Paper tigers?
A model of the Asian crisis*

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Abstract

This paper develops an interpretation of the Asian meltdown focused on moral hazard as the common source of overinvestment, excessive external borrowing, and current account deficits. To the extent that foreign creditors are willing to lend to domestic agents against future bail-out revenue from the government, unprofitable projects and cash shortfalls are re-financed through external borrowing. While public deficits need not be high before a crisis, the eventual refusal of foreign creditors to refinance the country's cumulative losses forces the government to step in and guarantee the outstanding stock of external liabilities. To satisfy solvency, the government must then undertake appropriate domestic fiscal reforms, possibly involving recourse to seigniorage revenues. Expectations of inflationary financing thus cause a collapse of the currency and anticipate the event of a financial crisis. The empirical section of the paper presents evidence in support of the thesis that weak cyclical performances, low foreign exchange reserves, and financial deficiencies resulting into high shares of non-performing loans were at the core of the Asian collapse.

J.E.L. classification F31, F34, G15, G18.

Keywords: moral hazard; balance of payment crisis; banking crisis; speculative attacks; Asia.

paper tiger: *a Chinese expression first used by Chairman Mao, a person, country, etc., that appears outwardly powerful or important but is actually weak or ineffective* (Oxford English Dictionary, 2nd edition).

1 Introduction

This paper develops a model of financial and currency crises led by moral hazard, with special reference to the recent Asian events, and presents a preliminary empirical analysis of the extent to which the 1997/98 turmoil was related to the macroeconomic and structural weaknesses highlighted by the model.

Our theoretical construction focuses on moral hazard as the common source of overinvestment, excessive external borrowing, and current account deficits in a poorly supervised and regulated economy. Private agents act under the presumption that there exists public guarantees on corporate and financial investment, so that the return on domestic assets is perceived as implicitly insured against adverse circumstances. To the extent that foreign creditors are willing to lend against future bail-out revenue, unprofitable projects and cash shortfalls are re-financed through external borrowing. Such a process translates into an unsustainable path of current account deficits.

While public deficits need not be high before a crisis, the eventual refusal of foreign creditors to refinance the country's cumulative losses forces the government to step in and guarantee the outstanding stock of external liabilities. To satisfy solvency, the government must then undertake appropriate domestic fiscal reforms, possibly involving recourse to seigniorage revenues through money creation. Speculation in the foreign exchange market, driven by expectations of inflationary financing, causes a collapse of the currency and anticipates the event of a financial crisis.

Financial and currency crises thus become indissolubly interwoven in an emerging economy characterized by weak cyclical performances, low foreign exchange reserves, and financial deficiencies resulting into high shares of non-performing loans. The empirical section of the paper applies our interpretive framework to the recent events in the Asian region, and presents evidence in support of the thesis that the combination of the structural factors above was at the core of the Asian collapse.

The paper is organized as follows. Section 2 introduces our micro-founded

model of joint currency and financial crises, while Section 3 presents our econometric results. Building on these results, Section 4 presents a general discussion of the moral hazard problem and the structural imbalances in Southeast Asia on the eve of the crisis, and outlines policy implications and potential extensions of our framework. Section 5 answers the question in the title and concludes.

2 A theoretical framework

It has been recently argued that a full understanding of the recent currency and financial crises in Southeast Asia requires a new theoretical paradigm, since the traditional conceptual and interpretive schemes[1] do not appear, *prima facie*, to fit well the data and fall short in a number of dimensions.[2]

A first reason is the role of fiscal imbalances. At the core of 'first generation' (or 'exogenous-policy') models of speculative attacks á-la-Krugman (1979) and Flood and Garber (1984), the key factor that explains the loss of reserves leading to a crisis is the acceleration in domestic credit expansion related to the monetization of fiscal deficits. In the case of Southeast Asia, the pre-crisis budget balances of the countries suffering from speculative attacks were either in surplus or limited deficit.

In 'second generation' (or 'endogenous-policy') models of currency crisis governments rationally choose — on the basis of their assessment of costs and benefits in terms of social welfare — whether or not to maintain a fixed rate regime. A crisis can be driven by a worsening of domestic economic fundamentals, or can be the result of self-validating shifts in expectations in the presence of multiple equilibria,[3] provided that the fundamentals are

[1] See Buiter, Corsetti and Pesenti (1998a), Calvo (1998), Calvo and Vegh (1998), Cavallari and Corsetti (1996) and Flood and Marion (1998) for recent surveys.

[2] A partial list of recent studies providing empirical evidence on the Asian crisis includes Alba *et al.* (1998), Corsetti, Pesenti and Roubini (1998), Dornbusch (1998 a), Feldstein (1998), Goldstein (1998), IMF (1998), and Radelet and Sachs (1998). A large number of contributions on the crisis are available online on Nouriel Roubini's Asian Crisis Homepage at www.stern.nyu.edu/~nroubini/asia/AsiaHomepage.html.

[3] See among others Obstfeld (1994), and Cole and Kehoe (1996). If investors conjecture that a country's government will eventually devalue its currency, their speculative behavior raises the opportunity cost of defending the fixed parity (for instance, by forcing a rise in short-term interest rates), thus triggering a crisis in a self-fulfilling way. Note that multiple equilibria can arise even in 'first-generation' models (see for instance Obstfeld (1986)). Somewhat confusingly, the literature occasionally identifies 'first-generation' models with

weak enough to push the economy in the region of parameters where self-validating shifts in market expectations can occur as rational events. The indicators of weak macroeconomic performance typically considered in the literature focus on output growth, employment, and inflation. In the Asian economies prior to the 1997 crisis, however, GDP growth rates were very high and unemployment and inflation rates quite low.

In the following pages we suggest a formal interpretive scheme that, while revisiting the classical models, brings forward new elements of particular relevance for the analysis of the 1997-98 events. Specifically, we analyze financial and currency crises as interrelated phenomena, focusing on moral hazard as the common factor underlying the 'twin' crises.[4]

At the core of our model is the consideration that, counting on future bail-out interventions, weakly regulated private institutions have a strong incentive to engage in excessively risky investment. A bail-out intervention can take different forms, but ultimately has a fiscal nature and directly affects the distribution of income and wealth between financial intermediaries and taxpayers: an implicit system of financial insurance is equivalent to a stock of contingent public liabilities that are not reflected by debt and deficit figures until the crisis occurs.

These liabilities may be manageable in the presence of firm-specific, or even mild sector-specific shocks. They become a concern in the presence of cumulative sizable macroeconomic shocks,[5] which fully reveal the financial fragility associated with excessive investment and risktaking. While fiscal deficits before a crisis are low, the bail-outs represent a serious burden on the *future* fiscal balances. The 'currency' side of a 'financial' crisis can therefore be understood as a consequence of the anticipated fiscal costs of financial restructuring, that generate expectations of a partial monetization of future

unique equilibria, and 'second-generation' models with multiple equilibria. A classification of the models based on exogenous versus endogenous policies provides a more accurate taxonomy.

[4] Among recent contributions to the literature on the 'twin' crises see *e.g.* Velasco (1987), Kaminsky and Reinhart (1997), Goldfajn and Valdes (1997), Kumhof (1997), Chang and Velasco (1998a,b). The role of moral hazard in the onset of the Asian crisis has been discussed by a number of authors. See *e.g.* Krugman (1998 a), Greenspan (1998), Fischer (1998 b).

[5] As pointed out in Section 4, the mid-1990s macroeconomic shocks of particular relevance for the unraveling of the Asian crisis were the prolonged slump in Japan, the strong appreciation of the dollar, negative terms of trade fluctuations, and a regional productivity slowdown.

fiscal deficits and a fall in economic activity induced by the required structural adjustment.[6]

Expectations of a future bail-out need not be based on an explicit promise or policy by the government. Bail-outs can be rationally anticipated by both domestic and foreign agents even when no public insurance scheme is in place and the government explicitly disavows future interventions and guarantees in favor of the corporate and banking sectors. In his celebrated analysis of currency and financial crises of the early 1980s, Carlos Díaz-Alejandro stresses the time-consistency problem inherent in moral hazard:

> *"Whether or not deposits are explicitly insured, the public expects governments to intervene to save most depositors from losses when financial intermediaries run into trouble. Warnings that intervention will not be forthcoming appear to be simply not believable."*[7]

This is because no *ex-ante* announcement by policy-makers can convince the public that, *ex-post* (that is, in the midst of a generalized financial turmoil) the government will cross its arms and let the financial system proceed towards its debacle. Agents will therefore expect a bail-out regardless of "*laissez-faire commitments*" — in the words of Díaz-Alejandro[8] — "*which a misguided minister of finance or central bank president may occasionally utter in a moment of dogmatic exaltation*". In what follows we suggest a simple formal elaboration of the above remarks.

2.1 Technology, market structure and constraints

Consider a small open economy specialized in the production of a traded good Y. The aggregate production function is

$$Y_t = \tilde{A}_t K_t^{\alpha} L^{1-\alpha}$$

[6] In order to maintain both focus and tractability, the model in this contribution necessarily abstracts from a number of factors that are relevant in a comprehensive reading of the Asian crisis. Namely, we do not explicitly model the role of real exchange rate fluctuations in determining the domestic burden of external debt. By the same token, we do not address contagion and issues related to the systemic dimension of the Asian crisis. For an overview of systemic models of currency crises and competitive real depreciations see Buiter, Corsetti and Pesenti (1998a,b) and Corsetti, Pesenti, Roubini and Tille (1998).

[7] Díaz-Alejandro (1985), p.374.

[8] Ib., p.379.

where K is physical capital, L is labor and $\tilde{A}$ is a technology parameter. Labor is inelastically supplied, and normalized to 1.[9] The production technology is stochastic, say

$$\tilde{A}_t = \begin{cases} A+\sigma & \text{with probability } 1/2 \\ \\ A-\sigma & \text{with probability } 1/2. \end{cases} \qquad A > \sigma > 0$$

We posit two assumptions regarding the financial structure of the economy. *First*, the country's asset markets are assumed to be incomplete and segmented: a fraction β of domestic agents — the country *élite* (ELI) — benefit from full access to capital markets, while financial market participation by the remaining $1-\beta$ agents, the *rest of the country* (ROC), is confined to holding domestic real balances.[10] There is no segmentation in the market for labor, assumed to be competitive for both ROC and ELI agents. The assumption of asymmetric financial market participation allows us to analyze distributional issues raised by moral hazard in lending. *Second*, the initial capital stock of the nation is assumed to be entirely financed through external borrowing. This assumption simplifies the exposition of the model without affecting the main results, and is consistent with empirical evidence on the insufficient capitalization of firms in the emerging economies of the Asian region.[11]

Under these assumptions, the representative élite agent borrows funds from abroad, denoted D, and lends capital K to the country's firms, owned by the élite itself. Moreover, as discussed below, to the extent that the élite agents are allowed to borrow in the international financial markets, they do so at the constant world interest rate r. The aggregate budget constraint of

[9] As regards the timing of the variables, K_t, the level of capital in place at time t, is determined at time $t-1$, before the shock $\tilde{A}_t$ is realized and observed.

[10] Note that the asymmetric characterization of private agents in our setup stems exclusively from market segmentation, and need not reflect social or political stratification. The latter aspect is somewhat emphasized in Krugman (1998), who in a similar context refers to the country élite as the class of *minister's nephews*. The political economy of the crisis is a promising direction of research that is not pursued in this paper.

[11] Focusing for instance on the Korean case, by the end of 1996 — well before the onset of the crisis — the average debt-equity ratio for the top-30 chaebols was 333% (the comparable figure for the US being close to 100%). Those chaebols that went bankrupt or had severe financial problems in 1997 tended to have even larger debt-equity ratios. In 1996 some two-thirds of corporate debt in Korea were short-term, of which one quarter was foreign. For details, see Corsetti, Pesenti and Roubini (1998) and OECD (1998).

the élite is therefore:

$$\begin{aligned} & K_{t+1} - K_t - (D_{t+1} - D_t) \frac{\mathcal{E}_t}{P_t} \\ = \; & Y_t - W_t - r \frac{\mathcal{E}_t}{P_t} D_t - C_t^{ELI} - T_t^{ELI} - \frac{M_t^{ELI} - M_{t-1}^{ELI}}{P_t} \end{aligned} \tag{1}$$

where W are labor costs in real terms net of the remuneration of élite labor, C^{ELI} is the élite's consumption, T^{ELI} are net taxes paid by the élite to the government, M^{ELI} is nominal money holdings,[12] P is the domestic price level, and $\mathcal{E}$ is the nominal exchange rate (domestic currency per unit of foreign currency). The standard transversality condition applies.

Labor incomes are the only source of wealth for the agents of the rest of the country, and there is no capital market whereas they can borrow against future incomes. The aggregate budget constraint of the ROC is therefore

$$W_t = C_t^{ROC} + T_t^{ROC} + \frac{M_t^{ROC} - M_{t-1}^{ROC}}{P_t}$$

where C^{ROC} is consumption, T^{ROC} net taxes and $\left(M_t^{ROC} - M_{t-1}^{ROC}\right)/P_t$ the seigniorage tax.

The government implements tax and transfer policies, as well as manage its stock of foreign reserves R, denominated in foreign currency. *Before* a crisis, the government budget identity is therefore

$$T_t + \frac{M_t - M_{t-1}}{P_t} + r \frac{\mathcal{E}_t}{P_t} R_t = \frac{\mathcal{E}_t}{P_t} \left(R_{t+1} - R_t\right)$$

where $T = T^{ELI} + T^{ROC}$ and $M = M^{ELI} + M^{ROC}$. The specification of the budget constraint *after* the crisis — which includes a stock of public liabilities emerging as a consequence of the government bail-out of insolvent private firms — is discussed below.

Accounting for international arbitrage in the goods market (so that purchasing power parity holds and $P_t = \mathcal{E}_t$, where the foreign price level is

[12] The time-subscripts adopted here follow the notational conventions suggested by Obstfeld and Rogoff (1996): the élite enters period t with a stock of capital equal to K_t, a stock of external debt equal to D_t, but a stock of money holdings equal to M_{t-1}^{ELI}. This convention regarding the time-subscript of the money stock is maintained throughout the paper.

assumed to be constant and normalized to one), and by aggregating the budget constraints above we obtain the current account relation

$$-\left(D_{t+1}-R_{t+1}\right)+\left(D_t-R_t\right)=Y_t-r\left(D_t-R_t\right)-C_t-\left(K_{t+1}-K_t\right) \quad (2)$$

where $C=C^{ROC}+C^{ELI}$ denotes aggregate consumption.

2.2 Preferences and optimal behavior

The élite representative agent is risk neutral and her rate of time preference is equal to the world interest rate r. Real money balances provide liquidity services that enter her utility function. Formally, we parameterize the expected utility of the élite agents as:

$$E_t\sum_{s=t}^{\infty}\frac{1}{(1+r)^{s-t}}\left[C_s^{ELI}+\chi\ln\left(M_s^{ELI}/P_s\right)\right] \quad (3)$$

The élite agents maximize (3) with respect to capital K and money holdings M^{ELI}, subject to (1).[13]

The optimal capital choice equates the expected marginal return on capital, adjusted to account for distortionary taxes and transfers, to the cost of funds:

$$E_t\frac{\partial Y_{t+1}}{\partial K_{t+1}}-E_t\frac{\partial\sum_{s=0}^{\infty}T_{t+1+s}^{ELI}/\left(1+r\right)^s}{\partial K_{t+1}}=r \quad (4)$$

In the above expression, the second term on the left hand side allows for the possibility that current investment decisions affect the stream of net taxes (or subsidies) T^{ELI} in future periods. If this term is identically equal to zero (as is the case with lump-sum taxes), the capital stock is set at its efficient level $\bar{K}$ such that $r\bar{K}=\alpha A\bar{K}^{\alpha}$. This is the capital level that maximizes steady-state consumption in the country when the entire stock of capital is financed through net external borrowing ($\bar{K}=D$).[14] If agents expect to receive, on average, a net transfer from the government when they expand investment, the desired capital stock will be larger than $\bar{K}$.

[13] Observe that under the assumption that the entire capital stock is leveraged and the labor market is competitive, in equilibrium the present discounted value of consumption of risk-neutral élite agents is equal to the present discounted value of their after-tax labor incomes.

[14] In a steady state, the current account equation (2) yields $C=AK^{\alpha}-r\left(D-R\right)$, the expression linking long-run consumption to capital and net foreign assets.

Maximizing (3) with respect to money, the optimal demand for real balances by the élite is derived as:

$$\frac{M_t^{ELI}}{P_t} = \chi \frac{1 + i_{t+1}}{i_{t+1}}. \tag{5}$$

In the previous expression, i_{t+1} denotes the domestic nominal interest rate, defined according to the uncovered interest parity relation:

$$1 + i_{t+1} = (1 + r)\, E_t \left(\frac{\mathcal{E}_{t+1}}{\mathcal{E}_t} \right) = (1 + r)\, E_t \left(\frac{P_{t+1}}{P_t} \right).$$

As opposed to the élite, agents in the rest of the country cannot engage in intertemporal asset trade. Their money demand function is interest-inelastic and determined as a cash-in-advance constraint:

$$M_{t-1}^{ROC} = P_t C_t^{ROC}$$

At the aggregate level, demand for money — the sum of M^{ELI} and M^{ROC} — includes both the forward-looking component (5), such that expected future exchange rate depreciation affects current real balances through a variation of the nominal interest rate, and a 'myopic' component proportional to current output (see Appendix I).

2.3 Moral hazard, overinvestment and excessive current account deficit

2.3.1 Modeling moral hazard

In our model, a *financial crisis* can be defined as the event such that the outstanding stock of liabilities of the élite is larger than the capital stock *and* financial markets allow no private borrowing in excess of the capital stock. The essence of moral hazard is that, once a financial crisis materializes, agents rationally expect the government to step in and modify its course of action in order to rescue troubled private firms. Thus, a key maintained assumption underlying our analysis is that government preferences conform the 'Diaz-Alejandro' paradigm discussed at the beginning of this section: in a financial crisis, government welfare falls below the level associated with *any* alternative scenario. It should be clear that this hypothesis by no means implies that the government provides public guarantees to risky projects out of irrationality

or myopia. Rather, the government is unable to commit credibly to *laissez-faire,* so that *ex-post* — in a time-consistent equilibrium — it has no choice but to intervene and validate agents' expectations of a bail-out.

Formally, we have seen that the optimal capital choice is driven by expectations about future net taxes or transfers. For convenience we can rewrite the anticipated stream of net transfers from a marginal increase in the capital stock as

$$\partial \left[\sum_{s=0}^{\infty} T_{t+1+s}^{ELI} / \left(1+r\right)^{s} \right] / \partial K_{t+1} = -\tilde{\theta}_{t+1}$$

Since both domestic and foreign agents rationally anticipate positive bail-out revenue from the government when a crisis occurs, moral hazard can then be modeled as a non-negative transfer scheme $\tilde{\theta}$ contingent on the realization of $\tilde{A}$ and determined as follows. If the realization is negative ($\tilde{A} = A - \sigma$), at the margin agents expect additional transfers from the government, equal to the difference between the bad payoff and the cost of funds. If the realization of the shock is positive ($\tilde{A} = A + \sigma$), no additional transfer is expected to take place. In equilibrium, then, the perceived bail-out transfer per unit of capital is

$$\tilde{\theta}_{t+1} = \alpha \left(A + \sigma - \tilde{A}_{t+1} \right) K_{t+1}^{\alpha-1} = r - \frac{\alpha Y_{t+1}}{K_{t+1}}.$$

As long as élite agents act under the presumption that they will be 'insured' against adverse contingencies, they have no incentive to take a loss (*i.e.,* to lower their consumption) when facing a negative shock: they will instead borrow in the international financial markets and re-finance shortfalls in earnings. It is straightforward to show that the desired level of capital, denoted $\hat{K}$, is higher than the efficient level $\bar{K}$ defined above:

$$\hat{K} \equiv \left(\frac{\alpha \left(A + \sigma \right)}{r} \right)^{\frac{1}{1-\alpha}} > \bar{K} \equiv \left(\frac{\alpha A}{r} \right)^{\frac{1}{1-\alpha}}$$

In Krugman (1998) terminology, such scenario corresponds to 'overinvestment' driven by 'Pangloss values'.

2.3.2 Implications for the current account

A key implication of moral hazard is excessive foreign borrowing, for two reasons. First, as shown above, moral hazard translates into overinvestment. Since the entire capital stock is leveraged, the élite must increase its external

liabilities to finance a stock of capital $\hat{K}$ which is larger than the optimal one. Second, as a negative shock to profitability (a bad realization of $\tilde{A}$) is not offset by a contemporaneous government transfer, in the aggregate élite agents cover their losses and cash shortfalls through the recourse to further foreign borrowing — a process that in jargon is referred to as *evergreening*.[15]

In the presence of evergreening, it is convenient to write total external debt D as the sum of two components:

$$D_{t+1} = K_{t+1} + F_{t+1}$$

where K, the stock of capital, is constant at the level $\hat{K}$, while F is the cumulative level of evergreening since the initial date t_0, that is:

$$F_{t+1} = \sum_{s=t_0}^{t} \left[\alpha \left(A + \sigma - \tilde{A}_s\right) \hat{K}^{\alpha}\right] (1+r)^{t-s} \tag{6}$$

The above equation shows that, other things being equal, F will be higher the worse is the history of 'bad' shocks, and the higher is the 'excessive' capital level $\hat{K}$. At any point in time, the expression in square bracket on the right hand side of (6) has a simple interpretation: it is the *trade deficit associated with the refinancing of an adverse shock to production*. Note that such a deficit is non-negative in all state of nature, so that the recourse to evergreening can cause persistent current account imbalances, and increase the stock of foreign liabilities even when the government budget is balanced, or in surplus.[16]

Since both foreign creditors and domestic agents rely on future public intervention to save troubled private firms in the event of a financial crisis, the country's external deficit is financed at the riskless international lending

[15] See *e.g.* Kumhof (1997).

[16] The overall framework of analysis is by no means confined to the Asian case. For instance, it is instructive to quote once again Díaz-Alejandro (1985) on the Chilean case: "the massive use of central bank credit to 'bail out' private agents raises doubts about the validity of pre-1982 analyses of the fiscal position and debt of the Chilean public sector. The recorded public-sector budget deficit was nonexistent or minuscule for several years through 1981, and moderate during 1982. The declining importance of ostensible public debt in the national balance sheet was celebrated by some observers; [...] *ex-post* it turned out that the public sector, including the central bank, had been accumulating an explosive amount of contingent liabilities to both foreign and domestic agents who held deposits in, or made loans to, the rickety domestic financial sector. This hidden public debt could be turned into cash as the financial system threatened to collapse" (p.372).

rate r. It is straightforward to show that F increases at a rate on average faster than the international interest rate r, reflecting the addition of new borrowing to the dynamics of existing liabilities. It should be clear, however, that evergreening cannot be practiced without limits. For instance, if the dynamics of F led to a persistent current account deficit, the stock of external liabilities of the country would grow faster than the cost of debt, ultimately violating the solvency constraint. If this were the case, the élite would be playing a Ponzi game at the expense of international investors.

Since private debt is perceived as guaranteed by the public sector, a natural constraint to evergreening is the maximum size of F consistent with the government intertemporal budget constraint. In principle, then, international investors could rationally lend to the country at the market rate r as long as F is below such a limit. More realistically, however, it is possible that foreign creditors' willingness to lend vanishes before the government and the country become technically insolvent, reflecting an element of confidence that drives the behavior of international financial markets.[17] We will focus on the implications of such a constraint on external borrowing in the next section.

2.3.3 The role of financial liberalization

Before delving into the analysis of the eruption and consequence of a crisis, it is worth stressing that, in the presence of distortions related to moral hazard, a process of financial liberalization is a key factor in magnifying the adverse implication of moral hazard on macroeconomic stability.

The simplest way to illustrate this point is to model capital controls as a tax on foreign borrowing, say ϕ, such that the cost of borrowing is equal to $r(1+\phi)$. Then, with a perfectly elastic supply of international funds, the élite would equate the *cum-tax* cost of borrowing to the (perceived) return on capital:

$$r(1+\phi) = \alpha(A+\sigma)K^{\alpha-1}$$

corresponding to a lower investment rate relative to $\hat{K}$. In this sense, capital liberalization (the removal of ϕ) aggravates the moral hazard problem and enhances overinvestment and evergreening.[18]

[17] See *e.g.* Milesi-Ferretti and Razin (1996). For a theoretical analysis of confidence, see Morris and Shin (1998).

[18] Similar considerations hold as regards the implications of political distortions on excessive fiscal deficits and external debt accumulation (see Corsetti and Roubini (1997)).

2.4 The dynamics of a crisis

2.4.1 Willingness to lend, government solvency and expected monetization of future deficits

What are the effective constraints on the ability of the private sector to refinance its losses in international financial markets? In addressing this issue, we focus on markets' willingness to lend and posit the following maintained hypothesis: foreign creditors are willing to re-finance domestic firms against expected public guarantees only insofar as the country's liquid collateral, i.e. the stock of foreign official reserves, remains above some minimum threshold expressed as a fraction γ of the evergreening-related stock of debt F. When R reaches the threshold γF, foreign creditors not only refuse to finance new losses: they also refuse to roll-over the outstanding stock of debt, unless the country comes up with enough resources to service its cumulated external liabilities fully and permanently. We will refer to this condition, self-explanatorily, as the *show me the money* constraint,[19] and we will denote t_c the first time at which

$$R_{t_c+1} = \gamma F_{t_c+1} \qquad 0 < \gamma < 1 \tag{7}$$

When the 'show me the money' constraint becomes binding the private sector goes explicitly into a financial crisis, since the outstanding stock of liabilities is larger than the capital stock due to evergreening, and no further increase in foreign borrowing is allowed. Consistent with the moral hazard argument, the élite agents 'present the bill' to the government, which steps in and bails them out. The distinction between private and public debt withers, private liabilities become *de jure* or *de facto* public or publicly guaranteed, corresponding to an appropriate flow of transfers from the public to the élite, and from the élite to international creditors.[20] It should be stressed

[19] The 'show me the money' constraint could also be derived by setting an arbitrary upper limit to the level of *net* external debt (in the spirit of the 'unpleasant monetarist arithmetic'). This limit would take the form $D - K - R \leq \Omega$, where Ω is some positive parameter. Using the definition of F, we could then write:

$$F_{t_c+1}\frac{R_{t_c+1}}{R_{t_c+1}+\Omega} \equiv F_{t_c+1}\gamma_{t_c+1} \leq R_{t_c+1}$$

[20] Typically, a government bail-out consists in guaranteeing all bank deposits, including interbank cross-border liabilities — as was the case in Korea, Thailand and Indonesia.

that, at the time of a crisis, the country is not necessarily forced to repay F at once — rather, the government and the élite are expected to implement a credible plan generating enough resources to service the country's external and internal debt.[21]

To the extent that the crisis leads to the elimination or reduction of implicit public guarantees on investment, capital stock and output fall — so that a crisis corresponds to a contraction in the level of economic activity, a fall in investment, and a sharp adjustment of the current account. In the case in which, after the crisis, no further distortions affect the return on *new* financial investment in the country, the end of moral hazard brings about a contraction of new investment towards its efficient level, so that the post-crisis permanent level of capital stock, denoted $\widetilde{K}$, will be equal to $\bar{K}$.[22]

Assessing the ability of the government to extract fiscal resources from the rest of the country to solve the financial imbalance of the élite, at the time of a crisis agents revise their expectations of money growth. To clarify this point, observe that, *at the time of the crisis,* the solvency condition of the public sector can be written as

$$(1-\gamma)\,F_{t_c+1} - \frac{\eta}{r}\,(1-\alpha)\,A\widetilde{K}^{\alpha} = E_{t_c+1}\sum_{s=t_c+1}^{\infty}\left(\frac{1}{1+r}\right)^{s-t_c}\left(\frac{M_s - M_{s-1}}{P_s}\right) \quad (8)$$

The left hand side of the above expression includes the outstanding stock of implicit liabilities of the government, net of reserves (recall that $R_{t_c+1} = \gamma F_{t_c+1}$), minus the discounted value of the anticipated tax revenue flows. These depend on the post-crisis tax rate on labor income η, as well as on the average size of the post-crisis capital stock. The right hand side includes the discounted value of seigniorage revenue. Algebraic details are presented in Appendix 1.

This implies that the government is assuming responsibility for the gap created by the bad loans on the asset side of the banks' balance sheet. In the case of an explicit bank recapitalization, the government takes over the bad loans of the banking system in exchange for safe government bonds (loans for bond swap). The fiscal cost is the interest payment on these bonds.

[21] For example, if bad loans amount to 20% of GDP, the nominal interest rate is 15% and the real interest rate is 5%, the fiscal cost of servicing the debt is 3% of GDP per year in nominal terms, and only 1% of GDP in real terms.

[22] However, if the crisis itself magnifies the adverse effects of other types of distortions in the financial markets, $\widetilde{K}$ will be lower than $\bar{K}$. For instance, drawing on the Asian experience, the crisis may result in a credit crunch due to the rapid deterioration of the banks balance sheet, or in debt overhang.

The key implication of the above intertemporal budget constraint is that, if the left hand side is positive, agents expect money to grow at a positive average rate. From the crisis onward, this rate is in fact a positive function of the outstanding stock of implicit government liabilities F, and a negative function of the reserves to debt ratio γ, the tax rate η and the post-crisis permanent level of the capital stock $\widetilde{K}$.

2.4.2 The role and timing of speculative attacks on the currency

We can now delve into the analysis of the dynamics of a joint financial *and* currency crisis when the government pegs the nominal exchange rate at some level $\overline{\mathcal{E}}$. Ruling out unrealistic scenarios in which contingent public liabilities F grow over time at a slower rate than public assets R,[23] sooner or later the economy will run into the 'show me the money' constraint, because of the steady increase in the F/R ratio. Conditional on a given γ, then, the timing of the crisis can be determined by following the logic of the standard 'first generation' model of currency crises. In particular, we will focus on the conditions under which a speculative attack on the foreign reserve is a necessary feature of the equilibrium.

In analogy to Grilli (1986), define a 'natural collapse' of the financial system a situation in which no speculative attack on the country's currency occurs before the F/R ratio reaches the threshold γ. According to our analysis above, at the time of the natural collapse there are two possible scenarios.

If η is sufficiently large in equation (8), it is possible that the government be able to raise sufficiently large revenues from explicit taxation without resorting to seigniorage. In this case, the financial crisis does *not* coincide

[23] We have seen that, as a consequence of moral hazard, F grows at a rate higher than r. Yet, neither the solvency nor the 'show me the money' constraints would ever be violated if R also grew at least as fast as F. Since international reserves do not yield an interest rate higher than r, the only way in which R could grow as fast as F is an early fiscal reform raising tax rates on either sectors of the economy, and/or raising seigniorage revenues (but the latter option is not available in a fixed exchange rate regime: as shown in Appendix 1, under a peg seigniorage revenues are on average zero). In this scenario, moral hazard alters the distribution of gains and losses among domestic agents in the society but does not translate into an increase in *net* external liabilities $D - R$. Thus, there are no structural current account deficits, and no external crisis needs to materialize: while private investors take on too much risk, at the aggregate level excessive risktaking is compensated by policies that raise taxes against firms' losses. The picture changes radically when the stock of reserves does not grow as fast as F, as assumed in our analysis.

with an exchange rate crash.[24] If however the size of the bail-outs is such that agents rationally anticipate the need for current and future seigniorage revenue, expectations of future money growth translate into expectations of exchange rate depreciation, driving a sizeable wedge between the domestic and the international nominal interest rates, and causing a currency crisis.

To see this, observe that if left hand side of equation (8) is positive at the time of a natural collapse, money supply must grow at some positive average rate, say $E_t M_{t+1} = (1+\mu) M_t$ with $\mu > 0$. It is straightforward to show that, keeping capital constant at the post-crisis level $\tilde{K}$, the steady-state nominal interest rate is equal to $(1+r)(1+\mu)$ and the steady-state money demand is constant at the level

$$\frac{M}{\mathcal{E}} = \chi \frac{1+r}{r} \frac{1+\mu}{\mu} + A(1-\alpha)(1-\beta)(1-\eta)\tilde{K}^{\alpha},$$

whereas both the price level and the exchange rate also grow at the rate μ. In this case, the forward-looking nature of the exchange rate implies that the natural collapse coincides with the abandonment of the peg and a jump in the value of the currency. Since such a jump is anticipated by economic agents who know the dynamics of debt and reserves, *the natural collapse cannot be a rational expectation equilibrium* (that is, with rational expectations, the peg will collapse before the economy reaches the point of a natural collapse).

Observe that in each period agents can attack the currency and bring down foreign reserves held by the central bank. An crisis will occur when the post-attack equilibrium exchange rate depreciates relative to the current parity. Using the money market equilibrium, the conditions for an attack to occur in period t_S can be written as follows:

$$E_{t_S-1}\mathcal{E}_{t_S} \leq \overline{\mathcal{E}} \qquad E_{t_S}\mathcal{E}_{t_S+1} > \overline{\mathcal{E}}$$

As soon as these conditions hold, speculation in the foreign exchange market drive reserves below γF. At that point, the government stops intervening in the currency market, since the 'show me the money' condition (8) forces the monetary authorities to resort to seigniorage financing and thus to float the exchange rate. As a result, the time of a currency crisis t_S coincides with the time of a financial crisis t_c.

[24] Talvi (1997) considers a model of endogenous fiscal response to the announcement of an inconsistent exchange rate-based stabilization program.

The key point of the above analysis is that a currency crisis 'causes' a financial crisis by bringing R/F down to its lower limit γ. At the same time, a currency crisis is triggered by the anticipation of seigniorage financing of the government bail-outs. The attack will take place as soon as the fundamentals are weak enough (that is, when the stock of external debt no longer refinanced by foreign creditors and now backed by the government is sufficiently high) to induce expectations of a sustained permanent monetary expansion.[25] A crisis thus takes the form of a 'twin' run on the monetary balances (as in the traditional stock-shift reshuffle of money and foreign reserves) and on the foreign liabilities of the financial and corporate sector (the international creditors withdraw the loans triggering a financial crisis).

Our analysis has a final important implication for the post-crisis dynamics of money demand, investment and output. At the time of a 'twin' crisis, the money demand from the élite falls due to the increase in the interest rate i_{t_c+1}, reflecting expectations of exchange rate depreciation. However, demand for money from the rest of the country is still high, as it depends on the existing moral hazard-induced high level of capital and output $\hat{K}$. It is only in the following period $(t_c + 1)$ that external debt, capital, output and ROC money demand all drop, triggering a further depreciation of the exchange rate besides the one induced by high money growth. Such scenario of financial collapse, currency attacks, explicit fiscal imbalances and economic slowdown worsening over time captures in a highly stylized yet coherent way the events that have characterized the onset and aftermath of the 1997-98 crisis in several Asian economies.

3 Empirical evidence

This section presents some preliminary evidence on the determinants of the crises in Asia, testing for the empirical relevance of a set of macroeconomic factors that are consistent with our theoretical interpretation of the 1997-98 events. In our tests we compare the performance of all the Asian countries that were subject to pressures in 1997 with the performance of other emerging economies, for a total sample of 24 countries whose selection has been

[25] Rational agents will never find it optimal to attack the currency 'too soon', when the stock of outstanding liabilities is still too small relative to the country's future tax revenue: in this case, the need for seigniorage revenue is contained, and the anticipated rate of post-attack money growth is correspondingly negligeable.

determined by data availability.[26] Following the methodology suggested in previous studies,[27] we first construct a 'crisis index' as a measure of speculative pressure on a country currency, and then regress this variable on a set of indexes of financial fragility, external imbalances, official reserves adequacy, and fundamental performance.

3.1 The crisis index

Our crisis index (IND) is a weighted average of the percentage rate of exchange rate depreciation relative to the US dollar — if such depreciation can be deemed as abnormal, as explained below — and the percentage rate of change in foreign reserves between the end of December 1996 and the end of December 1997.[28] The logic underlying the index IND is quite simple. A speculative attack against a currency is signalled either by a sharp depreciation of the exchange rate or by a contraction in foreign reserves that prevents a devaluation.[29] We present the values for IND in Table 1: a large negative value for IND corresponds to a high devaluation rate and/or a large fall in foreign reserves, *i.e.* a more severe currency crisis.

In evaluating the crisis index we need to control for the fact that, in some countries, a high rate of depreciation in 1997 may reflect a past trend rather than severe speculative pressures. For example, the fact that the Turkish currency depreciated by over 50% in 1997 should not be interpreted as a signal of 'crisis,' as chronically high inflation rates in Turkey over the 1990s have been associated with 'normally' high depreciation rates.[30]

[26] The countries are Argentina, Brazil, Chile, China, Columbia, Czech Republic, Hong Kong, Hungary, India, Indonesia, Jordan, Korea, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Singapore, Sri Lanka, Taiwan, Thailand, Turkey and Venezuela.

[27] See *e.g.* Eichengreen, Rose and Wyplosz (1996), Sachs, Tornell and Velasco (1996), and Kaminsky, Lizondo and Reinhart (1998).

[28] The weights assigned to exchange rate and reserves changes in IND are respectively 0.75/0.25. For the purpose of sensitivity analysis, we consider alternative crisis indexes with different weights, and find that the choice of the weight coefficients is not crucial to our results. Also, alternative tests with different samples of shorter size provide similar results. All tests are available upon request.

[29] While of course an increase in domestic interest rates may also signal a frustrated speculative attack, our crisis index excludes changes in interest rates. This is because an increase in interest rates in the presence of speculative pressures is highly correlated with non-sterilized foreign exchange intervention leading to a fall in reserves.

[30] Note that Turkey exhibited a satisfactory economic performance in 1997, with GDP growing over 6% and its stock market being a leading performer among emerging countries.

There is no obvious way to purge the sample of the effects of trend depreciations not associated with a crisis. In this study, we take the following approach: if a currency in 1997 has fallen in value by less than its average depreciation rate in the 1994-1996 period, we consider this as being part of a trend depreciation and set the 1997 depreciation rate equal to zero in constructing the index.[31] In our sample, such screening procedure leads to a significant re-sizing of the crisis index for two high-depreciation countries: Turkey and Venezuela.

As Table 1 shows, the countries that in 1997 appear to have been hit by the most severe crises are, in order, Thailand, Malaysia, Korea, Indonesia, Philippines and the Czech Republic. Among Asian countries, the currencies of Singapore and Taiwan were also moderately devalued in 1997, but these two countries were not subject to such extensive and dramatic financial turmoils as the ones affecting other East Asian economies. Conversely, outside the Asian region the Czech Republic appears as a crisis country since its currency, that had been pegged since 1992, suffered a severe speculative attack in the spring of 1997 leading to a devaluation.[32]

3.2 Indexes of financial fragility

Measures of the weakness of the banking system are provided by the stock of non-performing loans as a share of total assets in 1996 (NPL),[33] and an index of 'lending boom' (LB), defined as the growth of commercial bank loans to the private sector (as percentage of GDP) in the period 1990-96. The latter is an indirect measure of financial fragility suggested by Sachs, Tornell and Velasco (1996).[34] Both variables (NPL and LB) are reported in Table 1.

[31] Other authors use a different approach to the same problem. For example, Sachs, Tornell and Velasco (1996) control for the variance of the exchange rate and reserves in the last 10 years.

[32] The Czech Republic shared many symptoms with the Asian crisis countries: a fixed exchange rate regime maintained for too long, a severe real appreciation, a dramatic worsening of the current account, and a weak banking system with large shares of non-performing loans.

[33] Appendix 2 describes in detail our methodology to estimate the series NPL.

[34] These authors argue that such a measure is a proxy for financial fragility as the quality of bank loans is likely to deteriorate significantly — and a large fraction is likely to become non-performing — when bank lending grows at a rapid pace in a relatively short period of time.

We adopt two indicators of domestic financial fragility. The first one encompasses the information in both NPL (non performing loans) and LB (lending boom) and is defined as follows:

$$NPLB = \begin{cases} NPL & \text{if} \quad LB > 0 \\ \\ 0 & \text{if} \quad LB \leq 0 \end{cases}$$

If the sign of the lending boom in the 1990s is positive, we assign to the new indicator $NPLB$ the original value of NPL; if the lending boom in the 1990s is negative, we set $NPLB$ equal to zero.[35]

As regards the second indicator, note that according to our theoretical model the vulnerability of a country to currency and financial crises increases with the implicit fiscal costs of financial bail-outs. To get an appropriate statistical *proxy* for these costs, we therefore measure non-performing loans as a share of GDP, rather than banking assets. In our regressions the series is denoted $NPLY$, and is defined as the product of NPL times commercial banks loans to the private sector as a share of GDP in 1996. This variable allows us to assess properly the performance of those countries with low ratios of bank loans to GDP but relatively large non-performing loans as a share of banking assets (*e.g.* India and Pakistan). In those countries, the contingent fiscal liabilities related to the bail-out costs are smaller relative to countries with a similar NPL, but a higher ratio of bank lending to GDP.

3.3 Indexes of current account imbalances

Table 1 reports the average current account balance as a share of GDP in the 1994-1996 period (CA), and the real exchange rate appreciation in the 1990s (RER). There is no simple way to assess when a current account balance is sustainable (*e.g.*, when it is driven by investment in sound projects) and when is not (*e.g.*, when it reflects a structural loss of competitiveness), or to what extent a real appreciation is due to misalignment, as opposed to an appreciation of the fundamental equilibrium real exchange rate. However, the consensus in the empirical literature on crisis episodes is that the *combination* of a sizable current account deficit and a significant real appreciation represents a worrisome signal of external imbalance.

[35] The logic of the $NPLY$ variable is straightforward: non-performing loans represent a source of severe tension only when observed in tandem with excessive bank lending that enhances the vulnerability of the country to a crisis.

Consistently with this view, we construct an index of *current account imbalance*, CAI, defined as follows:

$$CAI = \begin{cases} CA & \text{if } RER \text{ appreciates by more than } T \\ & (T = 0,\ 10\%) \\ \\ 0 & \text{otherwise} \end{cases}$$

If the rate of real exchange rate appreciation is above a given threshold T, CAI is equal to the current account balance (as a share of GDP); if the real appreciation is below the threshold (or there is a real depreciation), CAI is set equal to zero.[36]

3.4 Indexes of foreign reserves adequacy and fundamentals performance

In our empirical section, we are interested in testing whether the effects of external imbalances and financial fragility are magnified by the inadequate availability of foreign exchange reserves and by the weak performance of other fundamental variables. Other things being equal, the vulnerability of a country to a currency crisis is higher when reserves are low relative to some measure of domestic liquid assets or short-term foreign debt. To assess the role played by reserves availability, we construct three different measures: the ratio of $M1$ to foreign exchange reserves ($M1/RES$), the ratio of $M2$ to foreign reserves ($M2/RES$), the ratio of the foreign debt service burden (i.e. short-term foreign debt plus interest payments on foreign debt) to foreign reserves (STD/RES). The values of these variables are reported in Table 1.

To test for the joint role of fundamentals and foreign reserves in determining a currency crisis, we classify the countries in our sample as being *strong* or *weak* with regards to these two dimensions using dummy variables. As regards foreign reserves, we use a broad classification according to which a country is strong if the ratio of $M2$ to reserves is in the lowest quartile of the sample. The resulting dummy variable for low reserves, $D2^{LR}$, is defined as:

$$D2^{LR} = \begin{cases} 1 & \text{if } M2/RES \text{ above lowest sample quartile} \\ \\ 0 & \text{otherwise} \end{cases}$$

[36] In the tables, we present regression results for the 10% threshold, but similar results are obtained for the zero threshold.

Similar dummies are created by replacing $M2/RES$ with $M1/RES$ and STD/RES; such dummy variables are labelled $D1^{LR}$ and $D3^{LR}$.

As regards fundamentals, we focus on current account imbalances and financial fragility. Countries are classified as being *strong* or *weak* according to the scheme:

$$D^{WF} = \begin{cases} 1 & \text{if } CAI \text{ in highest sample quartile} \\ & \text{or } NPLB \text{ in lowest sample quartile} \\ 0 & \text{otherwise} \end{cases}$$

A similar dummy can be obtained by replacing $NPLB$ with $NPLY$.[37]

3.5 Testing for the role of fundamentals imbalances in the crisis

In column (1) of Table 2, we report the results of the regression of IND on CAI and $NPLB$. The two variables have the expected sign and are statistically significant at the 5% level: both a large current account deficit associated with a real appreciation, and a larger rate of non-performing loans associated with a lending boom worsen the crisis index. In columns (2)-(4) we interact the two regressors with the dummies for low reserves. The coefficients β_2 and β_3 measure the effects of CAI and $NPLB$ on the crisis index in countries with high reserves ($D^{LR} = 0$); conversely, the sums of the coefficients $\beta_2+\beta_4$ and $\beta_3+\beta_5$ measure the impact of fundamental imbalances on the crisis index in countries with low reserves ($D^{LR} = 1$).

In regressions (2)-(4) the coefficients β_2 and β_3 are not significant on their own, but only when reserves are low. In fact, the Wald tests indicate that the hypotheses $\beta_2 + \beta_4 = 0$ and $\beta_3 + \beta_5 = 0$ can be rejected at the 1% and 10% significance levels[38] for the case in which we use the reserve dummy $D2^{LR}$, based on $M2$ data. Similar or stronger results are obtained when we use the other two low-reserves dummies, $D1^{LR}$ and $D3^{LR}$. As a whole, these results suggest that structural imbalances (current account deficits/currency

[37] In this case, the dummy variable would be equal to zero for countries with our index of current account imbalance (CAI) in the highest quartile of the sample, or with a rate of non-performing loans as a share of GDP, *i.e.* $NPLY$, in the lowest quartile of the sample; it would be equal to one otherwise.

[38] Their *p-values* are 0.005 and 0.09 respectively.

appreciation and non-performing loans/lending boom) play a role in the onset of a crisis to the extent that there is insufficient availability of foreign reserves — that is, in the light of our model, to the extent that low reserves enhance the vulnerability of the economy to the 'show me the money' constraint.

Next, in Table 3 we test whether the effects of current account imbalances CAI on the crisis index depend on weak fundamentals D^{WF} and low reserves $D2^{LR}$. Relative to column (2) of Table 2, in column (1) of Table 3 we consider an additional regressor, namely an interaction term equal to CAI times $D2^{LR}$ times D^{WF}. In this case, the sum of the coefficients $\beta_2+\beta_4+\beta_6$ captures the effects of current account imbalances on the crisis index in countries with low reserves and weak fundamentals. If $\beta_2+\beta_4+\beta_6$ is positive while $\beta_2+\beta_4$ is not significantly different from zero, the crisis index worsens when a high-deficit country with an appreciated currency meets both 'weak fundamentals' and 'low reserves' criteria, but the crisis index does not respond to the reserves indicator if such a country is in the 'strong fundamentals' region. The results of the Wald tests show that $\beta_2+\beta_4+\beta_6$ is indeed significantly positive at the 1% significance level, while $\beta_2+\beta_4$ is not significantly different from zero.[39]

In column (2) of Table 3 we consider a similar test for the role of non-performing loans. Here we add another regressor to the ones of column (2) in Table 2, *i.e.*, an interaction term equal to $NPLB$ times $D2^{LR}$ times D^{WF}. Thus, the sum of the coefficients $\beta_3+\beta_5+\beta_7$ captures the effects of non-performing loans on the crisis index in countries that meet both 'low reserves' and 'weak fundamentals' criteria. Our tests show that $\beta_3+\beta_5+\beta_7$ is negative at the 5% significance level while $\beta_3+\beta_5$ is not significantly different from zero, that is the crisis index depends on non-performing loans in countries with weak fundamentals and weak reserves, but not in countries with strong fundamentals and weak reserves. The implication of these results is that a crisis need not be related to current account imbalances or bad loans *per se*: such imbalances represent a source of severe tension only when they are observed in parallel with fundamental *and* reserve weaknesses.[40]

[39] Note also that the coefficient on $NPLB$ (β_3) is still significantly different from zero in this regression.

[40] In column (3) of Table 3, we consider interactions of both CAI and $NPLB$ with the dummies for weak fundamentals and low reserves. The results for $NPLB$ are similar to those in column (2). For the current account, instead, we fail to reject the hypothesis that both $\beta_2+\beta_4+\beta_6$ and $\beta_2+\beta_4$ are equal to zero. Formal tests such as the variance inflation test suggest that this is due to multicollinearity between the two interaction terms: when they both appear in a regression, the effects of CAI are swamped by those of $NPLB$.

Regressions similar to those in Tables 2 and 3 can be performed by substituting $NPLB$ — the non-performing loans ratio adjusted to account for the lending boom — with $NPLY$ — the more direct *proxy* for the implicit fiscal costs of banking sector bail-outs. The results are very similar and, if anything, even stronger than those shown in Tables 2 and 3. In particular, *the coefficient on $NPLY$ tends to maintain the right sign and be statistically significant on its own, affecting the crisis index regardless of whether reserves are low or high, as well as regardless of whether fundamentals are weak or not.*[41]

These results provide evidence in support of the thesis that crises are systematically related to the fundamental weaknesses individuated in our model. The recent turmoil in Asia does not seem to represent an exception in this respect. External imbalances, as measured by the current account deficit interacted with the degree of real appreciation, are significantly correlated with the crisis index. So are measures of the fiscal costs of financial bail-outs (non-performing loans as a share of GDP interacted with measures of lending boom). The effects of these variables on the crisis index are found to be stronger in countries with low reserves.

4 Implications and extensions

Adopting the framework suggested by our model, and drawing on the empirical evidence considered above, in this section we discuss the implications of our analysis for an interpretation of the Asian meltdown. A synthetic overview of the role of moral hazard in magnifying the financial vulnerability of the region during the process of financial market liberalization in the 1990s, and exposing its fragility *vis-à-vis* the macroeconomic and financial shocks that occurred in the period 1995-1997, highlights three different, yet strictly interrelated dimensions at the corporate, financial, and international level.

At the *corporate* level, political pressures to maintain high rates of economic growth had led to a long tradition of public guarantees to private projects, some of which were effectively undertaken under government control, directly subsidized, or supported by policies of directed credit to favored firms and/or industries.[42] Even in the absence of explicit promises of bail-out,

[41] Regression results are available upon request.

[42] See IMF (1997).

the production plans and strategies of the corporate sector largely overlooked costs and riskiness of the underlying investment projects.[43] With financial and industrial policy enmeshed within a widespread business sector network of personal and political favoritism, and with governments that appeared willing to intervene in favor of troubled firms, markets operated under the impression that the return on investment was somewhat 'insured' against adverse shocks.

Such pressures and beliefs represented the underpinnings of a sustained process of capital accumulation, resulting into persistent and sizable current account deficits. While common wisdom holds that borrowing from abroad to finance domestic investment should not raise concerns about external solvency — it could actually be the optimal course of action for undercapitalized economies with good investment opportunities — the evidence for the Asian countries in the mid-1990s highlights that the profitability of new investment projects was low. [44]

Investment rates and capital inflows in Asia remained high even after the negative signals sent by the indicators of profitability. In part, this occurred because the interest rate fall in industrial countries (especially in Japan) lowered the cost of capital for firms and motivated large financial flows into the Asian countries. However, the crucial factor underlying the sustained investment rates was the *financial* side of the moral hazard problem in Asia, leading national banks to borrow excessively from abroad and lend excessively at home. Financial intermediation played a key role in channelling funds toward projects that were marginal if not outright unprofitable from a social point of view.[45]

[43] See Pomerleano (1998) for a thorough assessment of the corporate roots of the financial crisis in Asia.

[44] For instance, in Korea, 20 of the largest 30 conglomerates displayed in 1996 a rate of return on invested capital below the cost of capital. In 1997, before the crisis, as many as 7 of the 30 largest conglomerates could be considered effectively bankrupt. See *e.g.* OECD (1988) for the analysis of the Korean case.

[45] The literature has focused on a long list of structural distortions in the pre-crisis Asian financial and banking sectors: lax supervision and weak regulation; low capital adequacy ratios; lack of incentive-compatible deposit insurance schemes; insufficient expertise in the regulatory institutions; distorted incentives for project selection and monitoring; outright corrupt lending practices; non-market criteria of credit allocation, according to a model of *relationship banking* that emphasizes semi-monopolistic relations between banks and firms, somehow downplaying price signals. All these factors contributed to the build-up of severe weaknesses in the undercapitalized financial system, whose most visible manifestation was

The adverse consequences of these distortions were crucially magnified by the rapid process of capital account liberalization and financial market deregulation in the region during the 1990s, which increased the supply-elasticity of funds from abroad.[46] The extensive liberalization of capital markets was consistent with the policy goal of providing a large supply of low-cost funds to national financial institutions and the domestic corporate sector. The same goal motivated exchange rate policies aimed at reducing the volatility of the domestic currency in terms of the US dollar, thus lowering the risk premium on dollar-denominated debt.

The *international* dimension of the moral hazard problem hinged upon the behavior of international banks, which over the period leading to the crisis had lent large amounts of funds to the region's domestic intermediaries, with apparent neglect of the standards for sound risk assessment.[47] Underlying such overlending syndrome may have been the presumption that short-term interbank cross-border liabilities would be effectively guaranteed by either a direct government intervention in favor of the financial debtors, or by an indirect bail-out through IMF support programs. A very large fraction of foreign debt accumulation was in the form of bank-related short-term, unhedged, foreign-currency denominated liabilities: by the end of 1996, a share of short-term liabilities in total liabilities above 50% was the norm in the region. Moreover, the ratio of short-term external liabilities to foreign reserves — a widely used indicator of financial fragility — was above 100% in Korea, Indonesia and Thailand.

The core implication of moral hazard is that an adverse shock to profitability does not induce financial intermediaries to be more cautious in lending, and to follow financial strategies reducing the overall riskiness of their portfolios. Quite the opposite, in the face of negative circumstances the anticipation of a future bail-out provides a strong incentive to take on even more risk — that is, as Krugman (1998 a) writes, "to play a game of heads I win, tails the taxpayer loses." In this respect, a number of country-specific and global shocks contributed to severely deteriorate the overall economic outlook in the Asian region, exacerbating the distortions already in place.

In particular, the long period of stagnation of the Japanese economy in the 1990s led to a significant export slowdown from the Asian countries; in

eventually a growing share of non-performing loans.

[46] See *e.g.* McKinnon and Pill (1996).

[47] See *e.g.* Stiglitz (1998).

the months preceding the eruption of the crisis, the hopes for a Japanese recovery were shattered by a sudden decline in economic activity in this country. Sector-specific shocks such as the fall in the demand for semiconductors in 1996, and adverse terms of trade fluctuations also contributed to the worsening of the trade balances in the region between 1996 and 1997.

The sharp appreciation of the US dollar relative to the Japanese yen and the European currencies since the second half of 1995 led to deteriorating cost-competitiveness in most Asian countries whose currencies were effectively pegged to the dollar. Based on standard real exchange rate measures, many Asian currencies appreciated in the 1990s, although the degree of real appreciation was not as large as in previous episodes of currency collapses (such as Mexico in 1994). In general, competitive pressures were enhanced by the increasing weight of China in total export from the region.

As a result of the cumulative effects of the financial and real imbalances considered above, by 1997 the Asian countries appeared quite vulnerable to financial crises, either related to sudden switches in market confidence and sentiment, or driven by deteriorating expectations about the poor state of fundamentals. In 1997, the drop of the real estate and stock markets — where sustained speculative trends were in part fueled by foreign capital inflows — led to the emergence of wide losses and outright defaults in the corporate and financial sectors. Policy uncertainty stemming from the lack of commitment to structural reforms by the domestic authorities worsened the overall climate. From the summer of 1997 onward, rapid reversals of financial capital inflows led to the collapse of regional currencies amidst domestic and international investors panic.

Our interpretive scheme suggests that, provided the crisis coincides with the end of moral hazard and the early dismantling of the public guarantees on investment reduces the extent of overinvestment, financial speculation ends up forcing an economic system out of an inefficient equilibrium. At the same time, at the new efficient level of investment, the real income of the rest of the country falls, both because of a lower real wage and a higher tax rate. The crisis thus coincides with a sizeable redistribution of resources from the rest of the country to the élite.

More generally, the crisis makes the end of moral hazard coincide with the magnification of other severe distortions in the financial and real sectors of the economy. Liquidity problems and credit crunch, debt overhang and a persistent loss of confidence by international financial markets reduce output, employment and investment in the crisis countries. As a promising

and important extension of our analysis, some of these mechanisms can be modeled within the theoretical framework outlined in Section 2.

The key role played by the fiscal dimension of the crisis in our model is consistent with the view that structural, or long-run, primary balances should be improved *vis-à-vis* the fiscal burden of the bail-outs. In many of the Asian countries, the magnitude of required public bail-outs of financial institutions is estimated to be as high as 20%-30% of GDP. On a yearly basis, the fiscal costs of the bail-outs only consist in financing the interest payment on the additional public liabilities. Under reasonable assumptions about interest rates, the yearly costs will amount to 2-4 percentage points of GDP. Solvency thus requires an equivalent permanent adjustment in the primary surplus of the public sector. This in part reflects the recommendations by the International Monetary Fund in the summer and the fall of 1997. However, it should be stressed that the model makes a theoretical case for the need to adjust the *structural* (or long-run) primary balance, as a strategy to finance the reform of the financial system and to strengthen the external value of the currency. A mechanical extension of these prescriptions to the short-run, overlooking cyclical arguments in economies hit by sharp recessions, is unwarranted.

5 Conclusions

Many decades of economic growth and development in the region make it clear that there were no *paper tigers* among the East Asian countries. Yet, our analysis of the dramatic break-down of currencies and economic activity in 1997-98 suggests that severe structural weaknesses in the financial and corporate sectors had been masked by strategies of overinvestment. Eventually, the Asian tigers collapsed under the excessive weight of the paper liabilities which had financed projects of doubtful profitability, covered losses, and led to unsustainable external imbalances.

Further research is needed to shed light on the many issues left open for a thorough understanding of the causes of the crisis, its international propagation, and its welfare implications. A partial list of questions includes: the analysis of real depreciations and their effects on the real burden of foreign debt, through the disruptive increase of short-term foreign liabilities by domestic firms and banks; the assessment of self-fulfilling liquidity crises, under scenarios in which sudden shifts in market confidence lead to large-

scale reversals of short-term capital flows; and the contagious elements of the crisis, including — but not limited to — the 'beggar-thy-neighbor' spiral of competitive devaluations and speculative attacks in the region.

Nonetheless, the analysis in this paper stresses that at the root of the Asian currency and economic crisis was a complex web of structural distortions and fundamental weaknesses. Because of moral hazard banks borrowed heavily in foreign currency, and their debt positions were often short-term and unhedged, as borrowers acted on the presumption that the exchange rates would remain stable, and they would be bailed-out if things went wrong. When indeed things went wrong and a series of domestic and external shocks revealed the low profitability of past investments, the shaky foundations of investment strategies in the region emerged, and currency and financial crises appeared inextricably intertwined.

Almost fifteen years ago, Diaz Alejandro interpreted the Chilean crisis in terms of the inconsistency between a policy of rapid liberalization of domestic and international capital flows, and the lax supervision of financial institutions. Our analysis suggests that, to a large extent as well as to a much larger scale, the Asian region witnessed in the 1990s a materialization of the same scenario: "good-bye financial repression, hello financial crash".

Appendix 1

To obtain an expression for aggregate money demand, assume that the share of the élite in total workforce is β and recall that with competitive labor markets the wage incomes of ROC agents are equal to $W = (1-\beta)\,\partial Y/\partial L$. Modelling net taxes on labor incomes as a fraction η of real wages, aggregate money demand can be written as:

$$\frac{M_t}{P_t} = \frac{M_t^{ELI} + M_t^{ROC}}{P_t} = \chi \frac{1+i_{t+1}}{i_{t+1}} + (1-\alpha)(1-\beta)(1-\eta_t)\,\tilde{A}_t K_t^{\alpha}.$$

Under the pre-crisis fixed exchange rate regime, $P_t = \overline{\mathcal{E}}$, $i_{t+1} = r$, $K = \hat{K}$, so that for constant η seigniorage revenues are, on average, zero:

$$\frac{M_t - M_{t-1}}{\overline{\mathcal{E}}} = (1-\alpha)(1-\beta)(1-\eta)\left(\tilde{A}_t - \tilde{A}_{t-1}\right)\hat{K}^{\alpha}.$$

At time t_c, the budget constraint of the government is

$$0 = (1+r)\,R_{t_c+1} + E_{t_c+1}\sum_{s=t_c+1}^{\infty}\left(\frac{1}{1+r}\right)^{s-t_c-1}\left(T_s^{ELI} + T_s^{ROC} + \frac{M_s - M_{s-1}}{P_s}\right)$$

The level of reserves R_{t_c+1} is equal to γF_{t_c+1} by definition of t_c. The present discounted value of T_s^{ROC} is equal to

$$E_{t_c+1}\sum_{s=t_c+1}^{\infty}\left(\frac{T_s^{ROC}}{1+r}\right)^{s-t_c-1} = E_{t_c+1}\sum_{s=t_c+1}^{\infty}\left(\frac{\eta W_s}{1+r}\right)^{s-t_c-1} = \frac{1+r}{r}\eta(1-\alpha)(1-\beta)A\bar{K}$$

The present discounted value of T_s^{ELI} is equal to the present discounted value of taxes on élite labor incomes minus the current level of foreign debt backed by implicit government guarantees, that is:

$$E_{t_c+1}\sum_{s=t_c+1}^{\infty}\left(\frac{1}{1+r}\right)^{s-t_c-1} T_s^{ELI} = \frac{1+r}{r}\eta(1-\alpha)\beta A\bar{K} - F_{t_c+1}(1+r)$$

Rearranging, we obtain expression (8) in the main text.

Appendix 2

In this appendix we describe in detail the construction of the variables used in the empirical analysis.

Crisis index (IND)

The index is a weighted average of the percentage rate of exchange rate depreciation relative to the US dollar and the percentage rate of change in foreign reserves between the end of December 1996 and the end of December 1997. A large negative value for IND corresponds to a high devaluation rate and/or a fall in foreign reserves, *i.e.* a more severe currency crisis. All data are from the International Financial Statistics of the International Monetary Fund (IFS-IMF).

Real exchange rate appreciation

This variable measures the percentage rate of change of the real exchange rate between the end of 1996 and an average over the 1988-1990 period. The real exchange rate measure is based on wholesale price indexes, using trade weights of OECD countries (excluding Mexico and Korea). For the three transition economies — Czech Republic, Hungary and Poland — whose real exchange rates exhibit large fluctuations in the early transition years, the appreciation is calculated between 1996 and 1992. For Argentina, whose real exchange rate experienced large swings in the hyperinflation period, the real exchange rate is computed between 1996 and the end of 1990.

Current account deficits and the CAI index

The current account deficit as a share of GDP is an average over the 1994-96 period. Data are from IFS-IMF. The index of current account imbalances CAI is computed as follows: for countries where the real exchange rate appreciated more than 10% over the period defined above, CAI takes the value of the average 1994-96 current account balance (as a share of GDP); for all other countries, CAI is set equal to zero.

Lending boom (LB)

This variable is the rate of growth between 1990 and 1996 of the ratio between the claims on the private sector of the deposit money banks (line 22d in IFS-IMF) and nominal GDP. All data are from IFS-IMF. In the case of transition economies whereas either data since 1990 are not available or the ratio is very unstable in the early transition years, we take 1992 (rather than 1990) as the starting date.

Non-performing loans as a share of total bank assets (NPL).

As there are no homogeneous series for non-performing loans, we need to build our dataset relying on several sources. For most of the Asian countries in our sample (Korea, Indonesia, Hong Kong, Taiwan, Malaysia, Thailand) there are two available estimates of NPL in 1996; one from the 1997 BIS Annual Report, the other from Jardine Fleming. Both estimates are biased:

the former underestimates non-performing loans before the onset of the crisis (for instance, the end-of-1996 figure for Korea is 0.8%); the latter is based on data from the third quarter of 1997, when non-performing loans are already reflecting the consequences of the currency crises on the financial conditions of banks and corporate firms (for instance, Korean non-performing loans are estimated to be 16%). We take the average of the two figures as a reasonable estimate of the non-performing loans before the onset of the crisis, *i.e.* end 1996-early 1997. For the remaining countries, we proceed as follows: for India, Argentina, Brazil, Chile, Colombia, Mexico, Peru, Venezuela we use the estimates for 1996 in the BIS 1997 Annual Report. For China, Singapore and the Philippines, we use estimates from Jardine Fleming. For the other countries in the sample, we rely on information derived from IMF country reports. It is worth emphasizing that our estimates do not appear to be systematically biased towards the countries that suffered a crisis in 1997. Note in fact that non-crisis countries such as Mexico, China, India and Pakistan all show a very large fraction of non-performing loans (over 10% of total loans).

Fiscal cost of the bail-out of the banking system as a share of GDP ($NPLY$)

This variable is computed as follows. We take the estimate of the non-performing loans as a share of banks assets (NPL) derived above and we multiply it by the ratio to GDP of claims on the private sector by deposit money banks at the end of 1996. The latter variable is computed from IFS-IMF data.

The NPLB index

In deriving $NPLB$, we interact the lending boom variable with the non-performing loans variable: for countries where the sign of the lending boom variable is positive, we set *NPL2* equal to NPL; for countries with a negative lending boom, we set $NPLB$ equal to zero.

Reserve adequacy ratios

We compute three ratios for reserve adequacy at the end of 1996. The first is the ratio of $M1$ to foreign exchange reserves ($M1/RES$); the second is the ratio of $M2$ to foreign reserves ($M2/RES$); the third is the ratio of the foreign debt service burden (*i.e.* short-term foreign debt plus interest payments on foreign debt) to foreign reserves (STD/RES). Foreign exchange reserve data are from the IFS-IMF (line 1l.d). Data on short term debt and interest payments on foreign debt are from Datastream.

Taiwan

Taiwan is not included in the IMF data base. Our data for Taiwan are

from Datastream and rely on Taiwan national data sources.

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Table 1. Crisis and Economic Indicators
Percentage or percentage change

Country	*Crisis Index (IND)*	*Real Appreciation (RER)*	*Current Account (CA)*	*Lending Boom (LB)*	*Non-Performing Loans (NPL)*	*Reserves Adequacy (M2/RES)*	*Reserves Adequacy (M1/RES)*	*Reserves Adequacy (STD/RES)*
Argentina	4.9	38.6	-1.9	16.5	9.4	351.0	108.2	147.8
Brazil	-0.5	75.8	-2.0	-26.3	5.8	345.9	66.8	78.3
Chile	-1.4	37.5	-1.7	24.1	1.0	188.2	41.9	53.3
China	7.6	4.9	0.8	6.9	14.0	828.9	334.0	26.7
Columbia	-9.1	26.6	-5.0	35.0	4.6	209.4	104.3	73.9
Czech	-19.5	50.7	-4.4	22.7	12.0	356.9	139.5	42.9
Hong Kong	5.7	31.8	-1.6	25.5	3.4	411.9	34.2	20.0
Hungary	-1.6	-38.8	-6.5	-56.5	3.2	167.1	83.3	52.3
India	5.7	-29.1	-1.2	-2.3	17.3	860.0	296.5	37.2
Indonesia	-38.3	17.5	-2.9	9.6	12.9	614.8	114.3	188.9
Jordan	9.8	6.1	-4.5	1.4	6.0	437.8	141.4	33.9
Korea	-38.6	11.1	-2.5	11.2	8.4	665.4	147.6	217.0
Malaysia	-38.8	19.9	-6.4	31.1	9.9	364.8	115.6	45.3
Mexico	10.9	8.9	-2.7	-10.9	12.5	444.8	129.3	142.9
Pakistan	11.4	-2.0	-5.3	-3.7	17.5	3369.9	1822.8	399.0
Peru	0.7	-20.4	-6.2	177.2	5.1	123.6	32.4	61.6
Philippines	-29.8	38.9	-4.6	150.8	14.0	465.6	91.8	849.3
Poland	3.5	30.0	0.9	38.5	6.0	262.3	95.9	14.2
Singapore	-15.7	4.7	16.5	16.7	4.0	103.5	25.0	20.0
Sri Lanka	-1.0	17.7	-5.7	28.4	5.0	236.4	72.9	26.8
Taiwan	-11.4	-7.0	2.9	43.4	3.9	575.1	141.0	22.8
Thailand	-47.8	20.0	-7.2	58.0	13.3	380.5	43.3	121.5
Turkey	4.3	-16.1	-0.1	43.2	0.8	302.6	48.9	76.0
Venezuela	4.9	2.2	6.8	-51.5	3.8	102.4	58.5	28.2

Table 2. Explaining the Crisis Index[a]

Estimated coefficient and summary statistic	*Independent variable*	*(1)*	*(2)* *Regression with M2/RES*	*(3)* *Regression with M1/RES*	*(4)* *Regression with STD2/RES*
β_1	constant	6.877	7.073	7.437	5.324
		(3.755)	(4.094)	(3.956)	(3.552)
β_2	*CAI*	3.768	0.849	2.210	0.569
		(1.254)	(2.869)	(3.677)	(1.971)
β_3	*NPLB*	-1.338	-2.888	-2.805	-0.476
		(0.605)	(2.073)	(1.946)	(0.782)
β_4	$CAI \times D2^{LR}$		3.613		
			(3.191)		
β_5	$NPLB \times D2^{LR}$		1.761		
			(2.035)		
β_4	$CAI \times D1^{LR}$			1.467	
				(3.982)	
β_5	$NPLB \times D1^{LR}$			1.534	
				(1.929)	
β_4	$CAI \times D3^{LR}$				3.571
					(2.564)
β_5	$NPLB \times D3^{LR}$				-0.864
					(0.986)
Summary statistic					
$\overline{R}^2$		0.555	0.541	0.536	0.622
R^2		0.594	0.621	0.616	0.688
Addendum: Wald tests					
Null hypothesis		*p values*	*p values*	*p values*	*p values*
$\beta_2 + \beta_4 = 0$			0.005	0.018	0.023
$\beta_3 + \beta_5 = 0$			0.099	0.057	0.091

[a] The dependent variable is the crisis index, *IND*. See Table 1 and Appendix for definition of variables. Standard errors are shown in parentheses.

Table 3. Explaining the Crisis Index[a]

Estimated coefficient and summary statistic	*Independent Variable*	(1)	(2)	(3)
β_1	constant	-2.861	5.535	5.602
		(2.138)	(3.887)	(4.082)
β_2	*CAI*	0.841	0.762	0.766
		(2.946)	(2.694)	(2.771)
β_3	*NPLB*	-1.338	-2.569	-2.583
		(0.605)	(1.954)	(2.017)
β_4	$CAI \times D2^{LR}$	2.851	1.118	1.559
		(6.650)	(3.274)	(6.293)
β_5	$NPLB \times D2^{LR}$	1.769	2.448	2.446
		(2.091)	(1.945)	(2.000)
β_6	$CAI \times D2^{LR} \times D^{WF}$	0.834		-0.497
		(6.337)		(6.004)
β_7	$NPLB \times D2^{LR} \times D^{WF}$		-2.120	-2.131
			(1.123)	(1.164)
Summary statistic				
$\overline{R}^2$		0.516	0.596	0.572
R^2		0.621	0.684	0.683
Addendum: Wald tests				
Null hypothesis		*p values*	*p values*	*p values*
$\beta_2 + \beta_4 = 0$		0.547	0.337	0.688
$\beta_2 + \beta_4 + \beta_6 = 0$		0.009		0.388
$\beta_3 + \beta_5 = 0$		0.146	0.883	0.875
$\beta_3 + \beta_5 + \beta_7 = 0$			0.017	0.026

[a] The dependent variable is the crisis index, *IND*. See Table 1 and Appendix for definition of variables. Standard errors are shown in parentheses.