lloyds Bank and Citibank to be found all over Buenos Aires. For the monetary authorities, this was clear evidence of their adoption of best practice in matters of financial regulation: and for the public it seemed to offer security against violation of contracts. This undoubtedly represented a sea-change in the nature of banking and bank regulation in Argentina, as is clear from the question posed by Gerchunoff & Llach (2003) [cited on the title page of this paper]: "Why the catastrophic collapse of a financial system that had attracted great praise and enjoyed popular support until the last moment?"

Could the answer to this question lie in conflicting beliefs? For historical reasons outlined by DT, the government could well have assumed that actions which render banks technically insolvent were acceptable if accompanied by the promises of future compensation: *but branches and subsidiaries of multinational banks answerable to overseas managers would not be able or willing to accept such promises.* The Inter-American Development Bank Report on Unlocking Credit observes IADB (2004, p80) that "the combination of all the measures [taken by the government]implied a breach of existing contracts and significant legal uncertainty, which prompted the headquarters of foreign banks to deny financial support to their branches and subsidiaries. By mid-2002 the banking system was completely inoperative...". In the strategic analysis that follows, we show how differences of belief about the nature of the banks (and of the acceptability of government promises) can lead to catastrophic errors of policy.

Consider a two-player game between the government and banks where the government may choose pesify deposits and loans symmetrically (say, 1:1) or asymmetrically (say, 1.4:1), and the banks can either accept government policy or resist it. (When asymmetric pesification was imposed, banks imposed restrictions on deposit withdrawal, they ran down their existing loan stock without issuing any new lending. This is what we characterize as resistance.) Note that if the government pesifies deposits and loans symmetrically, there is no need to recapitalise banks. If, however, deposits and loans are pesified asymmetrically, recapitalisation is required to avoid financial collapse.

Now assume that there are two "types" of banks, each of which is characterised

by a pair of parameters (δ, μ), where δ here indicates how heavily banks discount government promise of honouring its bonds and μ the multiplier on banks local net losses. If banks are of the "Gaucho" type, enjoying a cosy relationship with the government, they accept government promises at or close to face value (δ close to 1) and their losses are confined to domestic markets ($\mu = 1$). If however banks are of the "multinational" type, they would have serious doubts about government's promises (setting δ close to zero); and they would also be concerned about the international spill-over of losses in Argentina — i.e. that other governments might adopt similar strategies vis-à-vis branches elsewhere — so they set $\mu > 1$ Let the payoffs be specified as follows.

Assume that the government wants to assist borrowers by writing down their dollar loans by the amount α. To recapitalise banks, it issues debt to the value ρ at a perceived "cost" $\phi\rho$ with $0 < \phi < 1$ (which indicates a preference for bailing out producers at a cost to the general taxpayer). So the payoff for the government is given by the net transfer α to depositors and borrowers *less* the cost of recapitalising banks $\phi\rho$.[14] The payoffs to banks are their net asset position, i.e., capital injection less the net transfer to depositors and firms. With immediate and complete recapitalisation, $\rho - \alpha = 0$; with discounting of government promise of future compensation, the banks' perceived net assets are given by $\rho - \delta\alpha > 0$ with $0 \leq \delta \leq 1$ reflecting discounting.

To start with, we look at a case where the government has full credibility in honouring its debt for recapitalisation, i.e., it is playing against "Gaucho" banks. This game is illustrated in Table 3 where each cell indicates the payoffs to both players. When symmetric pesification is accepted by banks, their respective payoffs are normalised to zero. Banks would be inclined to accept symmetric pesification, as resisting costs ϵ. If the government decides to pesify asymmetrically, with immediate compensation, the payoffs to the banks become $\alpha - \rho = 0$; the payoffs to the government are $\alpha - \phi\rho > 0$. Resistance of asymmetric pesification leads to financial collapse, in this case, losses to government are $\gamma > 0$ and losses to banks are $\beta > 0$. Accepting asymmetric pesification is the unique pure strategy Nash equilibrium as indicated by the arrows in the table. This could be the scenario perceived by Remes Lenicov and his economics team when they insisted on recapitalisation of banks.

[14]Here we ignore the gains to government by defaulting on its existing dollar debt.

Table 3: Asymmetric pesification with fully credible recapitalisation.

		Banks	
		Accept	Resist
National	Symmetric Pesification	0, 0 $\downarrow$	$\leftarrow$ 0, $-\epsilon$
Government	Asymmetric Pesification	$\alpha - \phi\rho > 0$, 0 $\leftarrow$	$\uparrow$ $-\gamma$, $-\beta$

If, on the other hand, the government recognised that it was playing against "Multinational" type banks, the game may have no Nash equilibrium. Multinationals set $\delta = 0$ and $\mu > 1$ as in Table 4. Additionally, they may be tempted to accept government intervention (in their balance sheet) insofar as it frees they from their obligation to recapitalise the insolvent branches: with payoffs normalised as they are, this would be included in the "resistance" cost ϵ. As long as $\mu(\alpha - \delta\rho) > \beta$, the game produces no pure strategy equilibrium (see arrows in the table).

Table 4: Asymmetric pesification without fully credible recapitalisation.

		Multinational Banks	
		Accept	Resist
National	Symmetric Pesification	0, 0 $\downarrow$	$\leftarrow$ 0, $-\epsilon$
Government	Asymmetric Pesification	$\alpha - \phi\rho > 0$, $\mu(-\alpha + \delta\rho)$ $\rightarrow$	$\uparrow$ $-\gamma$, $-\beta$

Refining the game by specifying the move order can generate a unique equilibrium, as is shown in 6, where it is assumed that the government moves first. (This is consistent with what happened in Argentina: faced with heavy pressure from the industrial lobby, Duhalde's government promptly decided to pesify loans and deposits asymmetrically, enacting decree No 214/2002 within a month of assuming office.) Conditional on its perception that banks are of the "Gaucho type" (i.e. the government believes $\delta = 1$ and $\mu = 1$), backward induction makes asymmetric pesification the optimal choice for the government. Faced with this policy choice by the government, multinational banks (for whom with $\delta \approx 0$ and $\mu > 1$) are forced to resist in order to reduce their losses. The equilibrium so selected, AP without cooperation from the banks, is the worst possible for both the players. Here conflicting beliefs play a crucial role in

precipitating the collapse in the banking system, as resistance by the banks severely disrupted the functioning of the financial market.

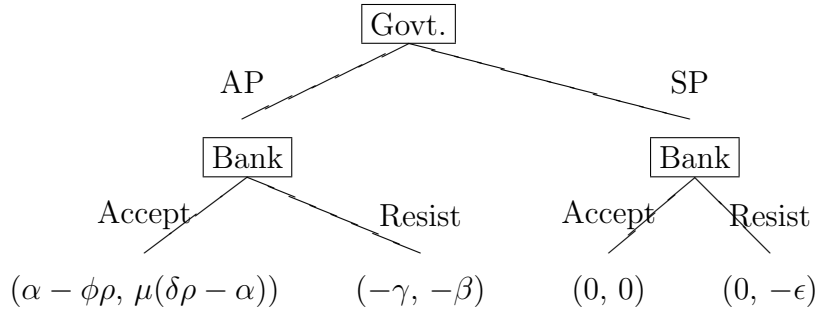

Figure 6: Sequential game with conflicting beliefs.

Note that , in the game described above, the crisis is not caused by asymmetric pesification per se, but by how the associated compensation (to the banks) is handled (or perceived to be handled). If the compensation is distributed quickly (analogous to Table 3 where compensation is fully credible), the crisis can be avoided by using asymmetric pesification. If, however, compensation is disbursed slowly (analogous to Table 4 where the government lacks credibility), this triggers collapse. The strong assumption required to generate such result is that the government believed that most of banks were of the "Gaucho" type while in reality "multinational" banks dominate. (To see how robust are these results, this assumption is relaxed in Appendix C where government credibility is analysed in a repeated game framework.)

VI Capital Flight

It must be acknowledged that the problem of resolving financial crisis was greatly exacerbated by two factors — the prolonged domestic recession and cumulative capital flight. Despite sovereign spreads over 2000 basis points — the market's signal that substantial default and/or devaluation was in prospect — the capital account was left open; and official dollar reserves fell by $20bn between 6 October 2000, when Vice President Alvarez resigned and the political crisis began, and the end of 2001, when the peg collapsed. (It has been estimated that capital flight was $23bn in 2000-2001, and an additional $16bn in the last year of convertibility, see Bonelli, 2004, p216.)

These outflows had effectively to be financed by official borrowing from the IMF, dollar debts that must now be repaid at three times their initial peso cost.

In these circumstances many have argued that Argentina should have left the peg earlier — at least one year earlier according to Michael Mussa (2002), then Head of the Research division at the IMF. Subsequently, prompt devaluation helped Brazil to recover from similar adverse sovereign spreads in 2002. But the government of De la Rua was committed to defended the peg — especially after Cavallo was recalled as Minister of Finance in 2001.

If devaluation had to be delayed, capital controls should surely have been considered as an emergency measure — along the lines taken earlier by President Mahatir in Malasyia in 1997/8, for example. But there were no capital controls in Argentina until December 2001, which was far too late. That such measures were not considered is no surprise: the late 1990s were the high-water mark of the fashion for prompt and comprehensive financial liberalisation, a fashion of which the governments of Menem and de la Rua were keen followers. Nor would the IMF have approved of such measures: there is certainly no criticism of the open capital account in Mussa's monograph, for example.

The use of such measures to mobilise the foreign assets owned by domestic citizens — by outflow controls and/or forced repatriation — raises political issues we do not discuss here: we restrict ourselves to indicating how action on the capital account impacts on the exchange rate and output in model being used. Modifying the IPLM curve to

$$E_1 \quad = \quad (1-c)\frac{1+i*}{1+i_1}\frac{M_2^S}{L(Y_2,\bar{i_2})} \tag{VI.1}$$

where $0 < c < 1$ indicates the degree of capital controls, see also Aghion, Bacchetta & Banerjee (2001). By choosing an appropriate c, one can, in principle, move the IPLM curve down sufficiently to intersect the W''-curve, avoiding the precipitate collapse of the output. The attraction of capital controls in this context is that they can help to strengthen the currency and/or limit outflows without raising domestic interest rates.

VII Conclusions

As Francoise Sgard (2004) notes in an elegant survey of opinions, the case of Argentina — where a currency peg came to such a spectacular end — will doubtless be debated for years to come. Here we try to show how existing models of crisis in emerging markets can — with modifications — help to throw some light on the issue.

After the devaluation and default, the government tried to protect producers by a policy of asymmetric pesification which, in the absence of credible capitalisation, bankrupted the banking system. To analyse the enormous plunge of the peso and the deepening recession that accompanied it, we appeal to models of crisis which incorporate balance sheet effects. Suitably adapted, the framework of Aghion, Bacchetta & Banerjee (2000) illustrates how high ex ante interest rates can have substantial adverse effect on the supply side and how asymmetric pesification of bank assets can greatly exacerbate the fall of the currency and the depth of the recession. But the level of unused resources implies that, as for the 1930s, one needs to model demand as well as supply: and we have modified the model to do just this.

To explain how such unfortunate policy steps could have been taken we describe a game in which the government mistakenly thought its policy of recapitalisation would be credible. This is only a first shot at analysing a very complex political situation; and can surely be improved upon, perhaps along the lines we explored in the appendix.

VIII *

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A The Shock to Banks' Net Worth

To quantify the shock to the banking system that the process of pesification posed, consider the consolidated financial statement of December 2001 in Tables 5. Note that share of dollar loans to the private sector was just over a third of total assets, while dollar liabilities were just below a third. The banks also held 21% of their assets in dollar-denominated government bonds. Although there was (negative) external dollar imbalance of 8%, see the last two columns of Table 5, on balance the banks clearly had a long dollar position and should have gained from devaluation. But, from a position when capital and reserves of about 16 bn pesos constituted 12% of assets, the situation was promptly transformed into one of insolvency.

Table 5: Banks balance sheet before the crisis.

Consolidated Financial Statements					
A. Pre-collapse (Measured in bn pesos)					
		Assets	**Liabilities**	**Assets** (%)	**Liabilities** (%)
Public	Dollar	26.70	1.50	21	1
	Peso	3.40	4.50	3	4
Private	Dollar	39.10	44.10	31	35
	Peso	15.00	15.90	12	13
External		6.50	16.30	5	13
Liquid		9.10		7	
Loans granted by BCRA			4.50		4
Capital, reserves and net income			15.80		12
Others		26.70	23.90	21	19
Total		126.50	126.50	100	100

Some have argued[15] that these balance sheet calculations are misleading as many of the loans were non-performing and government debt is entered at nominal value

[15]Lisandro Barry's written communication.

but not market value, so net worth, properly measured, would be a good deal lower. In any case, as we now show, asymmetric pesification further reduced net worth.

Table 6: Measuring the shock to bank net worth in pesos.

Consolidated Financial Statements				
B. Post-collapse[a](Measured in bn pesos)				
		Assets	**Liabilities**	**Loss in pesos**
Public	Dollar	37.38	2.10	-10.08
	Peso	3.40	4.50	
Private	Dollar	39.10	61.74	17.64
	Peso	15.00	15.90	
External		13.00	32.60	9.80
Liquid		9.10		
Loans granted by BCRA			4.50	
Capital, reserves and net income			-1.56	
Others		26.70	23.90	
Total		143.68	143.68	17.36

[a] For asymmetric pesification we assume government debt is pesified at 1:1.4, private loans are pesified at the rate of 1:1 and deposits at the rate of 1:1.4. The peso price of dollar is 2. Government dollar debt not in the form of guaranteed loans may in fact be written down more substantially.

Assuming AP with the conversion from deposits and government guarantee bonds at one dollar to 1.4 pesos, and the conversion rate for loans at one to one, we calculate the shock to bank solvency immediately after the financial collapse in which the dollar doubled in value to about 2 pesos. Net worth falls by approximately 17 bn pesos, a loss of about 15% with respect to the 126 bn pesos total of assets in December 2001. (The net worth of the banking system is shown as -1.6 bn pesos in Table 6 and as -0.8 bn dollars in Table 7.)

In Table 7 measured in dollars, we calculate the cost of AP of loans and deposits to banks' balance sheet amounts to $ 6.4 bn. In addition, we show a loss of 7.6 bn dollars due to the pesification of public dollar debt at the rate 1.4 pesos to the dollar.[16] These two changes together — a "hit" of 14 bn dollars — are enough to reduce net worth to practically zero.

Of course, the government mandated the prompt recapitalisation of banks balance sheets[17]: but what was offered was more government bonds — together with reassurance that the government could afford to issue these bonds because it was reneging on its previous promises! There is a clear "time consistency" problem here: how credible are promises of a government which flagrantly violates past commitments.[18] In the next section, we consider two types of banks the first which trusts the government and the second which does not.

I.1 Comparing Argentine Pesification with Roosevelt's Cancelation of the Gold Clause

Before turning to the analytical details of such a model, it may be as well to ask: why has precedent of Roosevelt in the 1933/4 apparently proved such a poor predictor of economic consequences for Argentina, where the process of pesification has crippled the banking sector and played a crucial role in propagating economic collapse? The action of President Roosevelt in cancelling the Gold Clause to stimulate America in the Great Depression has been adduced as a useful precedent for the pesification of Argentine debt, Hausmann (2001), Kroszner (2002) and Miller (2001); and *de facto* bank and sovereign debt either has been or is being largely pesified[19]. So what went wrong?

[16]This is broadly comparable with the figure of $7.8bn in Remes Lenicov *et al*, cited in Diez (2003) above.

[17]Assuming fully credible recapitalisation of the AP of loans and deposits, net worth would amount to about $ 6bn as opposed to $ 16bn before devaluation and default. (These figures are broadly comparable with those reported in the Economist (June 5, 2004, Argentina Supplement, p10) which however used current exchange rates.)

[18]In the words of the Economist (June 5, 2004, Argentina Supplement, p10): "This debt, though in good standing, has been issued by a government in default, so nobody knows what its real value might be."

[19]At Dubai, the Argentine government proposed a 75% write down of $100bn of its sovereig debt, which amounts to approximate pesification.

Table 7: Measuring the shock to bank net worth in dollars.

Consolidated Financial Statements				
C. Post-collapse (Measured in $bn)				
		Assets	**Liabilities**	**Loss in dollars**
Public	Dollar	18.69	1.05	7.56
	Peso	1.70	2.25	-0.55
Private	Dollar	19.55	30.87	6.37
	Peso	7.50	7.95	-0.45
External		6.50	16.30	0
Liquid		4.55		4.55
Loans granted by BCRA			2.25	-2.25
Capital, reserves and net income			-0.78	
Others		13.35	11.95	1.40
Total		71.84	71.84	16.63

By *pesifying public debt* did Argentina make the mistake of going further than the US, as Sturzenegger (2003, p49) suggests[20]? Not according to Kroszner (1999) — the source cited by Sturzenegger for details of the Supreme Court decision — who says that all four suits to the Court for the restoration of the Gold Clause were rejected, both in respect of public and private debt. That is to say, America downgraded the gold value of public debt too. Presumably US banks in the 1930s also held Government paper: but when it was stripped of the Gold Clause, the banks merely lost an unanticipated capital gain. Likewise, although Argentine bank portfolios in 2001 included some 21% of government paper with a dollar guarantee, action taken by the government (partially) to pesify sovereign debt need not have carried immediate implications for bank solvency. If deposits and loans had been treated symmetrically, Argentine banks would gained from their net position in dollars as the peso fell, leaving

[20] "Debts of the public sector had to be honoured in gold for it was unacceptably risky for the state, as the interested party, to be able unilaterally to diminish the value of its debts".

some considerable margin for writing down their holdings of government debt[21].

The US Supreme Court decisions in 1933/4 were in fact restricted to long term bonds: *they did not involve bank loans.* But surely private loan customers could also benefit from some relief from the sudden increase in peso cost of dollar debts as the peso fell? True, but as in Argentina over a third of bank liabilities were dollarized, any action to pesify loans would necessarily put bank balance sheets at risk, *unless both were treated symmetrically.* (Dollar deposits were roughly matched by dollar loans, see Table 1.) Indeed there is good reason to believe that the balance sheet effects of symmetric pesification (at a common rate of 1.4 to one, for example) would have been positive, serving "to protect banks from devaluation, inasmuch as to have maintained deposits and loans in dollars would have made it very difficult to recover loans in sufficient volume to honour deposits" Sturzenegger (2003, p49).

We conclude that where the Argentine government did go much further than the US in the 1930s was in pesifying bank balance sheets and privileging loan customers (with at a conversion rate of one-to-one, much lower than the 1.4 offered to depositors) without regard to the resulting insolvency of the banks, a dangerous game of 'robbing Peter to pay Paul' which the government must surely regret (as it has to pay compensation to the banks in any case). Why the government chose to play this game, we try to explain below.

B Contraction under the dollar peg

To make the model in the text more suitable to describe what happened in Argentina while it remained on the dollar peg, one could follow Aghion, Bacchetta & Banerjee (2001) to incorporate government debt; and impose a balanced budget condition to reflect the policy of zero deficit.

[21]But note that the risk of bankrupting the banks was, apparently, the rock on which plans by Cavallo to pesify government debt foundered.

II.1 Corporate Tax

Assuming that corporate tax is levied at a given rate of τ on the firm's realised profits. Introducing taxes reduces the investment in time 1, which in turn affects negatively the output in period 2:

$$Y_2 = \sigma(1+\mu)(1-\alpha-\tau)\left[Y_1 - (1+r_0)D^C - (1+i^*)\frac{E_1}{P_1}(D_1 - D^C)\right]. \tag{B.1}$$

II.2 Public debt

As in Aghion, Bacchetta & Banerjee (2001), the consolidated government financing equation can be written as

$$P_t(g_t - t_t) + \left[X^G(1+i_{t-1}) + (1-X^G)(1+i^*)\frac{E_1}{E_{t-1}}\right] d_t^G P_{t-1} = (d_{t+1}^G + s_t)P_t - E_t\Delta R_t \tag{B.2}$$

where g_t and t_t are real government expenditure and taxes, d_t^G is the government debt held by private individuals in period t and X^G is the fraction of its domestic component, s_t is the real seignorage, P_t is price level at t. Dividing both sides of (B.2) by P_t and omitting reserve changes yield

$$(g_t - t_t) + \left[X^G(1+r_{t-1}) + (1-X^G)(1+i^*)\frac{E_1}{P_t}\right] d_t^G = d_{t+1}^G + s_t. \tag{B.3}$$

II.3 Country risk

To capture the default risk for the dollar debt, we introduce risk premium to both the interest paid by government (π^G) and the interest rate paid by the firm (π^P). In the presence of such risk premium, the government budget (B.3) constraint becomes

$$(g_t - t_t) + \left[X^G(1+r_{t-1}) + (1-X^G)(1+i^*+\pi^G)\frac{E_1}{P_t}\right] d_t^G = d_{t+1}^G + s_t. \tag{B.4}$$

The output in period 2 becomes

$$Y_2 = \sigma(1+\mu)(1-\alpha-\tau)\left[Y_1 - (1+r_0)D^C - (1+i^*+\pi^P)\frac{E_1}{P_1}(D_1 - D^C)\right]. \tag{B.5}$$

II.4 Impact of pesification on corporate dollar liabilities

Assume that the dollar denominated corporate debt is pesified at E', the W-curve is then revised to

$$Y_2 = \sigma(1+\mu)(1-\alpha-\tau)\left[Y_1 - (1+r_0)D^C - (1+i^*+\pi^P)\frac{E'}{P_1}(D_1 - D^C)\right]. \quad \text{(B.6)}$$

Provided that pesification of corporate debt has no effect on credit market, Y_2 would increase as long as $E' < E_1$. This gives the positive effect of pesification on the output.

II.5 Pre-collapse contraction of supply: modifying the ABB model

In March 2001, after the first bank run, Domingo Cavallo — the architect of the currency peg or '*Convertibilidad*' — was recalled to the post of Minister of Economy in a move designed to restore investors' confidence. But Argentinean bonds continued to fall in global markets, and both government and the private sector faced higher borrowing charges of around 12%. So, in a further step to reassure capital markets, Cavallo tried to balance the budget, adopting the draconian policy of '*Deficit cero*' (zero deficit). Under this policy, however, higher borrowing costs required higher primary surplus, i.e., rising interest rates led to cuts in public expenditure and higher taxes. Confidence was not restored and Argentine sovereign spread rose to 1700bps in July.

That economic recession led to higher not lower interest rates in the highly indebted Argentine economy, and that recession was met with policies which increased tax and decreased public expenditure are identified by Gerchunoff & Llach (2003, p456) as two important 'crisis propagation mechanisms'. These could be incorporated in the model as follows. First, the high sovereign spreads force the government to increase corporate tax to maintain the "zero deficit" commitment with the IMF, as can be seen from the following accounting equation from (B.4) in the appendix

$$(g_t - t_t) + \left[X^G(1+r_{t-1}) + (1-X^G)(1+i^*+\pi^G)\frac{E_1}{P_t}\right] d_t^G = d_{t+1}^G + s_t = \text{C}onstant. \quad \text{(B.7)}$$

where the first term is the primary deficit and the second term represents the interest payment on public debt. Assuming that the sum of terms is fixed, the only way to adjust to rising interest costs is to run a primary surplus — by raising corporate taxes for example.

Secondly, the high credit risk π^P (risk over American companies) and the high peso interest r_0 also reduce corporate profits available for investment. Increasing τ, r_0 and π^P will lead to less investment in period 1, ceteris paribus, less output in period 2, as can be seen from the W equation (B.5).

C Asymmetric Pesification in a repeated game framework

Consider a two-stage game.[22] In the first stage, the government can choose either symmetric or asymmetric pesification. If the asymmetric pesification is handled well (we specify in detail below), it will be strictly preferred by the government. The symmetric pesification is preferred if the asymmetric pesification is badly handled and resisted by banks. If the symmetric pesification is chosen, the game ends. If, however, asymmetric pesification is chosen. The second stage sub-game is specified below.

Table 8: Asymmetric pesification: a Prisoner's dillema.

		Banks	
		Accept	Resist
National Government	Quick Compensation	$-\rho$, $\rho - \epsilon'$	$-\rho - \gamma$, ρ
	Slow Compensation	$-\phi'\rho$, $-b$	$-\phi'\rho - \gamma$, $-b$

Given asymmetric pesification, the government can choose either to pay compensation to banks quickly or slowly, and banks can decide whether to accept or resist it. Assume quick compensation involves the amount ρ to recapitalise banks and slow compensation costs less, $\phi'\rho$ where $\phi' < 1$. If banks accept asymmetric pesification with quick compensation, some effort by banks is required, so the payoff is $\rho - \epsilon'$, where ϵ' indicates effort cost. If they resist it, no effort is required, the payoff is sim-

[22] We thank Andrew Powell for suggesting this approach.

ply ρ. Resistance by banks to asymmetric pesification leads to collapse which costs government γ in addition to the compensation. Under slow compensation, payoffs to banks are simply $-b$. Clearly the stage game set up above is one of prisoner's dilemma where the equilibrium, (Slow compensation, Resist), is a crisis.

Let there be a small probability p that the bank is of the "Gaucho" type who chooses tit-for-tat strategy. The "Multinational" behaves rationally: it can choose either to imitate the Gaucho bank (selecting tit-for-tat strategy) or to "Fink" (selecting "Resist"). Let the above game be played repeatedly. Kreps, Milgrom, Roborts & Wilson (1982) (see also Rasmusen (1990, p118)) showed that in any perfect Bayesian equilibrium from the repeated T-stage Prisoner's Dilemma game without discounting, the number of stages that "Fink" strategy is chosen only depends on p. However, players do resort to "Fink" when last period approaches.

In this scenario, there are two possibilities that crisis can occur. First, the government believes that the Prisoner's Dilemma game is played repeatedly while multinational banks think its a one-shot game. In this case, from the government perspective multinationals would imitate Gaucho banks who use tit-for-tat strategy. Given government chooses quick compensation, the equilibrium for the second stage sub-game will be (Quick compensation, Accept), i.e., "well handled" asymmetric pesification. Backward induction leads the government to choose asymmetric pesification in the first stage. But since multinationals believe that the game in the second stage is one-shot, given asymmetric pesification, resistance is chosen and crisis ensues. The second route to crisis is that even if both government and banks view sub-game as repeated, the government may have a higher estimate of p than multinationals. This makes it more likely for multinationals to use "Fink" strategy than believed by the government, thus leading to crisis.