
The Economics of Currency Crises and Contagion: An Introduction

- Traditional models of currency crises suggest that weak or unsustainable economic policies are the cause of exchange rate instability. These models provide a partial explanation of the Asian currency crisis, but they cannot account for its severity.
- A more comprehensive view of the turmoil in Asia takes into account the interaction of policy and volatile capital markets. Weak policy makes a country vulnerable to abrupt shifts in investor confidence; the sudden rise of investor expectations of a crisis can force a policy response that validates the original expectations.
- Two additional factors help explain the severity of the Asia crisis: inadequate supervision of the banking and financial sectors in the affected countries and the rapid transmission of the crisis through structural links and spillover effects among the countries.

The 1990s witnessed several episodes of currency turmoil, most notably the near-breakdown of the European Exchange Rate Mechanism in 1992-93, the Latin American Tequila Crisis following Mexico's peso devaluation in 1994-95, and the severe crisis that swept through Asia in 1997-98.¹ However, the economic effects of this exchange rate instability have been especially devastating in Asia. Following years of stellar performances, the crisis-hit countries of Thailand, Malaysia, Indonesia, the Philippines, and South Korea experienced a plunge in the external value of their currencies and a sudden reversal of private capital flows from June 1997 onward. Investors had poured massive amounts of funds into the Asian countries until the first half of 1997, then drastically reversed the pattern in the summer, as "hot money" flowed out at a staggering pace. The ensuing \$100 billion net capital outflow represented a sizable shock to the region, accounting for 10 percent of the combined GDP of the five crisis-hit countries.

International economists and policy analysts attempting to explain the severity of recent currency and financial crises face a major challenge. These episodes have generated considerable—and a finely balanced—debate over whether currency and financial instability can be attributed to arbitrary shifts in market expectations and confidence, or to weakness in economic fundamentals.

To advance the discussion of currency crises, this article presents an introduction to the economic analyses of the crises.

Paolo Pesenti is a senior economist and Cédric Tille an economist at the Federal Reserve Bank of New York.

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We begin by discussing the so-called first generation of models, in which crises are viewed in the literature as the unavoidable result of unsustainable policies or fundamental imbalances. Next, we survey the literature on the second generation of models, which highlights the possibility of self-fulfilling exchange rate crises. We then turn to two key aspects of recent crisis episodes that were not fully addressed in earlier models—namely, the role of the banking and financial sectors and the issue of “contagion,” which is the transmission of a crisis across countries. We conclude by proposing a synthesis of the different views and applying it to the Asia crisis. We contend that far from being mutually exclusive, contrasted approaches complement each other by painting a comprehensive picture of the recent upheavals: the fundamental imbalances stressed by first-generation models make a country vulnerable to shifts in investor sentiment; once a crisis does occur, the second-generation models explain its self-reinforcing features.

First-Generation Models: Unsustainable Economic Policies and Structural Imbalances

In the literature on exchange rate instability, one approach—often referred to as first-generation or exogenous-policy models—views a currency crisis as the unavoidable outcome of unsustainable policy stances or structural imbalances.² This view stresses that the exchange rate regime is a component of a broader policy package, and the regime can be sustained only if it does not conflict with other monetary and fiscal objectives. The ability of a country to cover its current account deficits by generating sufficient export earnings in the future is also a major factor affecting the viability of an exchange rate regime, according to the first-generation view.

Consider a country with an expansionary monetary policy and a fixed exchange rate. In this economy, the defense of the exchange rate peg will lead to a depletion of foreign reserves held by the domestic central bank. More precisely, the rate of domestic credit expansion is bound to exceed the growth in demand for the domestic currency. Agents who are accumulating excess liquidity prefer to exchange domestic currency for foreign-denominated securities or domestic interest-bearing assets. Both scenarios lead to a depreciation of the domestic currency. In the former case, pressures stem directly from increased demand for foreign securities. In the latter, domestic bond prices will rise and their yields will fall, leading market participants to sell domestic securities and buy

higher yielding foreign assets. Since the domestic central bank is committed to keeping the exchange rate fixed, it must accommodate the increased demand for foreign currency by reducing its foreign reserves. In sum, the process of domestic credit expansion translates into a loss of reserves.

At first glance, we would expect the stock of foreign reserves to fall over time. When the reserves are exhausted, the central bank would have no choice but to let the domestic currency float. A key insight of the first-generation model, however, is that the exhaustion of reserves takes the form of a sudden depletion, instead of a gradual running down of the stock. Acting in anticipation of an exchange rate depreciation, market participants liquidate their domestic currency holdings while the stock of foreign reserves held by the central bank is still relatively large. In the context of this model, a currency crisis takes the form of a speculative attack and a stock-shift portfolio reshuffling occurs as soon as agents can confidently expect a non-negative return on speculation. In such a crisis scenario, agents buy the entire stock of foreign reserves that the central bank is willing to commit to defend the fixed exchange rate. In the aftermath of the speculative attack, the central bank is forced to float the currency.

It is easy to interpret this exogenous-policy model in terms of an inconsistency between a fixed exchange rate regime and domestic fiscal imbalances. In fact, the credit expansion described above can be thought of as the result of a fiscal deficit monetization by the central bank. From this vantage point, we see that the model shows that fiscal imbalances directly contribute to a country’s vulnerability to currency crises and speculative attacks.

However, there is an important qualification to the above analysis. Since a speculative attack is triggered by the market’s *foresight* of an unavoidable depreciation, what matters for the analysis are the *future* policy stances that investors foresee, not the ones observed in the *past*. In other words, the fact that a country does not run a sizable fiscal deficit is not a legitimate reason to rule out the possibility of a currency crisis. This is because the observed fiscal balance may be a poor indicator of the effective government net liabilities. To understand this, consider a country in which there is no public deficit or debt, but whose private sector is subject to a series of shocks that threaten corporate and banking profitability. These financial difficulties may require the government to bail out troubled institutions. Bailout intervention can take different forms, but ultimately it has a fiscal nature and it directly affects the distribution of income and wealth between financial intermediaries and taxpayers. Agents observing the weaknesses of the private sector can see that the government will be forced to adopt an expansionary monetary stance in the future to

finance the costs of bailout intervention.³ Since such expansion is inconsistent with maintaining the exchange rate peg, investors will expect the currency to depreciate, and this expectation will trigger a speculative attack.

These considerations can be extended to shed light on the role of structural imbalances—such as chronic current account deficits—in triggering currency crises. A current account deficit represents net borrowing from the rest of the world, so dependency on foreign sources of capital can put a country in a vulnerable position. For example, a deterioration in the country's terms of trade can significantly reduce its ability to repay its debt. Foreign investors might then decide not to extend lending further. Should the private sector become insolvent vis-à-vis its external creditors, the buildup of private sector liabilities ultimately becomes a severe burden for the

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public sector. The latter would be asked to rescue private institutions as soon as foreign creditors stopped rolling over existing debt and called in their loans. The dynamics of a currency crisis then follow the same logical steps of the first-generation model analyzed above. Note that a currency devaluation in this framework can help to restore current account sustainability by boosting foreign demand for the country's exports.

The above scenario raises the question, under what conditions can a current account deficit be unsustainable? A country's ability to generate the funds required to pay off its debt is related to its ability to run future trade surpluses. Clearly, a deterioration of the export outlook adversely affects the ability to repay debt. Such a deterioration can result from several factors. For example, domestic inflation can increase the price of traded goods and services under a fixed exchange rate, leading to a slowdown in exports. A similar loss of competitiveness can occur under a fixed exchange rate regime when the exchange rate appreciates against important trading partners. For example, as the countries affected by the Asia

crisis were pegging their currencies to the U.S. dollar, the competitiveness of their exports to Japan suffered from an appreciation of the dollar against the yen in the two years preceding the crisis.

The sustainability of a current account deficit also depends on the use of the borrowed funds. If the deficit finances investment projects in the traded sectors, such investment will provide a new source of export revenue, thereby generating the earnings required to repay the debt. By the same token, a current account deficit that finances investment in a nontraded sector—such as real estate—or in low-profit projects is less sustainable since the return on the investment will not be sufficient to service the debt.

Second-Generation Models: Self-Fulfilling Expectations and Multiple Equilibria

In first-generation interpretations of currency crises, the viability, or lack thereof, of an exchange rate peg is determined by exogenous fundamentals unrelated to the behavior of economic agents. In the model considered above, for instance, market participants base their expectations on the presumption that their actions will not affect fiscal imbalances or domestic credit policies. By contrast, the interaction between expectations and actual outcomes is at the core of the second-generation models of crises, in which market expectations directly influence macroeconomic policy decisions.⁴ Such models are also referred to as the endogenous-policy approach, since policymakers' actions in these models represent optimal responses to macroeconomic shocks.

The key point emphasized in second-generation models is that the interaction between investors' expectations and actual policy outcomes can lead to self-fulfilling crises. This point can be illustrated by means of a stylized example in which entirely different outcomes can occur depending on the agents' expectations. This indeterminacy is at the core of the model's ability to rationalize large market movements, even in the absence of corresponding changes in fundamentals.

Consider a country whose monetary authorities are committed to maintaining the exchange rate peg, but are willing to float their currency under extraordinary circumstances such as a sharp cyclical downturn. If the country's loans from abroad were denominated in the borrowing nation's domestic currency, foreign investors would face the possibility of a devaluation of that currency, which would reduce the value of their claims. If foreign investors considered the possibility of a devaluation to be

very likely, they would charge a high-risk premium on their loans. The country's borrowing costs would rise significantly, reducing credit opportunities and curtailing output growth. The country's authorities would then deem the costs of maintaining the peg to be too high and choose to devalue their currency to boost aggregate demand and employment. The devaluation, in turn, would validate the initial investors' expectations. Ultimately, investors' forecasts are self-fulfilling prophecies: expectations of devaluation lead to actions (the risk premium hike) that raise the opportunity cost of defending the fixed parity. Therefore, the forecasts force a policy response (the abandonment of the peg) that validates the original expectations.

Note that the crisis scenario described above is not the only possible outcome of our simple model. Consider an alternative scenario in which investors do not forecast any devaluation and do not charge any risk premium. In this case, borrowing costs would remain low and the authorities could maintain the exchange rate peg, thereby validating the expectations of no devaluation. Our model is then characterized by the possibility of multiple outcomes, or "equilibria." All things being equal, there are situations in which currency stability is undermined and situations in which it is not. A currency crisis can be thought of as a shift in expectations toward the devaluation outcome. Such a shift suddenly makes the defense of the peg excessively costly.

The main advantage of resorting to such an interpretation of currency crises is the ability to distinguish between two kinds of volatility: one related to financial markets and one related to macroeconomic fundamentals.

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The former volatility substantially exceeds the latter. Market sentiment—in the form of sudden and arbitrary changes in market participants' expectations—then plays a prominent role in the determination of a crisis. Exchange rates (and other asset prices) are less predictable than they are in models with a unique outcome. As a result, second-generation models are deemed to "square better with the stylized facts of global financial markets" (Masson 1999). These models, however, do not explain what *causes* the shifts

in private agents' expectations. In other words, the theory remains silent on the determinants of the losses of confidence that are the cornerstone of the analysis.

Features of Crisis Episodes Highlighted by the Asian Turmoil

The fundamental and self-fulfilling views of currency crises outlined above provide the two main analytical and conceptual frameworks in which to interpret cases of currency instability. However, it has been argued that these two theories—developed *before* the recent crisis episodes—overlook several features that played central roles in the turmoil of the 1990s, especially the Asia crisis. We now take a close look at two of these features, emphasized in the post-Asia crisis literature—namely, the role of the banking and financial sector and the mechanisms of crisis transmission across countries, or contagion.

The Banking and Financial Sector

Several recent studies have argued that currency and banking crises in emerging markets should be seen as twin events, and that the feedback channel between them should be investigated.⁵ In other words, banking and currency crises can generate a vicious circle by amplifying each other. Indicators of financial strength are therefore crucial when assessing a country's vulnerability to a crisis and the economic impact of exchange rate instability. The central role of financial institutions also points to the need to supervise and regulate the sector, to limit excessive borrowing from abroad, and to reduce the risk that temporary liquidity shortages will trigger full-fledged financial crises. In terms of the distinction between fundamental and self-fulfilling views, the role of the banking sector spans both approaches. The feedback channel between banking and currency crises falls under the fundamental approach, as do the health of the financial sector balance sheets and the overborrowing syndrome. By contrast, liquidity-driven crises in the banking sector reflect the interaction between expectations and outcomes.

A currency crisis has an adverse effect on the banking sector when banks' liabilities are denominated in a foreign currency. A devaluation suddenly and sharply increases the value, expressed in the domestic currency, of these liabilities. As banks typically lend domestically in the local currency, a devaluation exposes them to a sizable currency mismatch and

a deterioration of their balance sheets.⁶ In turn, a banking crisis can lead to a currency crisis through the burden it imposes on the fiscal side of the economy. The cost of addressing the consequences of a banking crisis, such as the liquidation of insolvent banks, is borne by the public sector. A banking crisis is therefore associated with a large, and possibly unexpected, worsening of the fiscal position of a country. A drastic change in effective public liabilities can trigger expectations of monetization of the fiscal deficit and exchange rate depreciation. The mechanism is similar to the one in first-generation models of currency crises stressing the role of unsustainable fiscal policies.⁷

In sum, a country's vulnerability to currency crises strongly depends on the health and stability of its banking sector. The strength of financial intermediaries also affects the impact of a devaluation on real variables. By worsening the balance sheets of financial intermediaries, a devaluation can generate a pronounced tightening in credit market conditions, possibly leading to a contraction in output. The adverse consequences of a devaluation are therefore more severe if banks' balance sheets are plagued with nonperforming loans, or if financial intermediaries borrow heavily in foreign currencies at short horizons.

The central role of financial intermediaries has a number of important implications. First, microeconomic indicators (such as corporate profitability, and debt-to-equity ratios) can help predict the imminence and the likelihood of a currency crisis better than the standard macroeconomic indicators (such as fiscal imbalances and current account deficits). For instance, if firms do not scale back their operations when they experience a fall in investment profitability, they must resort to external financing. To the extent that most of the additional borrowing is short-term, debt financing adds to the fragility of the corporate sector. From the vantage point of the banking sector, low corporate profits and corporate weaknesses result in significant shares of nonperforming loans.⁸

Second, particular attention should be paid to effective supervision and regulation of financial intermediaries in the process of capital market liberalization. Liberalization implemented amid weak supervision can increase a country's vulnerability to external crises by magnifying existing distortions and weaknesses. The reduction in borrowing costs due to financial deregulation can lead banks and firms to borrow extensively in foreign currencies, and funnel the funds toward the acquisition of highly risky assets and/or toward the financing of low-profit and dubious investment projects. The limited ability of the financial regulators to enforce prudential rules makes such excessive borrowing possible.

Third, explicit or implicit government guarantees to the private sector magnify a *moral hazard* problem faced by

financial intermediaries.⁹ Banks will engage in excessively risky borrowing and investment if they expect that the authorities will intervene in the event of massive financial distress.¹⁰ The expectation of financial bailouts can also lead foreign investors to lend with little regard to the riskiness of the projects they are financing.¹¹ From this vantage point, a fixed exchange rate regime is intrinsically unstable and contains the seed of its own collapse. This is because the apparent stability of the exchange rate peg leads financial intermediaries to overlook currency risk, and induces them to borrow heavily in foreign currencies without hedging their exposures.¹²

The central role played by the financial sector in the recent turmoil raises the possibility of liquidity-driven crises, as opposed to the usual solvency-driven events analyzed in earlier models. Chang and Velasco (1998) have stressed the possibility

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of self-fulfilling international liquidity crises and international bank runs.¹³ In an open economy with unrestricted capital markets, domestic banks are free to accept deposits from both domestic and foreign residents, in both domestic and foreign currencies. These liabilities are used primarily to fund longer term illiquid investments that cannot be readily converted to cash. If bank depositors—both foreign and domestic—anticipate a speculative run, they will seek to exchange their claims on financial institutions for the foreign currency. Banks are then forced to liquidate their investments in order to raise the cash needed to pay off their depositors. Since investments are long-term, they can be liquidated only at highly discounted prices. As a result, even a well-managed bank can quickly exhaust its cash reserves and become insolvent, thereby validating the initial expectation of a run. Because of systemic links, the run could spread to the entire banking and financial sector. If such an event were to occur, extreme strain on the exchange rate and a rapid loss of official reserves are likely to ensue.¹⁴

Contagion

A striking aspect of the crises in the 1990s was their occurrence across several countries and their fast regional spread. For instance, the devaluation of the Thai baht in July 1997 was followed by currency crises in Malaysia and Indonesia within a month and in Korea a few months later. In the literature, this phenomenon is usually—and perhaps mistakenly—referred to as contagion.

Various explanations for the transmission of a crisis across countries can be offered. First, several countries can be similarly affected by a common shock (although a crisis can spread even in the absence of such a shock). Trade linkages can transmit a crisis, as a currency depreciation in one country weakens fundamentals in other countries by reducing the competitiveness of their exports. Financial interdependence can also contribute to the transmission of a crisis, as initial turmoil in one country can lead outside creditors to recall their loans elsewhere, thereby creating a credit crunch in other debtor countries. Finally, a currency crisis in one country can worsen market participants' perception of the economic outlook in countries with similar characteristics and trigger a

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generalized fall in investor confidence. Explanations of the international transmission of crises contain elements that fall under both the fundamental and the self-fulfilling approaches. Common shocks, along with transmission through trade channels and common creditors, can be categorized as fundamentals-driven crises. By contrast, the role of information frictions in capital markets is consistent with the self-fulfilling view.

The first explanation for the simultaneous occurrence of a crisis in different countries holds that the countries are hit by common shocks, or display similar elements of domestic vulnerability. For instance, several Asian countries shared common features such as a high reliance on foreign-

denominated debt and a relatively stable exchange rate against the U.S. dollar. The occurrence of a crisis across several countries can be seen as an initial disturbance being replicated in other places, rather than as the transmission of a shock from one country to another.

In the absence of common shocks, a currency crisis can be transmitted from one country (A) to another (B) if structural links and international spillovers make the economies of countries A and B interdependent. That is, if the currency devaluation by country A has a negative impact on country B's fundamentals, it will eventually force country B's currency devaluation.

International trade is an obvious candidate for such spillover.¹⁵ The devaluation by country A reduces the price of its goods in foreign markets, leading consumers to purchase more goods produced in country A and fewer goods produced in other countries, including country B, as they are now relatively more expensive. This consumption switching adversely affects the sales by firms in country B. The ensuing reduction in export earnings can, in turn, significantly hamper the ability of country B to sustain a current account deficit, which can leave that country's currency open to attack. Country B may then be left with no choice but to devalue its currency to sustain its exports since defending it may prove too costly in terms of higher interest rates and foreign reserve losses.

Interestingly, the international transmission of a currency crisis through the trade channel does not rely on large trade flows between the two countries. The transmission can occur even if countries A and country B do not trade with each other. The key feature is that their exports compete in other foreign markets. The strength of the transmission mechanism through the trade channel depends on the degree to which goods produced in different countries are similar to each other (so that world demand for goods produced by countries A and B is highly sensitive to price differentials). Also, the trade channel is especially relevant in the transmission of currency crises when countries A and B sell their products in the same markets (see Box 1 for an example).

Besides trade links, different countries are interdependent if they borrow from the same creditors. Indeed, the central role played by capital flows during the Asia crisis suggests that such linkages are especially relevant, as discussed in Kaminsky and Reinhart (2000).

A currency crisis in country A reduces the ability of domestic borrowers to repay their loans to outside banks. Faced with a larger share of nonperforming loans, foreign banks rebuild their capital by recalling some of their loans, including loans made to borrowers in other countries. Borrowers in country B then suffer from a credit crunch caused

by the impact of the currency crisis in country A on their creditors. Interestingly, such a recall can generate a regional pattern in the credit crunch even if banks recall their loans evenly across *all* countries in their portfolio. The credit crunch is sharper in the countries that depend on those banks that incurred heavy losses due to the initial crisis, as illustrated in Box 2.

Notwithstanding the spillover effects resulting from trade linkages or common creditors, a crisis can spread from one country to another because of information asymmetries in

financial markets. Gathering and processing country-specific data on a large number of emerging markets is costly. As pointed out by Calvo (1999) and Calvo and Mendoza (forthcoming), investors may downplay national specificities and asymmetries, and consider several countries in a region as substantially homogeneous. A new piece of information concerning one country can then be extrapolated and applied to the entire group. Country-specific events such as a devaluation may be perceived as “wake-up” calls leading to a generalized reevaluation of investment prospects in the region.

Box 1

Transmission of a Currency Crisis via Trade Channels

Country A and country B do not trade directly with each other, but they export goods to country C and country D. Table 1 presents a baseline case in which country B exports mostly to country D, whereas country A exports mostly to country C.

Table 1

Initial Trade Flows to	Export Share (Percent)			Market Share (Percent)	
	C	D	Total	C	D
From A	90	10	100	90	10
From B	10	90	100	10	90
Total				100	100

Note: Country B's exports fall 1.8 percent following a 10.0 percent devaluation of country A's currency.

The extent to which country B is adversely affected through this indirect trade link depends on the weight of country A exports in the markets on which country B depends most. In our case, the extent of competition between country A and country B is small, as they export to different markets. The devaluation by country A has only a moderate effect on country B exports, as a 10.0 percent devaluation reduces them by 1.8 percent. A technical analysis allows us to derive the following relationship between the percentage devaluation of country A currency vis-à-vis the currencies of countries C and D, *DEV*, and the percentage reduction in country B exports, *EXPRED*:

$$\frac{EXPRED}{DEV} = \sum_{k=C,D} [\rho(k) \times EXSH(B, k) \times MKSH(A, k)],$$

where *EXSH(B, k)* is the share of country B exports to market *k*, and *MKSH(A, k)* is the market share of goods produced in country A in market *k*. $\rho(k)$ reflects the degree to which goods from countries A and B are substitutable in market *k*. The numerical example assumes that a 10 percent decrease in the relative price of goods produced in country A, relative to goods produced in country B, leads to a 10 percent increase in the

demand for goods produced in country A, relative to goods produced in country B ($\rho(C) = \rho(D) = 1$).

Table 2 illustrates the impact of a larger market share of country A exports in country D. Note that the share of country B exports to country D remains unchanged at 90 percent.

Table 2

Initial Trade Flows to	Export Share (Percent)			Market Share (Percent)	
	C	D	Total	C	D
From A	10	90	100	50	50
From B	10	90	100	50	50
Total				100	100

Note: Country B's exports fall 5 percent following a 10 percent devaluation in country A's currency.

In the second example, a 10 percent devaluation by country A leads to a 5 percent contraction in country B exports. The contraction is sharper because country D relies more on country A exports than it does in the first example.

Table 3 illustrates the role of the geographical composition of exports. Compared with Table 1, a larger share of country B exports goes to country C. Note that the market share of country A goods in country C is unchanged. The impact of the devaluation by country A is stronger than in the baseline case, as a 10.0 percent devaluation contracts country B exports by 3.4 percent.

Table 3

Initial Trade Flows to	Export Share (Percent)			Market Share (Percent)	
	C	D	Total	C	D
From A	180	5	185	90	10
From B	20	45	65	10	90
Total				100	100

Note: Country B's exports fall 3.4 percent following a 10.0 percent devaluation in country A's currency.

A Credit Crunch

We consider a situation in which two financial institutions, say bank 1 and bank 2, hold a portfolio of loans in three countries: A, B, and C. The devaluation by country A reduces the ability of borrowers in this country to repay their debts. Banks incur losses, as the quality of their portfolio of borrowers from country A is reduced. In order to absorb these losses and rebuild their capital, the banks have to recall some of their loans to other countries, thereby generating a credit crunch.

The table presents a numerical illustration. It shows the portfolio of the two banks in the three countries, before the devaluation of country A's currency. For simplicity, we assume that all loans to country A are lost, and that each bank has to recall loans to countries B and C. It shows that bank 1 has the largest exposure to country A, as loans to country A represent 33 percent of its predevaluation portfolio, versus 10 percent for bank 2. Bank 1 therefore recalls 50 percent of its loans in countries B and C, whereas bank 2 recalls 11 percent of its loans.

The larger rate of recall by bank 1 is not sufficient by itself to generate a geographical spread of the credit crunch: if the share of bank 1 in total debt is the same in countries B and C, the extent of the credit crunch will also be the same. However, in our example country B is more dependent on bank 1 than country C is, as 66 percent of loans to country B represent bank 1 assets, versus 20 percent of loans to country C. Note that the stronger dependence on bank 1 in country B does not necessarily lead to a different extent of credit crunch across countries. If both bank 1 and bank 2 were to recall their loans at the same rate, the share of loans owed to bank 1 would be irrelevant.

	Initial Portfolio		Exposure (Percent)		Dependence (Percent)		
	From Bank 1	From Bank 2	Bank 1	Bank 2	Bank 1	Bank 2	Total
To A	20	10	33	10			
To B	20	10	33	10	66	33	100
To C	20	80	33	80	20	80	100
Total			100	100			

Note: The extent of the credit crunch is 37 percent in country B and 19 percent in country C. The amount of loans recalled by banks 1 and 2 is 20 and 10, respectively, representing $20/(20 + 20) = 50$ percent and $10/(10 + 80) = 11.1$ percent of the postdevaluation portfolios. The extent of the credit contraction in countries B and C is then 20×50 percent + 10×11.1 percent = 11.1 percent and 20×50 percent + 80×11.1 percent = 18.8 percent, respectively, representing 11.1 percent / $(20 + 10) = 37$ percent and 18.8 percent / $(20 + 80) = 19$ percent of their initial debts.

Our example is characterized by a combination of exposure differences among banks and dependence differences among countries, which lead to a geographical concentration of the credit crunch. Country B is more adversely affected than country C, as it depends on the bank that was most affected by the initial crisis in country A. It is worth stressing that geographical heterogeneity does not stem from banks recalling more loans to country B than country C. Instead, banks recall all loans worldwide to the same extent, and the more severe credit crunch experienced by country B only reflects the initial composition of portfolios.

In addition, information costs can lead investors to focus their efforts on a small number of countries, leading to the emergence of clusters of specialists. This phenomenon can cause herding behavior by investors, where the optimal investment strategy regarding a specific country involves following the lead of the investor most likely to be informed of the prospects of that country.

For illustrative purposes, consider two agents investing in assets issued by countries A and B. Because of information-processing costs, the two agents choose to focus their analytical efforts on, respectively, country A and country B. Due to her limited knowledge of country B, country A's specialist

determines the share of country B's assets in her portfolio by replicating the behavior of country B's specialist. The key aspect of such a strategy is that country A's specialist observes the action but not the ultimate motivation of country B's specialist. For instance, a sale of country B's assets by country B's specialist may be the result of adverse news regarding country B, or an investor-specific need for liquidity. In the latter case, as country A's specialist "mimics" the action of country B's specialist, a generalized capital outflow from country B occurs, even though there is no deterioration in fundamentals.¹⁶

A Synthesized View as Applied to Asia

Our discussion of the role of the banking and finance sectors and the international transmission of crises—two central aspects of the Asia crisis—has highlighted the fact that they encompass both the fundamental and self-fulfilling views of currency crises. This section suggests that the two views are ultimately complementary rather than opposing, and that their synthesis can help to create a comprehensive picture of recent episodes of turmoil in exchange rate markets.

Taken separately, each view offers an unsatisfactory explanation of the Asian events. Explanations based on the interactions between expectations and outcomes fail to account for the 1997 confidence crises and overlook the evidence of several factors that contributed to the deterioration of fundamentals in Asia well before the onset of the crisis. Moreover, explanations based on fundamentals cannot account for the unpredictability and severity of the crisis.

A synthesized approach combines the strengths of each view and stresses how they complement one another. Fundamental weaknesses leave countries at the mercy of sudden shifts in market sentiment, and confidence crises have devastating implications when they act as catalysts of ongoing processes.¹⁷ Indeed, advocates of both the fundamental and the self-fulfilling views agree in principle that a deteriorating economic outlook increases an economy's vulnerability to a crisis. Whether or not the plunges in asset prices after the eruption of the event are driven by self-fulfilling expectations and investor panic, weak economic fundamentals are a crucial element in the genesis and spread of a crisis.

According to such a synthesized view, the Asia crisis resulted from the interaction between structural weaknesses and the volatility of the international capital markets. The relevance of fundamental imbalances is illustrated by the different experiences of several countries during the crisis. Taiwan, Singapore, and Hong Kong were, relatively speaking, less affected by the regional turmoil. The Hong Kong currency parity was maintained despite strong speculative attacks. Taiwan and Singapore decided to let their currencies float rather than to lose reserves by trying to stabilize the exchange rate. The depreciation rates of their currencies were modest and, most important, they did not experience drastic reversals in market sentiment, financial panic, and large-scale debt crises.

These three countries shared a number of characteristics. Their trade and current account balances were in surplus in the 1990s and their foreign debt was low (Taiwan was a net foreign creditor toward Bank for International Settlements banks). They had a relatively large stock of foreign exchange reserves

compared with those of the crisis countries. Their financial and banking systems did not suffer from the same structural weaknesses and fragility observed in the crisis countries. And finally, they were perhaps less exposed to forms of so-called “crony capitalism” with intermingled interests among financial institutions, political leaders, and corporate elite. Conversely, the Asian countries that came under speculative attack in 1997—Thailand, Malaysia, Indonesia, the Philippines, and South Korea—had the largest current account deficits throughout the 1990s. Although the degree of real appreciation over the 1990s differed widely across Asian countries, all the currencies that crashed in 1997, with the important exception of Korea's, had experienced a real appreciation (Corsetti, Pesenti, and Roubini 1999b and Tornell 1999).

The major fundamental weakness of the Asian countries consisted of the exposed position of the banking and corporate sectors in an environment of limited prudential supervision. Indeed, it has been argued that the Asian miracle occurred despite significant distortions of the market mechanism in the financial sector. In the presence of extensive controls and limits on foreign borrowing, these distortions did not translate into high domestic vulnerability to external shocks. This key feature

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changed with the liberalization of financial markets in the early 1990s, which provided Asian borrowers with access to inexpensive foreign funds (McKinnon and Pill 1997). Although international capital markets became progressively more accessible and domestic markets were deregulated, supervision of the financial system remained inadequate—the best-known example being provided by the strong, unregulated growth of financial companies in Thailand.

In such an environment of limited prudential supervision, financial intermediaries borrowed heavily in foreign currencies over short horizons, as the stability of the exchange rate and the perception of government guarantees contributed to a false sense of safety. The funds were then channeled to investment projects of questionable profitability. Domestic banks and foreign investors downplayed the riskiness of their positions, in part because the authorities were perceived as guarantors and in part because the stellar past economic performance provided

the background for overly optimistic projections. The financial sector was therefore left with an increasing portfolio of nonperforming loans, financed by short-term foreign borrowing. The ensuing maturity and currency mismatch exposed the banks and the countries as a whole to reversals of capital flows.

As a result, even a small attack on a currency was bound to put a snowball mechanism in motion. The authorities' ability to defend the exchange rate peg through higher interest rates was limited, as such rates would have jeopardized the financial and corporate sectors. They were then left with little choice but to allow the currency to depreciate.¹⁸ But the outcome was a sharp deterioration of financial institutions' balance sheets and a surge in the domestic value of foreign debt, leading to the bankruptcy of several banks and firms. The fiscal cost of any bailout by the government in turn fueled the loss in investor confidence.

Conclusion

The central role of the financial sector has led to a reassessment of the optimal pace of financial liberalization, due to the necessity of setting up adequate supervisory and regulatory mechanisms—and being able to enforce them—as preconditions for the removal of obstacles to international borrowing and lending. In terms of its lessons for future crisis prevention strategies, the Asian episode points especially to the need to prevent the accumulation of a large stock of foreign-currency-denominated debt. It also emphasizes the need to control the magnitude of currency and maturity mismatches of the assets and liabilities of financial institutions and firms. Whether debt is held by the private or the public sector does not affect this conclusion, because the difference between the two categories blurs in crisis situations.

Endnotes

1. For recent studies focusing on the large-scale speculative episodes in the 1990s, see, for example, Eichengreen and Wyplosz (1993) and Buitier, Corsetti, and Pesenti (1998a, 1998b) on the European Monetary System crisis of 1992-93; Sachs, Tornell, and Velasco (1996) and Calvo and Mendoza (1996) on the Mexican peso crisis of 1994; and International Monetary Fund (1997, 1998), Corsetti, Pesenti, and Roubini (1999a, 1999b), Mishkin (1999), and Radelet and Sachs (1998) on the Asia crisis of 1997-98.
2. The approach was pioneered by Krugman (1979), who adapted a model by Salant and Henderson (1978) to the analysis of currency crises. It was further refined by Flood and Garber (1984).
3. For an earlier presentation of these considerations, see Diaz-Alejandro (1985). The contributions made by Dooley (1997) and McKinnon and Pill (1997) present an analysis along similar lines. For recent analytical models, see Corsetti, Pesenti, and Roubini (1999a) and Burnside, Eichenbaum, and Rebelo (1998).
4. The standard studies on self-fulfilling crises are Obstfeld (1986, 1994).
5. For instance, Kaminsky and Reinhart (1999) find that problems in the banking sector typically precede a currency crisis, which in turn deepens the banking crisis.
6. Caballero and Krishnamurthy (1999) and Krugman (1999) point to another impact of a currency crisis on balance sheets: devaluation reduces the foreign currency value of the borrower's collateral, thereby curtailing the country's access to additional funding.
7. Weaknesses in the banking sector played a key role in crisis episodes preceding the Asian meltdown. In Mexico, the banking and financial system was fragile even before the peso crisis of 1994 (see Krueger and Tornell [1999]). The peso devaluation of 1994 increased the pressure on the banking system, leading to a crisis estimated to have accounted for about 14 to 20 percent of GDP.
8. The profitability of Asian firms indeed appears to have decreased on the eve of the crisis. For instance, the Korean conglomerates (*chaebols*) relied heavily on debt to finance low-return investments, leading to very low profits, if any (World Bank 1998). Similarly, a study of a wide sample of firms in the Asian countries by Claessens, Djankov, and Lang (1998) shows reduced profits on investments since the mid-1990s.
9. See Krugman (1998), Mishkin (1999), and Corsetti, Pesenti, and Roubini (1999a).
10. Dooley (1997), and Chinn, Dooley, and Shrestha (1999) consider a model where the government cannot credibly commit not to use its reserves for an eventual bailout of the financial sector. Private agents then accumulate guaranteed assets in the country with the intention to redeem them eventually for government reserves. A crisis occurs when investors trade their assets for reserves.
11. Díaz-Alejandro (1985) highlights a similar problem underlying the financial crisis experienced by Chile during the process of deregulation and liberalization in the early 1980s.
12. Note that twin crises leave the authorities with a policy dilemma. If a currency comes under speculative attack, a defense of the exchange rate through an interest rate hike may be counterproductive, as higher interest rates contribute to the collapse of the weakened banking sector. However, if the country does not stabilize its exchange rate, a currency plunge worsens bank balance sheets and ultimately becomes a catalyst of further banking sector disruption.
13. The authors extend the banking crisis model developed by Diamond and Dybvig (1983) to an open economy.
14. The provision of liquidity in a currency crisis poses a problem not faced in domestic bank runs. Both types of crises begin with a widespread attempt to convert short-term claims into currency. In a closed economy, the central bank can satisfy these claims by issuing (in principle) an unlimited supply of domestic currency. In an open economy, however, the central bank can only provide foreign currency up to the extent of its stock of foreign reserves. Furthermore, in a closed economy, a bank run can be ruled out with deposit insurance and access to the central bank discount window. In an open economy, the central bank may not have enough reserves to function as its lender of last resort; hence, the potential need exists for an international lender of last resort.
15. For studies stressing the role of trade linkages, see Eichengreen, Rose, and Wyplosz (1996) and Glick and Rose (1998). Structural spillovers are at the core of the interpretation of the 1992-93 European Monetary System crisis by Buitier, Corsetti, and Pesenti (1998a, 1998b). A modern revisit of the theory of competitive devaluations is provided by Corsetti, Pesenti, Roubini, and Tille (2000).

Endnotes (Continued)

16. A related model by Chari and Kehoe (1997) assumes that each potential investor observes an imperfect signal of the profitability of an investment project and decides whether to invest based on this signal and the investment decisions of other investors. This strategy can lead to an entrapment of information. If the first—in terms of observed behavior—agents decide not to invest, subsequent investors may infer that their predecessors received adverse signals and decide to refrain from the project, even if their own signal is positive. Several authors analyze whether financial markets are characterized by “pure” contagion, in the sense that changes in asset prices in a country have an effect on prices in other countries that cannot be explained by trade or common creditor links. The debate remains active as there is no compelling evidence that emerging markets have experienced such contagion (Baig and Goldfajn 1999; Brown, Goetzmann, and Park 1998; Choe, Kho, and Stulz 1998; Forbes and Rigobon 1999).

17. Models with multiple equilibria show that an economy with strong fundamentals is not exposed to a crisis risk, whereas one with weak fundamentals is in a region of parameters where shifts in

investors’ expectations can occur as rational phenomena. Morris and Shin (1998) show that the multiplicity of equilibria disappears if investors receive private signals of the state of fundamentals. Their approach provides the foundation for an endogenous theory of confidence crises.

18. It has been argued that currency crises and their adverse impact could be avoided by adopting more stringent forms of exchange rate pegging. An example is a currency board in which the entire monetary base is backed by foreign reserves. However, it is unclear whether such arrangements address the core problem. Obstfeld and Rogoff (1995) stress that currency crises reflect the unwillingness of the monetary authorities to incur the costs of defending the exchange rate peg, and not their inability to do so.

References

- Baig, Taimur, and Ilian Goldfajn.* 1999. "Financial Market Contagion in the Asian Crisis." *International Monetary Fund Staff Papers* 46, no. 2: 167-95.
- Brown, Stephen, William Goetzmann, and James Park.* 1998. "Hedge Funds and the Asian Currency Crisis of 1997." NBER Working Paper no. 6427.
- Buiter, Willem, Giancarlo Corsetti, and Paolo Pesenti.* 1998a. *Financial Markets and European Monetary Cooperation: The Lessons of the 1992-93 Exchange Rate Mechanism Crisis.* Cambridge: Cambridge University Press.
- . 1998b. "Interpreting the ERM Crisis: Country-Specific and Systemic Issues." *Princeton Studies in International Finance*, no. 84 (March).
- Burnside, Craig, Martin Eichenbaum, and Sergio Rebelo.* 1998. "Prospective Deficits and the Asian Currency Crisis." NBER Working Paper no. 6758.
- Caballero, Ricardo, and Arvind Krishnamurthy.* 1999. "Emerging Market Crises: An Asset Markets Perspective." NBER Working Paper no. 6843.
- Calvo, Guillermo.* 1999. "Contagion in Emerging Markets: When Wall Street Is a Carrier." Unpublished paper, University of Maryland.
- Calvo, Guillermo, and Enrique Mendoza.* 1996. "Reflections on Mexico's Balance-of-Payments Crisis: A Chronicle of Death Foretold." *Journal of International Economics* 41 (November): 235-64.
- . Forthcoming. "Rational Contagion and the Globalization of Securities Markets." *Journal of International Economics*.
- Chang, Roberto, and Andrés Velasco.* 1998. "Financial Crises in Emerging Markets." NBER Working Paper no. 6606.
- Chari, V. V., and Patrick Kehoe.* 1997. "Hot Money." NBER Working Paper no. 6007.
- Chinn, Menzie, Michael Dooley, and Sona Shrestha.* 1999. "Latin America and East Asia in the Context of an Insurance Model of Currency Crises." NBER Working Paper no. 7091.
- Choe, Hyuk, Bong-Chan Kho, and René Stulz.* 1998. "Do Foreign Investors Destabilize Stock Markets? The Korean Experience in 1997." NBER Working Paper no. 6661.
- Claessens S., S. Djankov, and L. Lang.* 1998. "East Asian Corporates: Growth, Financing, and Risks over the Last Decades." Unpublished paper, World Bank.
- Corsetti, Giancarlo, Paolo Pesenti, and Nouriel Roubini.* 1999a. "Paper Tigers? A Model of the Asian Crisis." *European Economic Review* 43, no. 7 (June): 1211-36.
- . 1999b. "What Caused the Asian Currency and Financial Crisis?" *Japan and the World Economy* 11, no. 3 (October): 305-73.
- Corsetti, Giancarlo, Paolo Pesenti, Nouriel Roubini, and Cédric Tille.* 2000. "Competitive Devaluations: Toward A Welfare-Based Approach." *Journal of International Economics* 51: 217-41.
- Diamond, Douglas, and Phillip Dybvig.* 1983. "Bank Runs, Deposit Insurance, and Liquidity." *Journal of Political Economy* 91 (June): 401-19.
- Diaz-Alejandro, Carlos.* 1985. "Goodbye Financial Repression, Hello Financial Crash." *Journal of Development Economics* 19 (September): 1-24.
- Dooley, Michael.* 1997. "A Model of Crises in Emerging Markets." NBER Working Paper no. 6300.
- Eichengreen, Barry, Andrew Rose, and Charles Wyplosz.* 1996. "Contagious Currency Crises." NBER Working Paper no. 5681.
- Eichengreen, Barry, and Charles Wyplosz.* 1993. "The Unstable EMS." *Brookings Papers on Economic Activity*, no. 1: 51-124.
- Flood, Robert, and Peter Garber.* 1984. "Collapsing Exchange Rate Regimes: Some Linear Examples." *Journal of International Economics* 17 (August): 1-13.
- Forbes, Kristin, and Roberto Rigobon.* 1999. "No Contagion, Only Interdependence: Measuring Stock Market Comovements." NBER Working Paper no. 7267.

References (Continued)

- Glick, Reuven, and Andrew Rose.* 1998. "Contagion and Trade: Why Are Currency Crises Regional?" Center for Economic and Policy Research Discussion Paper no. 1947.
- International Monetary Fund.* 1997. World Economic Outlook, Interim Assessment, December. Washington, D.C.
- . 1998. World Economic Outlook, September. Washington, D.C.
- Kaminsky, Graciela, and Carmen Reinhart.* 1999. "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems." American Economic Review 89, no. 3 (June): 473-500.
- . 2000. "On Crises, Contagion, and Confusion." Journal of International Economics 51 (June): 145-68.
- Krueger, Anne, and Aaron Tornell.* 1999. "The Role of Bank Restructuring in Recovering from Crises: Mexico 1995-1998." NBER Working Paper no. 7042.
- Krugman, Paul.* 1979. "A Model of Balance-of-Payments Crises." Journal of Money, Credit, and Banking 11 (August): 311-25.
- . 1998. "What Happened to Asia?" Unpublished paper, Massachusetts Institute of Technology.
- . 1999. "Balance Sheets, the Transfer Problem, and Financial Crises." In Peter Isard, Assaf Razin, and Andrew K. Rose, eds., International Finance and Financial Crises: Essays in Honor of Robert P. Flood, Jr., 31-56. Boston: Kluwer Academic Publishers.
- Masson, Paul.* 1999. "Multiple Equilibria, Contagion, and the Emerging Market Crises." Unpublished paper, International Monetary Fund.
- McKinnon, Ronald, and Huw Pill.* 1997. "Credible Economic Liberalizations and Overborrowing." American Economic Review 87, no. 2 (May): 189-93. Papers and Proceedings of the 109th Annual Meeting of the American Economic Association.
- Mishkin, Frederic.* 1999. "Lessons from the Asian Crisis." NBER Working Paper no. 7102.
- Morris, Stephen, and Hyun-Song Shin.* 1998. "Unique Equilibrium in a Model of Self-Fulfilling Currency Attacks." American Economic Review 88 (June): 587-97.
- Obstfeld, Maurice.* 1986. "Rational and Self-Fulfilling Balance-of-Payments Crises." American Economic Review 76 (March): 72-91.
- . 1994. "The Logic of Currency Crises." Cahiers économiques et monétaires 43 (November): 189-213.
- Obstfeld, Maurice, and Kenneth Rogoff.* 1995. "The Mirage of Fixed Exchange Rates." Journal of Economic Perspectives 9, no. 4: 73-96.
- Radelet, Steven, and Jeffrey Sachs.* 1998. "The Onset of the East Asian Financial Crisis." NBER Working Paper no. 6680.
- Sachs, Jeffrey, Aaron Tornell, and Andrés Velasco.* 1996. "Financial Crises in Emerging Markets: The Lessons from 1995." Brookings Papers on Economic Activity, no. 1: 147-215.
- Salant, Stephen, and Dale Henderson.* 1978. "Market Anticipations of Government Policies and the Price of Gold." Journal of Political Economy 86 (August): 627-48.
- Tornell, Aaron.* 1999. "Common Fundamentals in the Tequila and Asian Crises." NBER Working Paper no. 7139.
- World Bank.* 1998. East Asia: The Road to Recovery. Washington, D.C.

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