Free Currency Markets, Financial Crises and the Growth Debacle: Is There a Causal Relationship?

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The paper develops an alternative hypothesis that attributes collateral responsibility for the recent spate of financial crises to a basic flaw of the architecture of the international financial system, free markets for foreign exchange. A valid positional distinction between reserve/hard and soft currencies, based on reputation, accounts for the systematic substitution of the former currencies for a country's soft currency in liquid asset holdings. The result of this "asymmetric reputation" in an environment of free currency markets is the systematic devaluation of soft currencies. Moreover, bubbles, devaluations and financial crises, far from being self-correcting monetary phenomena, can lead to sharp contractions in the economy through the misallocation of resources in competitive devaluation trade, as opposed to comparative advantage trade. In a case that is parallel to asymmetric information and incomplete credit markets, the appropriate policy intervention in asymmetric-reputation driven incomplete currency markets is maintaining mildly repressed exchange rates. The operational definition of "mild" is imposing restrictions on currency substitution, whether it is home-grown or it is the result of foreign financial capital taking short positions on the local currency. (*JEL* Classification: F31, F41, G15)

I. Introduction

Financial crises are happening with alarming regularity in the

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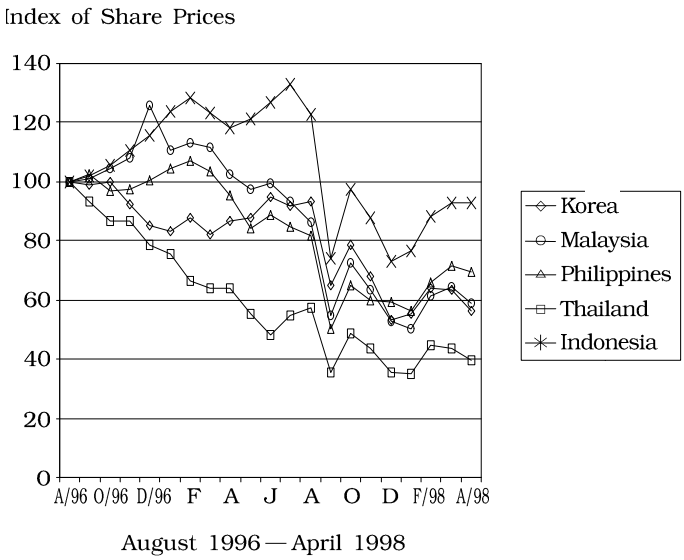
1990's. The defining characteristics of these crises, Asian or otherwise, can be distilled in three figures. The diagnosis of what happened, and the cures for the disease that have been prescribed, can also be organized and discussed around the three figures.

An asset value bubble preceded all the crises. In the Asian countries in specific the stock market capitalization had been increasing frenetically for at least a year, reaching historical highs by April 1997 (Figure 1). There is general agreement on the diagnosis of a speculative boom. Beyond that, most economists subscribe to the efficient market hypothesis asserting that stocks are always properly priced. Excessive speculation and speculative bubbles are merely instruments for making fools part with their money. The implication is that there can be no causal relationship between a speculative bubble and subsequent foreign exchange crises (Figure 2) or economic contraction, recession or depression (Figure 3).

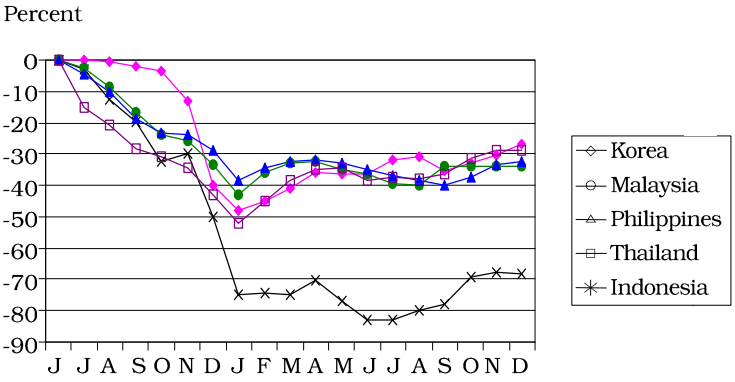
That speculative bubbles wrought no lasting harm in an economy is sometimes correct. The tulip mania of the 1630s left Amsterdam merchants who did not play the game unscathed; and the Dutch economy was no worse off when the tulip craze came to an abrupt halt (Chancellor 1999). But history is not always that forgiving and normally a bubble is followed by real-world effects and an economic debacle as in Figures 2 and 3. Then the search begins for fault-finding in the fundamentals of the economy and for fingering hapless policy-makers for sundry and various mistakes. There is valid currency in these attempts in many cases. Milton Friedman, for example, has long maintained that the Great Depression was not caused by the collapse of asset values after October 1929 but by a contraction in the money supply in the early 1930s (Friedman 1965). Peter Temin more recently has argued that the last time a stock market decline, as such, had an adverse effect on the economy was in 1903 (Temin 1976, 1998).

The fundamentals hypothesis as applies to devaluations and financial crises has been developed by Krugman (1979) and Flood and Garber (1984). They analyzed the endogenous monetary policy regimes that are practically important. There is no gainsaying that a disequilibrium in the fundamentals can lead to devaluations. Such a diagnosis is arguably tenable in dissecting, say, the Mexican crisis of 1994 or the Russian devaluation of 1999. But a fundamentals-based hypothesis can do no service in explaining the



August 1996 — April 1998

FIGURE 1
STOCKMARKET VALUATION (% OF AUGUST 1996)



June 1997 — December 1998

FIGURE 2
CURRENCY DEPRECIATION

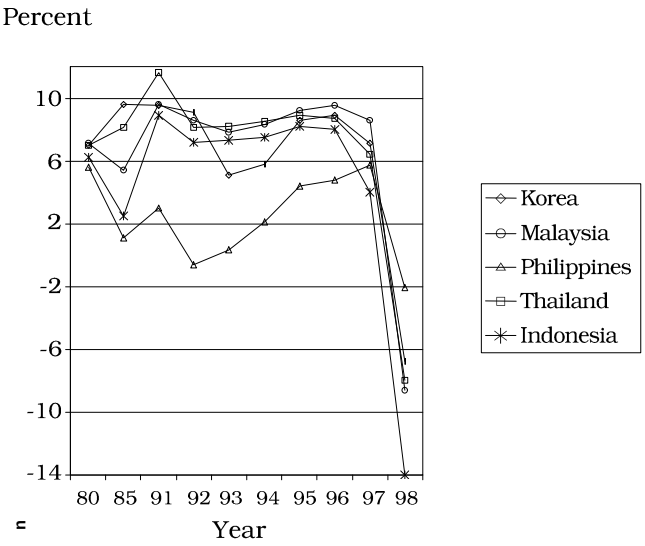


FIGURE 3

GROWTH RATES OF REAL GDP

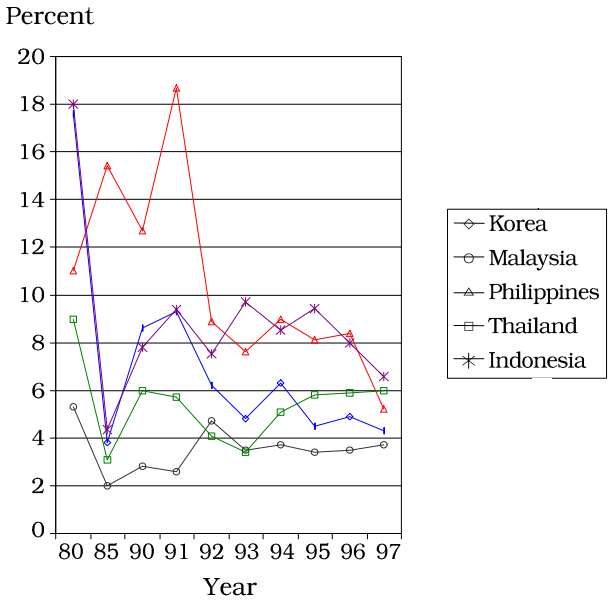


FIGURE 4

INFLATION RATES

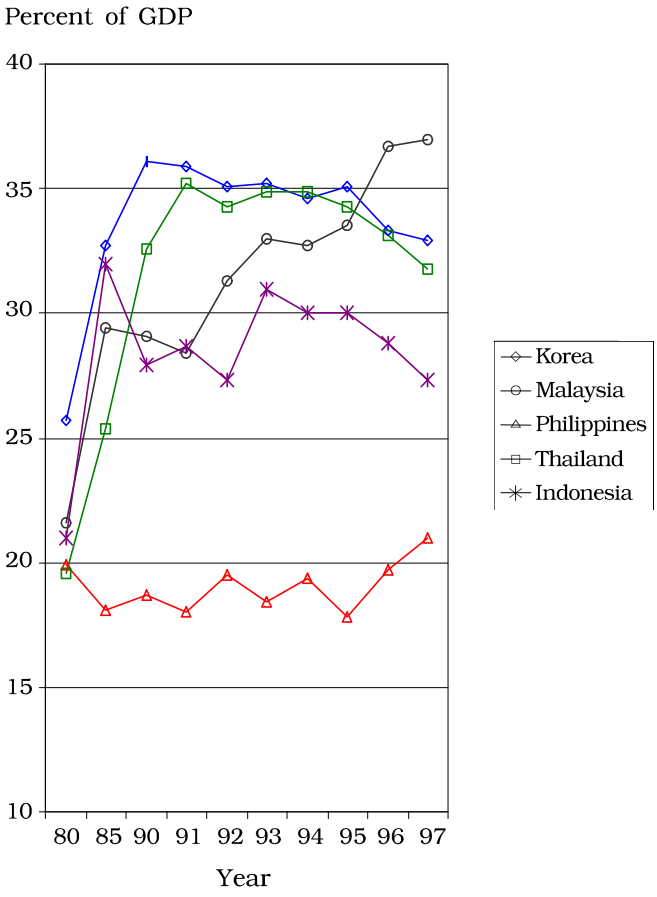


FIGURE 5
DOMESTIC SAVINGS

implosion of the East Asian miracle-economies in 1997— economies that had long been considered models of fiscal rectitude and economic probity (Figures 4 to 7).

The purpose of this paper is to develop and embed into the current literature a currency-substitution hypothesis of systematic devaluations that is independent of the fundamentals of an economy but relates endogenously to the state of the world regarding the objective positioning of a currency in the continuum

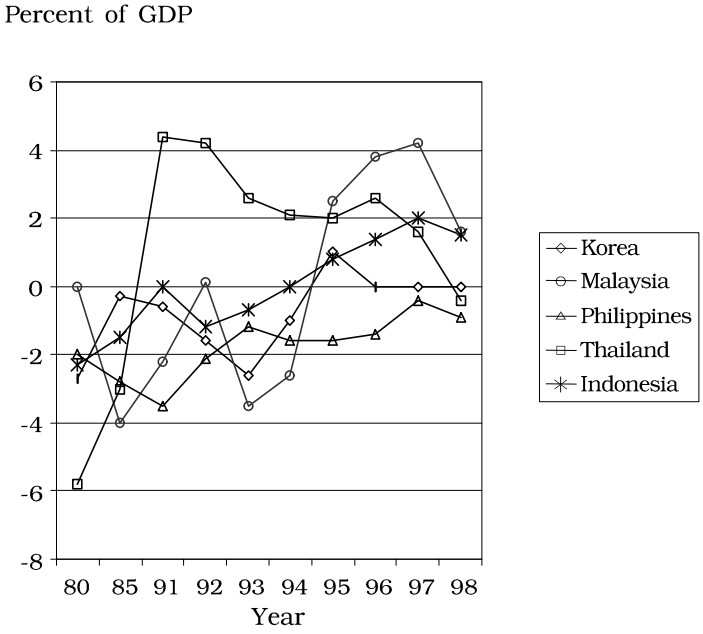


FIGURE 6
GOVERNMENT BALANCE

between reserve/hard and soft currencies. Moreover, bubbles, devaluations and financial crises, far from being self-correcting monetary phenomena, can lead to sharp contractions in the economy through the misallocation of resources in competitive devaluation trade, as opposed to comparative advantage trade.

Section II sets up the hypothesis and presents corroborative evidence that makes it relevant for explaining the financial crises. Moreover, it adumbrates a formal model of devaluations that, controlling for the fundamentals, still occur endogenously as a result of tastes for currency substitution. The model is fully developed in the Appendix. Granted that financial crises happen, why should they have any real impact on the economy, apart from helping fools part with their money? Section III helps explain the transition from Figure 1 to Figure 3 by setting up a model of

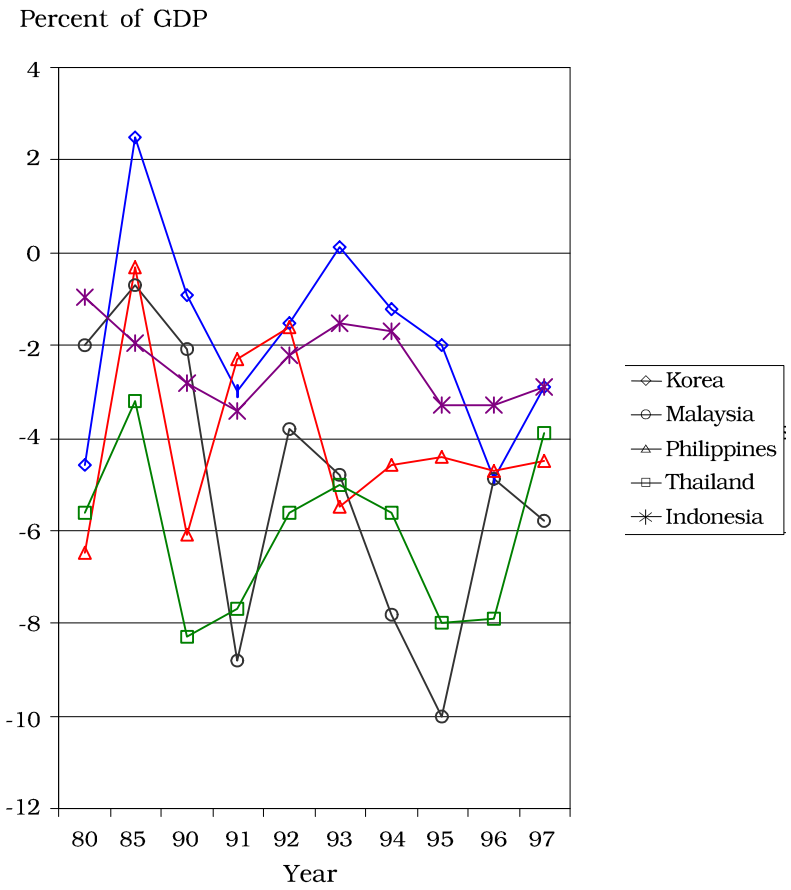


FIGURE 7
CURRENT ACCOUNT BALANCE

systematic misallocation of resources as a result of currency-substitution led devaluations. This model of contractionary devaluations is tested in Section IV within an endogenous growth framework. Section V presents the conclusions and policy recommendations of this study.

II. An Alternative Explanation of Foreign Exchange Crises

A. The Conceptual Underpinnings

In the conventional approach to exchange rate parities devaluation of a currency reflects the fundamentals of an economy. At the same time, devaluation has salutary healing effects by matching supply and demand and storing up the current account, thus improving the fundamentals. Devaluation is the instrument for initiating a process of stable interactions that restores equilibrium in the foreign exchange market.

A devaluation turns into a currency crisis when it is systematic and loses most of its remedial powers. And devaluations can be a prelude to a world currency meltdown when they are lined like dominoes in one country after another. The currencies that manage to butt the spiral of systematic devaluations, whether abrupt or creeping, are usually the "hard" currencies, and the dollar amongst them is the premier "reserve" currency. They share one characteristic. Reserve/hard currencies are treated as a store of value internationally, and they are held by central banks in their reserves. This asset-value quality of a reserve currency is based on reputation, which in the specific case means that there is a credible commitment to stability of reserve-currency prices relative to some other prices that matter.[1] Their inherent asset value makes reserve currencies a safe haven for international capital movements.

The alternative diagnosis of foreign exchange crises rests on the asset-value qualities of a currency. Drawing a sharp distinction between reserve/hard and soft currencies will help clarify the issues. There is a continuum in the asset-value quality of currencies, ranging, in descending order, from the reserve currencies, to the hard, the soft, and downright to the worthless. All currencies can do service, more or less, as instruments for trade and exchange. But when one holds currency as an asset, whether in a bank

[1]Reputation in this context is different from credibility that entered the literature on foreign exchange management following the seminal article of Barro and Gordon (1983). In this literature reputation is related to time inconsistency with policy-makers reneging on their commitment to target one of the two alternative targets, the inflation rate or the balance of payments. For examples of this literature see Agenor (1994) and references therein.

account or under the mattress, why not hold the best currency there is — the reserve currency! Other currencies, and especially soft currencies, lack the reserve currency's implicit commitment to stability of relative prices. Soft currencies are more likely to devalue than are reserve currencies. This distinction in asset-value quality between reserve and soft currencies becomes eminently functional in a free currency market where soft currencies are freely convertible into dollars. Competition in the currency market makes that conversion cheap. Starting in the 1980s, free currency markets have been enthusiastically embraced by developing and emerging economies — virtually all countries with soft currencies. This innovation in international finance is responsible for the huge traffic in currency substitution in a one-way street — the good (hard) currency driving out the bad (soft)! At the end of the process the soft currency is bound to tumble. It pays for a country to have a hard currency, especially if currency markets are free.

Currency substitution represents an asymmetric demand from Mexicans to hold dollars as a store of value, a demand that is not reciprocated by Americans holding pesos as a hedge against the devaluation of the dollar! Keynes (1973) had called "precautionary demand" this new splice on the demand curve for foreign exchange. The conventional view, on the other hand, considers the demand for foreign exchange as emanating from the demand for imports, and its supply reflecting the supply of exports. The alternative interpretation of the additional demand for foreign exchange for asset-holding purposes, accounts for the systematic devaluation of the peso, as long as it is not propped up by ever increasing transfers of foreign capital. And the more the peso devalues, the higher is the Mexicans' demand for dollar-hedge of their liquid assets, the deeper is the decline in the value of the local currency, and the bigger is the required infusion of foreign exchange to stem the peso's rout. The corollary of this proposition can be formulated as the **Y-Proposition**: In free currency markets hard currencies fluctuate, while soft currencies depreciate systematically (Yotopoulos 1996).[2] The alternative scenario deprives devaluation of any of its remedial properties that in the conventional view lead to a process

[2]A testable implication of this proposition is the property of mean-reversion of foreign exchange prices that holds for reserve/hard currencies, but not necessarily for soft.

of stable interactions and equilibrium.[3]

The valid distinction between hard and soft currency was posed above as an intuition. In fact it is a "one-way bet" only that, to our knowledge, one-way options do not exist in the literature — and therefore theorists assume they do not exist in practice! Still, the situation of a free currency market, where devaluation may happen, but it may not, is a very alluring no-brainer for an asset portfolio manager. By selling the peso short for foreign exchange, the "speculator" will reap a capital gain if the exchange regime collapses, but will not suffer an equivalent loss if it does not. What then prevents the public from becoming speculators at large by currency-substituting the reserve currency, courtesy of the free currency market? The pesos that are turned into dollars are not only those held by the men in Gucci shoes in Plaza Riforma. Pesos are also shorted by fund managers abroad, or they are borrowed locally by leveraging a few billion dollars' deposit into a peso loan that is also converted into dollars. Come devaluation, the international speculator pays back the peso loan in cents on the dollar and takes the balance of his dollars across the Rio Grande. The free currency market is an equal opportunity provider of a one-way bet to speculators of means, both domestic and foreign.

The difference between the conventional and the alternative view lies in the quality of a currency as an asset; it is accounted for in the latter interpretation, it is ignored in the former. By assuming away differences in the asset quality of currencies the conventional view sees price competition in setting the foreign exchange rate as "good competition." Market-clearing prices have remedial effects in matching demand and supply and make for efficient allocation decisions. In the alternative view, when the difference in asset-value quality of the currencies is factored in, price competition

[3]In this formulation of the reputation-based continuum between reserve/hard and soft currencies, a free currency market makes foreign exchange into a positional good. Following Hirsh (1976), Frank (1985) and Pagano (1999), prestige, power, and reputation are positional goods meaning that one individual's positive consumption of a positional good makes by necessity the other individual to consume a symmetrical negative amount of the same good. In a shared system of social status, for example, the consumption by an individual of a positive amount of prestige, such as a feeling of superiority, becomes possible only because the other individual has a symmetrical feeling of inferiority, i.e. negative prestige. Such situations of zero-sum positional goods lead to market failure (Pagano 1999).

constitutes "bad competition" in an incomplete market. Not unlike the case of the incomplete credit market where moral hazard and adverse selection of risk can lead to defaulting portfolio (Stiglitz and Weiss 1981), price competition in setting the exchange rate also constitutes a "race for the bottom" in spiral devaluations of the soft currency. The only difference between the credit and the foreign exchange market is that in the former the cause of incompleteness is **asymmetric information**, while in the latter it is **asymmetric reputation**. The implications of the two variants of market incompleteness are identical. Price controls are necessary in both cases, that is, interest rate controls for credit, and exchange rate controls in the alternative view. The remedy for exchange rate crises is maintaining mildly repressed exchange rates, in the same way that interest rates are set below their equilibrium levels that would make supply of credit equal to demand. Moreover, it is easy to determine the degree of repression that is requisite in the foreign exchange market. The exchange authority has to ration out of the market the component of foreign exchange demand that is due to "precautionary" motives.[4] There is no need to repress the current account items. Imports are still fully funded with foreign exchange and so is repatriation of profits by foreign investors. But there is need to scotch the demand for foreign exchange that buys a one-way bet on the depreciation of the local currency, and in the process makes depreciation inevitable.

B. Probative Evidence from Financial Crises

The systematic and endemic devaluation of soft currencies is likely to occur in a regime of free currency markets whether the soft currency is fixed, pegged, or floating freely (Yotopoulos 1996). The anatomy of the devaluation of the Mexican peso of December 1994 will be used to demonstrate the effects of currency substitution (Yotopoulos 1997).

The peso had been previously pegged (at 3.5 pesos to 1 US dollar) and it was initially devalued by roughly 20 percent. Within a week, in late December, the efforts to support the peso had failed and a free exchange rate was adopted that stabilized for a while (at

[4]Similarly in Pagano's analysis a reduction in consumption of a positional good can be achieved only by diminishing individuals' tastes of these goods, or reigning in their preferences (Pagano 1999, p. 79).

6 pesos to 1 US dollar). The peso has systematically devalued since then. There have been two (largely complementary) views of serious observers on what went wrong with the peso. The one is the fundamentals story, and the other the story of the flight of foreign financial capital.

The fundamentals story has certain merit. There has been a persistent current account deficit that by the end of 1994 had grown to 7.6 percent of GDP. Liberalization of a previously repressed economy was bound to contribute to the deficit, which it did. Dismantling of long-standing restrictions on imports, reducing tariffs and opening up the economy into a world-market system drove imports up. The consumerist drive is reflected in the rate of personal savings decreasing from 15 percent of GDP in 1988 to 7.4 percent in 1994. How was the Mexican penchant for consuming more and saving less financed? Enter the second story, the flood of foreign finance.

The net foreign capital streaming into Mexico in 1994 rose to $30 billion. Little of that was in equity capital of corporate investment in plant and equipment. And little was in long-term government debt, which actually had been drastically reduced from its pre-crisis peaks. Most foreign capital was short-term and it went to financial instruments or to portfolio investments. It was attracted by high interest rates, and it has been described as "the lemming-like march of multinational banks and mutual funds bearing loans to emerging markets" (McKinnon 1995). The explanation offered for the collapse of the peso invokes the panicky exit of this capital through the revolving door of financial flows. This supply side of the Mexican crisis also has merit.

But the import binge cannot explain the total debacle, and the supply of foreign financial capital was certainly not forced on non-consenting adults and on unwilling Mexican clients. What has been left out of both stories is the demand side by holders of pesos for currency-substituting the dollar. The data that emerged confirmed the alternative view (*Economist*, August 26, 1995). For the month as a whole the Central Bank lost $6.7 billion in reserves. Of this loss, the trade deficit for the month accounts for $1.7 billion. Foreign investors sold a total of only $370 million worth of debt and equity. This meager sell-out should come as no surprise, being consonant with the analysis in the previous section. The foreign investor in the financial capital market stands to make gains after

the devaluation, when the leveraged peso loans can be paid back with cents on the dollar. It is after the crisis that the capital flight starts, not before. The unaccounted balance of the loss in reserves is $4.6 billion. This accounting gap is consistent with the expectation of the currency-substitution hypothesis.

If the fundamentals had some role to play in the Mexico 1994 crisis, they are totally out of the picture in the East Asian crises. The five countries most severely hit by the crisis, Indonesia, Korea, Malaysia, the Philippines, and Thailand, had been through June 1997 the darlings of the investment community precisely on account of their fundamentals. Then in short order, starting in July 1997, they turned into international pariahs.

Figures 4 to 7 relating to the fundamentals serve to absolve the investors who placed their confidence in the Asian Miracles. Inflation (measured by the consumer price index) has been less of a problem in the 1990s worldwide than it was in the 1980s. Figure 4 indicates that from early tigerhood on, rates of inflation have been well under control in all five countries. The only possible exception is the Philippines that brought its rate of inflation within world levels only in the late 1990s.

The one most pronounced characteristic of the Asian economies is shown in Figure 5. Rates of domestic savings of 30 percent or more of GDP have been unprecedented in the annals of economic development. Even the Philippines, the laggard with savings rates of 20 percent, achieves double the landmark rate of 10 percent that was often used to indicate that a country has sprung out of poverty. The record of many developed countries, with savings rates in single digits, pales in comparison with the Asian countries. Equally high have been the rates of fixed capital formation with Korea, Malaysia, and Thailand, all above 30 percent of GDP.

The public sector variables, as shown by the government balance in Figure 6, denote prudent fiscal policies. All countries were close to a balanced budget, and there were even substantial surpluses in the cases of Malaysia and Thailand. The figure belies the main assumption of the fundamentals hypothesis.

Since the crisis first manifested itself in exchange rates and foreign reserves, the fragility of the international balance of the economies has attracted great scrutiny. The current account balance, shown in Figure 7, had not at the time been a cause of special concern. In 1997 there were moderate deficits from 2 to 4

percent of GDP, with the exception of Malaysia that had 6 percent. Even in retrospect these deficits do not seem to amount to the proverbial straw that broke the camel's back.

The solid fundamentals fostered (and were sustained by) unprecedented rates of growth of real per capita GDP. With the exception of the Philippines, a tiger cub, the other East Asian tigers maintained annual rates of growth ranging from 6 to 10 percent of GDP for over a decade (Figure 3). This sterling record of growth was reflected in the confidence of investors, which, in turn, was amply rewarded in the stock market (Figure 1). Exchange rates were pegged to the dollar or were free and floating gently. And all was well until the crisis erupted with little, if any, advance warning.

Figure 2 shows the barometer of the crisis, the collapse of the exchange rate regime.[5] In the period from April 1997 to December 1998, from peak to trough, the currencies lost from 82 percent of their value (Indonesia), to between 40 and 50 percent for the rest of the countries. The stock market bubble burst (Figure 1) with countries losing in the period of August 1996 to December 1997, from peak to trough (as a percent of stock market valuation in terms of local currency): Indonesia 60 percent, Malaysia 70 percent, the Philippines 60 percent, Korea 45 percent, and Thailand 65 percent. If one considers also the devaluation of the local currencies on top of the stock market indexes, the extent of the sell-off is extraordinary: nothing short of a fire sale where everything goes for a dime to the dollar.

Where the figures come home to roost is on the record of growth (Figure 3). In barely over 12 months (growth rates of 1996 and 1998) from the inception of the crisis the countries lost as a percent of their GDP: Indonesia 22 percent, Korea 15 percent, Malaysia 17 percent, the Philippines 15 percent, and Thailand 16 percent. Whatever the sins that precipitated the crisis — "policy mistakes" in managing the micro-fundamentals, lack of "appropriate institutions," or the "ailing nature of Asian capitalism" that reeks of institutional opacity and cronyism — the disproportion of the punishment meted out to the crime committed defies belief.[6]

[5]The data for the paragraphs that follow are from International Monetary Fund (1997a, b).

[6]By way of comparison, the contraction in the year that followed America's worst postwar recession of 1982 was 2.1 percent of GDP.

The macrofundamentals hypothesis obviously does not do service in explaining the Asian crises. The various *ad hoc* and episodic hypotheses that have been offered require the willful suspension of disbelief to be taken seriously. On the other hand, both the extent and the timing of the capital flight provides strong corroborative evidence on the explanatory value of the currency substitution hypothesis. Capital flight took place, but noticeably late in the cycle. IMF data analyzed by the Korea Institute of Finance show that capital took flight from the crisis economies only after the event: in the fourth quarter of 1997, which was after the onset of the crises (Cho and Rhee 1999). In the final quarter of 1997, capital flight from Korea amounted to $89 billion, or -18.9 percent of GDP, as compared to a positive flow of 0.7 percent of GDP for the third quarter of the year, when the crisis was being staged. Similar figures are reported for the fourth quarter of 1997 for the other countries (in percent of GDP, with the third quarter figures in parentheses): Indonesia, -15.8 (3.3); Thailand, -22.1 (-15.1); and the Philippines, -6.1 (9.0).[7] Not unlike the case of Mexico, these data imply that financial capital that came into the region during the bubble times was leveraged in local currency loans that were immediately converted into dollars. When the bubble burst and the devaluations followed, the leveraged loans were paid off at 50 cents to the dollar and the investors took their gains across another national currency border, or even home, to Geneva, Frankfurt or New York.

The Hong Kong experience of September 1998 provides additional confirmation to this scenario. With a monetary board and the Hong Kong dollar tied to the US dollar, the one-way-option game changes slightly. The foreign capital that is leveraged into a HK dollar loan is partly used to sell short the Hang Seng stock market index and partly to convert into US dollars. Given the existence of a monetary board, the currency substitution of the latter part of the loan results in an inevitable tightening of the money supply. Tight money leads to higher interest rates and a shift of funds from stocks to bonds. The ensuing decline of the stockmarket index rewards the shorts who cash out and take their capital home. The intervention of the Hong Kong Monetary Authority into the stock

[7]Malaysian data do not exist due to the exchange control regime that was imposed in August 1997.

market that followed the detection of this game brought howls of indignation from the financial press in New York (*Wall Street Journal*, Editorial, September 1998).

C. Modelling the Currency-Substitution Induced Crisis

Krugman (1979) first developed a model of the balance of payment crisis due to speculative attacks on the fixed-exchange-rate regime. Devaluation in this model is the outcome of the deteriorating fundamentals of an economy, as telescoped in the balance of payments. Flood and Garber (1984) developed the linear version of Krugman's model. These models are called the "first generation models" or the "fundamentals-approach" of the currency crisis (Eichengreen, Rose and Wyplosz 1994). From a different angle, Obstfeld and Rogoff (1996) presented a dynamic open macro model where the differential rate of inflation between the home and the foreign country induces home residents to substitute the foreign currency for the domestic. In this way they introduced the notion of currency substitution while still relying on the fundamentals hypothesis of crises — the high rate of inflation.

In the Appendix we develop a formal model that generalizes the first-generation models of financial crises by introducing currency substitution explicitly in the utility function and independently of the fundamentals of an economy. The model represents a state of the world where tastes alone are sufficient to lead to substitution of the reputable reserve or hard currency for the reputation-challenged (soft) home currency. This model is able to explain, as a result, low countries that are proximate models of economic probity can fall victims of currency crises: the East Asian Miracle economies (1997), but also Norway (1987), Sweden and Finland (1991), the United Kingdom, Italy and Spain (1992), among others. The implication of the model is that for the most part the recent crises were not fundamentals-induced. Instead, they originated in a fundamental flaw in the architecture of the international financial system. Free competition in the currency market leads to the substitution of the reserve/hard currency for the soft and therefore to systematic devaluations, and financial crises, in soft-currency countries.

III. From Systematic Devaluations to the Growth Debacle

The time elapsed since the beginning of the Asian crises has failed to reveal the healing powers inherent in devaluations that the conventional approach describes. Quite the contrary. The vertiginous collapse of growth, shown in Figure 3, requires more than the maladroitness of policy makers in order to be explained. It takes talent to manage to lose anywhere from one-sixth to a quarter of a country's GDP in just one year!

In the alternative interpretation currency-substitution induced devaluations are definitely contractionary. An attempt to link bubbles and devaluations to the evidence in Figure 3 raises an important question: How is currency substitution — which relates to the financial sector — transmitted to the real economy?

In answering this question it helps to return to the distinction between reserve and soft currency and link it to the distinction between tradables and nontradables. There are many advantages to a country's issuing a reserve currency — among others the windfall of seigniorage, and the ability to borrow its reserve currency from central banks at interest rates lower than would otherwise apply. But the most important benefit accruing to the issuer of reserve currency is that for its international transactions the operational and analytical distinction between tradables and nontradables becomes immaterial. For the other countries, and especially for the soft currency countries, the distinction can become binding.

Tradables can be defined as those commodities that enter a country's current account as exports or imports — and their respective values can be used as weights in constructing a commodity-specific index of tradability (Yotopoulos 1996). Nontradables are defined accordingly as commodities that do not enter to a significant degree a country's international trade. Tradability, therefore, is not a binary issue but a question of degree. And the degree, at least in part, is determined by what a country can afford to pay for in foreign exchange, most often in reserve currency.

One way of understanding the coupling of the distinction between hard and soft currency with that of tradables and nontradables is to compare two economies along the continuum of possibilities for transforming nontradable output, or the resources that produce it, into tradables. To enhance the intuition suppose both countries are overindebted, e.g. the United States and Mexico. With the peso

being a soft currency and the Mexican debt being denominated in dollars (because the peso is soft currency), Mexico cannot service its foreign debt from the proceeds of producing nontradables. These are traded in pesos. It has instead to shift resources away from the nontradable sector to produce tradable output in order to procure the dollars for servicing the debt. In the U.S., on the other hand, the debt is serviced in dollars. Then all output produced, whether it consists of more aircraft or more haircuts, serves directly to service the dollar-denominated debt.

A parable can help enhance understanding of how the process of shifting resources from the production of nontradables to that of tradables, when fuelled by currency substitution and systemic devaluations, can create a negative feedback loop that leads to resource misallocation in soft-currency countries. Consider an equilibrium allocation where a bundle of resources produces tradables (T) and nontradables (N), measured so that one unit of each is worth \$1. Entrepreneurs should be normally indifferent between producing one unit of the former or one of the latter. Should this equilibrium allocation of resources be changed one would expect to register losses. But this is precisely what happens in soft-currency countries. In the case of Mexico T trade in dollars while N trade in pesos. Since the soft currency may be devalued it becomes risky for Mexican entrepreneurs to produce (or hold) one unit of N that could not be converted for later spending into \$1. Expressed in another way, entrepreneurs see the future price of tradables increasing relative to the price of nontradables and they are attracted to producing T because that is the cheapest way they can acquire \$1 from their bundle of resources in the future. This dilemma does not exist with the countries that have hard currency. For their entrepreneurs \$1 of T will always be worth \$1 of N in hard currency, contrary to the soft currency case where the expectation of devaluation becomes a self-fulfilling prophecy.

Production in soft-currency countries becomes biased excessively toward T, despite the fact that the relative productivities of the bundle of resources have remained unchanged *ex hypothesi*. This shift of resources represents misallocation and produces inefficiency and output losses. The misallocation of resources is not the result of factor specificity. It is the result of "bad competition" in the currency market with good competition in the factor market. The situation then arises when prices of T are "high" relative to those

of *N*, with resources moving "excessively" from the latter to the former.[8] The case is a mirror image of the Dutch disease (Corden and Neary 1982), only that the origin is depreciation, as opposed to appreciation of the domestic currency, and the result is not de-industrialization but contraction in the *N* sector with detrimental outcomes for growth.

The intuition behind the parable is simple. Distortions inherent in free currency markets lead to systematic devaluation of soft currencies — to "high" nominal exchange rates. Devaluation of the exchange rate means increasing prices of tradables and leads to increased exports. But not all exports are a bargain to produce compared to the alternative of producing nontradables. For instance, some countries without a climatic or resource advantage in producing grapes are known to export wine. Other countries graduate from being exporters of sugar and copra to exporting their teak forests, and on to systematically exporting nurses and doctors, while they remain underdeveloped all the same. If this happens, it may represent **competitive devaluation trade** as opposed to **comparative advantage trade**. Competitive-devaluation trade is misallocating resources against nontradables at great cost to growth and to the detriment of development.

IV. Empirical Implementation: Endogenous Growth Analysis[9]

The propositions advanced in the previous sections are eminently testable. The maintained hypothesis is that competitive price-setting of foreign exchange rates in soft currency countries is detrimental to growth. In submitting the hypothesis to an empirical test we note that the nominal exchange rate (NER) is the intermediate variable. Currency-substitution-induced high NERs lead to high prices of tradables, and the expectation of further devaluation in the future gives the signal to producers for biasing resource

[8]Wouldn't the process make *N* relatively scarce and help restore equilibrium? This is the classical textbook case. But the answer is "no" in incomplete markets where there is "bad competition" that sets off a race for the exit of currency substitution.

[9]This section abstracts from Yotopoulos (1996, Chapter 7) where the dynamics between real and nominal exchange rates under free currency markets are fully treated.

allocation away from nontradables with adverse effects on growth.

For the test of the hypothesis an index is required of the relative price of tradables to nontradables. In constructing that index the operational framework of the research utilizes purchasing power parity data. International price parity data (from the *International Comparisons Project*; Kravis, Heston and Summers, 1982; and Penn World Tables) provide prices for a complete set of outputs of an economy, appropriately normalized by the international prices of the same commodities. Data from *International Trade Statistics* are used to define *T* ("tradeds") and *N* ("non-tradeds") on a country-by-country basis. The ratio of the prices of the two is an index of the real exchange rate (RER, with prices of *T* in the numerator). An example appears in Table 1 that ranks 33 countries by the value of their RER index in 1985.[10]

The meaning of "setting the prices right" is precisely setting the RER at its equilibrium value. And although the index as such cannot be used to measure the deviation of the RER from its equilibrium value, it can clearly indicate whether one country has higher prices of tradables relative to nontradables than another — i.e. it has a more undervalued RER, always in relative terms. Moreover, the proposition of reputation asymmetry of the previous section constitutes the link between the RER and the NER. Examined within an international cross-section, high values of the index (which mean high prices of tradables) are more likely to be associated with high NER than are low values. "High" exchange rates, or devaluations, lead initially to high prices of tradables, until the effect of devaluation is eventually offset by price increases in the nontradable sector.

The RER is related to the record of growth in an endogenous growth analysis. The objective of the endogenous growth literature is to go beyond the Solow-type decomposition that defines technological change as the residual, after accounting for the contribution of the neoclassical factors of production. Instead, growth is viewed as the endogenous outcome of the economic system. Accordingly, the empirical branch of the endogenous growth literature casts a broad net in identifying variables that represent private choices,

[10]For detailed methodology of constructing the RER index see Yotopoulos (1996, Chapter 6). For price parity data of the International Comparisons Project see web site, http://pwt.econ.upenn.edu.

public sector policies, and institutional factors that could explain the intercountry variance in rates of growth.

Two observations have been gleaned from the large number of empirical studies on the macroeconomics of endogenous growth. It is not hard to devise econometric specifications in which sundry variables measuring economic policy are significantly correlated with economic growth. It is almost impossible, however, to discover explanatory variables that are robust enough so that their estimated coefficients do not depend importantly on the conditioning set of information (Solow, 1994; and Pack, 1994). Levine and Renelt (1992) reviewed forty-one studies and found over fifty variables that correlated significantly with growth in various papers. But only one, the ratio of investment in GDP, had a robust coefficient in an "extreme bounds" analysis (Leamer 1985).

In the tradition of the endogenous growth literature we relate the rate of growth of real GDP per capita to a set of factors that reflect public sector choices (government consumption, inflation, education and population growth), to factors that represent private sector policies (investment), and to institutional factors that capture a country's exposure to international trade (the openness of an economy in trade and the direction of its trade flows).[11] The innovation in this paper is the introduction of the RER as a variable which varies directly with the NER, high values of which denote competitive price-setting of the foreign exchange rate. A free currency market, in turn is associated with low growth outcomes in developing countries. The motivation behind the analytical framework is to control for the effect of the stylized endogenous growth variables while measuring the impact that RER has on measures of development performance.

The reduced form of the estimating equation is:[12]

$$G_t = f(RER, DUM, OPEN, DIR, INV, GINFL, GOVCONS, SECENRL, GPOP),$$

where G_t is the rate of growth of real GDP per capita. The test of the hypothesis consists of explaining the intercountry variance in G_t by the variance in *RER*, subject to the other conditioning variables. The purpose of the *DUM* variables is to account for differences in

[11]For definition of variables see immediately below.

[12]For the complete specification of the model and the derivation of the reduced form equation see Yotopoulos (1996, Chapter 7).

TABLE 1

COUNTRIES RANKED BY THE VALUE OF THE RER INDEX, 1985

Country	RER	Country	RER
Ethiopia	1.967	Kenya	1.070
Rwanda	1.962	Morocco	1.069
Pakistan	1.747	Norway	1.013
Malawi	1.713	Netherlands	1.009
Sri Lanka	1.546	Turkey	0.998
Yugoslavia	1.542	Denmark	0.980
Greece	1.417	Australia	0.969
Ivory Coast	1.329	Belgium	0.963
Portugal	1.230	Jamaica	0.949
New Zealand	1.208	Sweden	0.933
Nigeria	1.196	Canada	0.928
Thailand	1.193	Japan	0.923
Hungary	1.192	Ireland	0.918
Egypt	1.186	Finland	0.879
India	1.178	Italy	0.831
Germany	1.155	Poland	0.829
France	1.095		

Source: Yotopoulos (1996), Chapter 6, Table 6.2.

initial per capita incomes by including as a variable the value of the real GDP per capita, *RGDPC*, or else a dummy, *DumL/M*, that distinguishes between low/middle income countries and developed countries. The classification of countries as low/middle and high income is from the World Bank (1992). The second dummy variable, *Dum*80/85 (with the value of 1 for the observations of 1980 and 1985) intends to control for the general slowdown in growth since the 1980s. In both cases the pooled data have also been partitioned so that the influence of these two factors has been excluded from the analysis.

Since Adam Smith first formulated the traditional trade-growth

nexus the extent of the market has been considered a determinant of efficiency. This is usually captured by the openness of an economy, *OPEN*, which is a measure of the ratio of trade to GDP. More recently a second effect, the direction of trade, *DIR*, has become a prominent variable. Controlling for the volume of trade, the direction-of-trade variable may capture the technological spillovers from trading with more developed partners. One advantage of such trade is that the innovation-producing skilled labor of DCs is extended to LDCs through technological diffusion (Grossman and Helpman 1990, 1992). Investment, *INV* (as opposed to the accumulated stock of capital), becomes an important vehicle for technological diffusion because of the vintage effect of new capital. The two conventional variables intended to capture the crowding out of private investment that may occur as a result of public sector policies are *GOVCONS*, which represents (unproductive) government consumption expenditure, and *GINFL*, the average rate of change in inflation that depresses the level of savings. Finally, an education variable, commonly *SECENRL*, secondary school enrollment, and a demographic variable, *GPOP*, the rate of growth of population, often appear in endogenous growth equations.

The results in Table 2 refer to the international cross section model of the parent study. The presentation is organized in five models that group variables so as to provide an immediate indicator of the robustness of the tests of the maintained hypothesis. The logic of the testing procedure is to regress *GRGDPC* on *RER*, the main variable of interest, and successively on a greater number of variables. Comparison of the parameter values across models gives an idea of the robustness of the functional form employed.

The first test reported is the longitudinal analysis for the sample of 123 observations (62 countries) for the years 1970, 1975, 1980 and 1985. In model I *RER* appears as the single variable. The simple regression of *GRGDPC* on *RER* has the expected negative sign and is consistently significant. Moreover, the coefficient of *RER* is robust, as evidenced from the fact that it varies within a very narrow range (from -0.020 to -0.024) as other conditioning variables are added *seriatim* in the other models reported in the table. The maintained hypothesis construes the inverse relationship between *RER* and *GRGDPC* as evidence that mild price repression in an incomplete foreign exchange market can lead to better developmental outcomes.

TABLE 2

CROSS-SECTION/TIME-SERIES REGRESSIONS ON GROWTH, ALL COUNTRIES, 1970, 1975, 1980 AND 1985

Explanatory variables	Model				
	I	II	III	IV	V
Constant	0.040	0.056	0.068	0.043	0.044
RER	-0.021 (-2.708)	-0.022 (-2.774)	-0.024 (-2.947)	-0.020 (-2.450)	-0.022 (-2.683)
Dummy low/middle (*DumL/M*=1)		-0.003 (-0.668)	-0.003 (-0.601)	-0.004 (-0.824)	-0.004 (0.493)
Dummy1980/1985 (*Dum*80/85=1)		-0.017 (-3.652)	-0.017 (-3.474)	-0.016 (-3.439)	-0.016 (-3.346)
Openness (*OPEN*)			-0.010 (-1.127)	-0.012 (-1.352)	-0.017 (-1.731)
Dir. of trade (share of OECD) (*DIR*)			0.015 (0.904)	0.023 (1.410)	0.022 (1.341)
Investment in GDP (*INV*)				0.104 (2.812)	0.089 (2.277)
Rate of inflation (*GINFL*) (change)					-0.023 (-1.960)
Gov. consumption in GDP (*GOVCONS*)					-0.000 (-0.178)
Secondary enrollment (*SECENRL*)					0.012 (0.880)
Population growth (*GPOP*)					-0.048 (-0.460)
Sample size	123	123	123	123	123
Adjusted R^2	0.049	0.142	0.139	0.187	0.193
Standard error	0.025	0.024	0.024	0.023	0.023
F-statistics (zero slopes)	7.333	7.754	4.944	5.682	3.923

Note: The dependent variable is annual rate of growth of real per capita GDP, *GRGDPC*, for the five-year period centered on the year of observation. For definition of independent variables see text. Numbers in parentheses are *t*-statistics.

Source: Yotopoulos (1996), Chapter 7, Table 7.1.

Model II increases the number of explanatory variables to three, by including the two dummy conditioning variables that describe the state of the world within which the *RER* operates. *DumL/M*(=1) accounts for the fact that incomplete markets in exchange rates are the characteristic of LDCs only and not of DCs. Its coefficient remains invariant as the other conditioning variables are introduced, but it is insignificant. *Dum*80/85(=1), on the other hand, has a robust coefficient that fully captures the slowdown of the rate of growth in the latter period of this study.

Model III includes *OPEN* and *DIR*, another two variables of primary interest that describe the trade regime that complements the RER policy instrument. The coefficient of *OPEN* is consistently negative, albeit significant only in the last iteration with model V. Its sign is different from the expected (and elusive) result in the literature. While the negative coefficient, ubiquitous in endogenous growth studies, is puzzling for the orthodox approach to trade and development, it can be readily explained in this interpretation. Controlling for the value of the *RER*, one would expect a negative relationship between *GRGDPC* and *OPEN*. Countries that control the level of NER, have low *RER*, and grow fast, are expected to have lower volume of trade than would have obtained under free foreign exchange markets. The more *OPEN* the economy is, as a result, the lower the rate of growth. The *DIR*, on the other hand, has a positive but nonsignificant coefficient. The sign indicates that, controlling for *RER* and *OPEN*, the benefit of trade arises from the technological spill-over of having more developed trading partners (proxied by OECD-member-countries).

Model IV increases the number of explanatory variables to six, by including *INV*, the only variable that has proven robust in other endogenous growth studies. The *INV* variable in model IV is highly significant with values ranging from 0.089 to 0.104, which is very close to the modal values reported in other studies for the same variable. This coefficient presents a strong link with the celebrated and most significant result that other studies of endogenous growth have established (Levine and Renelt 1992).

Model V increases the number of explanatory variables to ten by adding *GINFL, GOVCONS, SECENRL*, and *GPOP*. The last four variables are among those most commonly used in endogenous growth studies, and they were chosen, as were the new variables in each group, because they do not measure the same phenomenon

with the main variable of interest. The coefficient for *GINFL* is significant and has the expected negative sign. The coefficient of *GPOP* has the correct negative sign but is insignificant. Finally, *SECENRL* and *GOVCONS* have proven as difficult to capture in this study as they have in the parallel literature.

The grand theme that emerges from the analysis (and is further documented in the parent study) has as its foundation the negative relationship between the *RER* and *GRGDPC*, the rate of growth of real GDP per capita. The relationship is consistently significant and robust to changes in the other conditioning variables. Given the link that currency substitution establishes between RER and NER, the results favor policies that would reduce either one as leading to a better allocation of resources.

Causality in economics is not a heuristic attribute that is established merely by mechanistic tests.[13] It is, rather, an empirical implication of a model of mind — a hypothesis that is grounded on extant theory. Given the link that currency substitution establishes between RER and NER, the results are consistent with causality going from high NER to low *GRGDPC* and favor policies that would reduce *RER* as leading to a better allocation of resources.

Why should some countries, those with soft currency and specifically LDCs, tend to have high NERs that lead to high RERs? The explanation, as already mentioned, is substitution of the hard currency for the soft in free currency markets. It is triggered by the reputation asymmetry and the expectation that the soft currency will devalue — an expectation that is validated by the absence of restrictions in hedging soft-currency asset-holdings by converting them to hard currency. The implications of substitution in financial holdings extend also to the real world through the bias in the allocation of resources in favor of tradables. This misallocation is captured by the negative sign of the relationship between *GRGDPC* and *RER*.

Under these conditions policies that would reduce the RER would achieve a better allocation of resources. One such set of policies is

[13]Such tests were performed and are reported in the parent study. The assumption that the right-hand side variables of the model are truly exogenous was tested explicitly. Moreover, a simultaneous equation model was formulated with G_t, *RER*, and *INV* determined endogenously. The results of the reported formulation were proven extremely robust (Yotopoulos 1996, Chapter 7).

increasing the productivity in tradables, i.e. reducing their peso prices. Another policy reaction which has been largely ignored (or, worse, passionately dismissed) both in the literature and in operations so far is intervention in the foreign exchange market to reduce the NER by rationing or protection. Intervention contains the increase in RER and the premature shift of resources away from nontradables.

The results reported above confirm the causal link that exists between systemic devaluations in Figure 2 and deep economic contractions in Figure 3. The competition in a free currency market that leads to the systematic devaluation of the soft currency raises the expectation of rising prices of tradables (that trade in foreign exchange) relative to prices of nontradables (that trade in the local soft currency). A systematic misallocation of resources follows — one that is excessively biased in favor of tradables. In this process comparative advantage trade can turn into competitive devaluation trade. There lies the explanation of the disproportional losses in GDP that were registered in Figure 3. The results that find devaluations in free currency markets to be contractionary are consonant with the experience accumulated from the handful of financial crises that have been analyzed.

V. Conclusions and Recommendations

The paper has been built on the analytical premise that there is a valid distinction between hard and soft currencies. A free currency market that pits a hard currency (or even worse, the reserve currency) against a soft currency delivers "bad competition" and starts a "race for the bottom" with systematic devaluations of the soft currency that often end in a financial crisis. The mechanism that delivers this outcome is an incomplete market resting not in asymmetric information, as in the classical case, but in asymmetric reputation. This hypothesis has been corroborated with data from the Mexican crisis of 1994 and more recent data from the financial crises in East Asia.

Bubbles and financial crises would have been of little concern if they were merely monetary phenomena with little impact on the real economy. This is certainly not the case, in Figure 3, where the Asian economies impacted by the financial crisis lost anywhere

from 16 percent to 22 percent of the GDP in just twelve months! Such a debacle is certainly not the result of simple "policy mistakes" or of "lack of transparency" in the institutional structure. The model adumbrated in Sections III and IV explains the deep contraction and recession as the causal consequence of currency-substitution induced devaluations: what was comparative advantage trade turns into competitive devaluation trade.

The model that makes currency substitution the trigger to devaluations has sufficient generality to cover crises that occur in the fundamentals-challenged economies but also in countries that had been considered as being in near-pristine economic status. In the latter case in specific, various *ad hoc* explanations have emerged in an attempt to patch up the huge gap between economic theorising and the real world. Among other explanations for the implosion in the East Asian economies the following have greater current currency. First, in dissecting the macrofundamentals, analysts isolate specific subsets of policies that are deemed *ex post* as "policy mistakes." This can be characterized as the micro-fundamentals approach. The second explanation relates to a confidence crisis. Free markets are contingent on the existence of an institutional structure. Certain markets require supervision in order to work efficiently. In the absence of institutions, of reassuring rules, and of some controls, some markets can become unstable until panic sets in and a crisis ensues (Stiglitz 1998). The third explanation regards Asia's crash as the crisis of Asian capitalism — especially its opacity, poor regulation and cronyism (Krugman 1995, 1998a). The antidote on this view is to some extent the same with that of the previous view on confidence crisis: Reforms should be geared towards reinforcing transparency, improving supervision, and limiting moral hazard. A fourth explanation considers the role of the liberalization of capital markets in financial crises. More specifically, the technology-led increased mobility of financial flows has attracted renewed attention (Bhagwati 1998; and Rodrik 1998). The ability of fund managers to have short-term capital sloshing from one end of the world to the other at the click of the mouse has certainly contributed some fragility to the international financial system.

All these are familiar propositions and they certainly have merit. Fiscal rectitude and economic probity still matter in the world, as does error-free management of the economy. But controlling for

these fundamental factors of the economy, financial crises are more likely to occur if a free currency market offers the "attractive nuisance" of one-way options by betting against the soft currency. This moral hazard issue may require more severe re-engineering of the architecture of the international financial system than what is currently on the table.

The main recommendation that arises from this research is a mirror image of the situation of the incomplete market in credit. A mildly repressed exchange rate would contain the devaluation of the soft currency and would stem the trade-bias that feeds the process of economic contraction. The requisite mild repression of the exchange rate is readily quantifiable in incomplete currency markets — which is not always the case in credit markets. It consists of rationing out the asset-demand for foreign exchange — as opposed to the demand that emanates from current account transactions.

Exchange rate controls have also been advocated by Krugman (1998b) as a radical option that is worth trying when we have run out of ideas in dealing with the financial crises. But even earlier, they had been modeled and recommended by Yotopoulos (1996) in the same spirit they are being advocated here: as a perfectly respectable neoclassical solution to the defect of market incompleteness. If imposing exchange controls is a theory-sanctioned idea, and besides it has worked in practice, why has it been so late in being packaged for sale to the policy makers? One answer to the question is the power of the conventional wisdom. Neoliberal orthodoxy has considered free markets and strong currency as the two pillars of growth and prosperity at home and abroad. The implicit assumption has always been that currencies that are pitted in head-to-head competition with the world's reserve currency emerge as strong currencies and they can serve as the financial tail that wags the development dog. The position advocated here is that in the case of soft-currency countries, effectively most countries in the world, the juxtaposition of a free currency market and strong currency constitutes an oxymoron. Soft currencies become even weaker in free currency markets by depreciating systematically. The second reason that exchange controls have so far only been whispered, and not spoken, is that the success of intervention depends on the agent of intervention, the government.[14] Exchange controls

[14]The case studies of success and failure in development — for Japan, the

can be bungled by an incompetent bureaucracy and they can be suborned by a corrupt kleptocratic regime. In any case, they can be evaded by traders who underinvoice their exports and over-invoice their imports to hide their foreign exchange earnings and park their profits abroad. It is true, in this business the devil is in the details. All the same, the world has lived very well with draconian exchange controls through the 1950s to the 1970s. The very same period was graced with historically unprecedented rates of growth and with development results that have yet to be matched in their reach across the globe.

APPENDIX. Does Currency Substitution Trigger Financial Crises?

A. The First-Generation Crisis Models

Krugman (1979) was the first to model a balance-of-payments crisis that was caused by a speculative attack on the fixed-exchange-rate regime. Devaluation in this model is the outcome of the deteriorating fundamentals of an economy, as telescoped in the balance of payments. Flood and Garber (1984) developed the linear version of Krugman's model. These models are called the "first generation models" or the "fundamentals-approach" of the currency crisis (Eichengreen, Rose and Wyplosz 1994). From a different angle, Obstfeld and Rogoff (1996) presented a dynamic open macro-model where the differential rate of inflation between the home and the foreign country induces home residents to substitute the foreign currency for the domestic. This model introduces currency substitution which, however, is still endogenously determined by the fundamentals of an economy.

Our model generalizes the first-generation models by introducing currency substitution explicitly in the utility function and independently of the fundamentals of an economy. It represents a state of the world where tastes alone are sufficient to lead to substitution of the reputable reserve (or hard) currency for the reputation-challenged (soft) home currency. As a result our model is able to explain how countries that are proximate models of economic

Philippines, Taiwan and Uruguay — in Yotopoulos (1996, Chapters 9-11) address specifically this issue.

probity can fall victims of currency crises: the East Asian Miracle economies (1997), but also Norway (1987), Sweden and Finland (1991), the United Kingdom, Italy and Spain (1992), among others.

B. Substitution between Two Money Assets

Suppose that a representative agent's total money holding is composed of domestic currency, M_1 and foreign currency, M_F:

$$M = M_1 + \varepsilon M_F,$$

where ε is the nominal exchange rate. Assume a homothetic utility function. Then the optimal allocation of money holdings can be solved as a sub-optimization problem. With a Cobb-Douglas utility over the domestic and foreign money holdings, a consumer's sub-optimization problem becomes:

$$Max\ U = M_1^{1-\alpha} M_F^{\alpha},$$

$$s.t.\ M = M_1 + \varepsilon M_F.$$

From the first-order conditions, we have:

$$M_1 = (1 - \alpha)M, \tag{A1}$$

$$\varepsilon M_F = \alpha M. \tag{A2}$$

The key parameter α indicates the degree of the currency substitution. If $\alpha = 0$, there is no currency substitution effect and an agent holds only the domestic currency. The condition $\alpha = 0$ is also satisfied under strict capital control, since in this case foreign money holding is always forced to be zero. It should be noted that the parameter α reflects the degree of softness of a currency. It represents an inverse transformation of Gresham's law since it is the good (hard) currency that drives out the bad.

Now, we can employ the conventional money demand function:

$$\frac{M_t}{P_t} = L(Y_t,\ i_{t+1}), \tag{A3}$$

where P_t is the price level, Y_t is income and i_t is the nominal interest rate. Note that the real money demand function can be derived from a dynamic optimization model of a household (Sidrauski 1967; and Lucas and Stokey 1987). Combining equations (A1) and (A3), we have

$$\frac{M_{1t}}{P_t}=(1-\alpha)\frac{M_t}{P_t}=(1-\alpha)L(Y_t,\ i_{t+1}). \tag{A4}$$

C. The Basic Model-Setting

The following basic model-setting follows the log-linearized version of Krugman's model (Obstfeld and Rogoff 1996). The innovation in our model is that the currency substitution that triggers devaluation is exogenous, depending on the positioning of currencies in the hard/soft continuum. The first generation crisis models, on the other hand, are strictly propelled by the fundamentals: Balance-of-payments induced in the case of Krugman, or differential-inflation induced in the case of Obstfeld and Rogoff.

We model a small open economy with a foreign exchange rate that complies with purchasing power parity (PPP) and uncovered interest parity (UIP). The model assumes perfectly free international trade and perfect capital mobility:

$$p_t=e_t+p_t^*, \tag{A5}$$

$$i_{t+1}=i_{t+1}^*+E_te_{t+1}-e_t, \tag{A6}$$

where e is the logarithm of the nominal exchange rate of this economy. The log of the price level and the interest rate are denoted by p and i, respectively. We assume a continuous-time Cagan-type money demand function. Then, using equation (A4), the money market equilibrium condition becomes:

$$m_{1t}-p_t=\log(1-\alpha)+\phi y_t-\eta i_{t+1}. \tag{A7}$$

Combining (A5), (A6), and (A7), we have a dynamic equation of the exchange rate which satisfies PPP, UIP, and money market equilibrium:

$$m_{1t}-\phi y_t-e_t+\eta i_{t+1}^*-p_t^*=\log(1-\alpha)-\eta(E_te_{t+1}-e_t). \tag{A8}$$

Under the assumption of a small open economy the foreign variables are exogenously given. In order to simplify the argument, we assume that $-\phi y_t+\eta i_{t+1}^*-p_t^*=0$. Then we have a continuous version of the exchange rate dynamics under perfect foresight as follows:

$$m_t-e_t=\log(1-\alpha)-\eta\dot{e}_t. \tag{A8a}$$

D. The Role of the Central Bank

The central bank's balance sheet is represented as

$$B_H + \varepsilon A_F = MB, \tag{A9}$$

where B_H denotes the domestic government bond ownership of the central bank. A_F is the total foreign asset holdings, i.e. foreign bonds and reserve currency, of the central bank. The central bank's monetary base is $M_1 = \mu MB$, where $\mu > 1$ represents the money multiplier. Hence, equation (A9) gives

$$M_1 = \mu (B_H + \varepsilon A_F). \tag{A10}$$

E. The Collapse of the Fixed Exchange Rate Regime

From equation (A8a) we can see that a fixed exchange rate regime generates

$$m_{1t} - \bar{e} = \log(1 - \alpha). \tag{A11}$$

Suppose that the central bank is required to finance the ever-increasing fiscal deficit by buying government bonds. As a result, the central bank expands its nominal holdings of domestic government debt, B_H. If the growth rate of domestic bond stock is constant at λ, we have

$$\dot{B}_H = B_H \lambda. \tag{A12}$$

Following Krugman (1979), we can calculate the shadow exchange rate under flexible exchange rate assumption with no foreign reserves, i.e. $A_F = 0$. In this situation, the central bank's balance sheet equation (A10) implies that

$$m_{1t} = \log \mu + b_{Ht}, \tag{A13}$$

where b_H indicates the log of the central bank's bond holding. By combining equations (A12) and (A13), it becomes obvious that the money supply increases at the constant rate λ after the collapse of the fixed exchange rate regime, i.e. $\dot{m}_{1t} = \lambda$. Moreover, from equation (A8a), we can easily see that $\dot{m}_{1t} = \dot{e}_t = \lambda$ along the balanced growth path. Therefore, inserting equation (A13) into equation (A8a), we obtain

$$b_{Ht} - e_t = -\log \mu + \log(1 - \alpha) - \eta\lambda.$$

Finally, we can derive the log of the shadow exchange rate,

which is defined as the floating exchange rate that would prevail if the fixed exchange rate regime collapsed, as follows:

$$e_t = b_{Ht} + \log \mu - \log(1-\alpha) + \eta\lambda . \tag{A14}$$

We can see that $\partial e_t/\partial\alpha > 0$. This indicates that the currency substitution effects due to exogenous agents' preferences toward foreign currency will induce potential devaluation of the exchange rate over time. As a result, Krugman's the speculative attacks and the resulting collapse of the fixed exchange rate would occur earlier. We can formally derive the time to the collapse as follows:

From equation (A11) we have

$$b_{Ht} = b_{H0} + \lambda t, \tag{A15}$$

where b_{H0} is the initial value of the central bank's government bond holdings. Combining equations (A14) and (A15), together with $e_T = \bar{e}$, we can derive the time elapsed to the collapse of the fixed exchange rate regime as follows:

$$T = \frac{\bar{e} - b_{H0} - \log \mu + \log(1-\alpha)}{\lambda} - \eta .$$

Hence, we can easily inspect that $\partial T/\partial\alpha < 0$. Again, the softness of a currency is negatively related to the timing of the currency crisis. As indicated in Figure 8, e_T, the cross-over point from fixed to flexible exchange rate, marks the onset of devaluation. The equation and the figure denote that exogenous currency-substitution, totally independent of the fundamentals, will lead to an early collapse of the stable exchange rate regime.[15] It is important to note that even with a modest expansion in the level of government indebtness, λ, a large currency substitution effect, α, can accelerate the onset of the crisis. This is applicable to the recent Asian crises where the government account was in balance and otherwise the fundamentals were solid.

The intuition behind this result should be straightforward. A high degree of currency substitution generates a low demand for the domestic currency (equation A4). With the stream of the growth in the money supply given, a decline in money demand will increase the price level. This increase in the price level (that includes also the price of foreign exchange) is tantamount to devaluation by the

[15]We can easily note that the first generation currency crisis model *a la* Krugman (1979) is the special case of our model with no currency substitution effects, i.e. $\alpha = 0$.

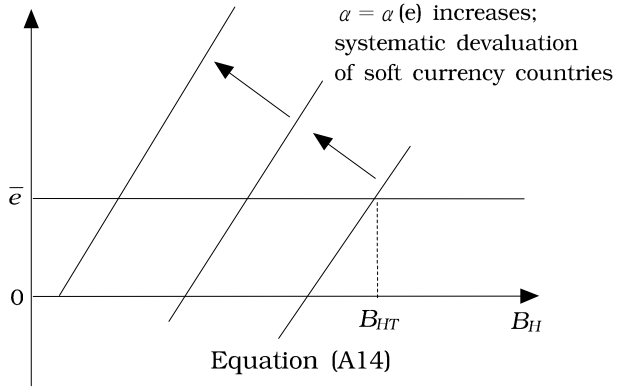


FIGURE 8
TIMING OF THE CRISIS

PPP identity (equation A5).[16] Although the devaluation rate itself will be equal to the growth rate of the money supply, it is currency substitution that shifts the entire locus of the shadow exchange rate towards devaluation (Figure 8).

In order to further illustrate the systematic-devaluation tendency of soft currencies due to asymmetric reputation, we can simply suppose that the currency substitution parameter is a function of the exchange rate, i.e. $\alpha = \alpha(e)$ with $\alpha'(e) > 0$. This indicates that a devaluation further reduces a currency's reputation among agents and increases the softness of the currency. Then once a country's currency is identified as the soft currency, the currency's shadow exchange rate line continues to shift to the left (Figure 8). Accordingly, soft currencies depreciate systematically and the crisis occurs more frequently. This is a simple reduced form representation of the **Y-Proposition.**

These results indicate that even under a prudent fiscal policy excessive currency substitution precipitates a devaluation that may

[16]This formulation is distinct from the Obstfeld and Rogoff (1996) model that assumes the money supply increases exogenously. In our case the tastes for currency substitution are exogenous, depending on the positioning of currencies in the hard/soft continuum. Monetary policy, on the other hand, is endogenously determined by the balance sheet of the central bank —as is the case also with the first generation models. This genre of models, as a result, can explain why a government is forced to employ a monetary policy that leads to the crisis.

turn into a financial crisis. On the other hand, strict capital controls with conservative monetary and fiscal policy will enable a country to avoid a currency-substitution-led devaluation. Moreover, a lower money multiplier will put off the timing of the collapse since $\partial T/\partial \mu < 0$. For example, a higher required reserve ratio will postpone the balance-of-payments crisis.[17]

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[17]Note that the money multiplier is defined as $\mu = (c+1)/(c+r_D+d)$, where c, r_D, and d represent the currency-deposit ratio, the required-reserve ratio, and the excess-reserve-deposits ratio, respectively.

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