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Multiple Equilibria, Contagion, and the Emerging Market Crises

Prepared by Paul R. Masson[1]

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Abstract

The paper surveys the types of models producing multiple equilibria in financial markets. It argues that such models are consistent with observed phenomena, such as the greater volatility of financial asset prices than of macroeconomic fundamentals. Alternative explanations are compared with the stylized facts concerning capital flows, portfolio shifts, and exchange rate crises. Implications for crisis prediction and prevention are then discussed.

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"The dominant theme that emerges is that there is more than one plausible explanation for any slightly mysterious phenomenon (such as the arrival and spread of cholera or yellow fever), that these contending plausible explanations often have radically different implications for public action, and that societies are reluctant to undertake costly or even inconvenient actions on the basis of contending thories of uncertain merit." (Cooper, 1989, pp. 180-81).

I. INTRODUCTION

It is not surprising that the increasing turmoil in global financial markets has stimulated interest in models with multiple equilibria, where the jumps between equilibria are triggered by extraneous events. What has seemed most striking about the crises in the mid to late 1990s is that their timing and virulence seem quite unrelated to the fundamental problems facing the countries and markets concerned. For instance, though the crisis in Mexico in 1994-95 seems to have among its causes an overvalued exchange rate and the large current account deficit, the devaluation of December 1994, which should have served to help solve these problems, instead led to a loss of confidence, a free-fall of the exchange rate, and the prospect of a massive default on exchange-rate-linked foreign debt, the Tesobonos.[2]

In addition, crises have triggered severe attacks on other currencies, where the trade and capital flow linkages between countries have been weak. This includes the contagion from Mexico to Argentina and Brazil, the contemporaneous crises in many East Asian countries in 1997, and the rippling effects of the Russian default in August 1998 on many emerging markets and even on U.S. corporate debt and mortgage backed securities spreads, resulting in a severe liquidity crisis which nearly brought down the hedge fund LTCM. The puzzle is why a crisis in a relatively small market should have global effects. Though there may be subtle reasons for other linkages to be sufficiently important to explain the above events—"wake up calls" or portfolio rebalancing or "common creditor effects," where losses in one market lead global investors to raise liquidity in other markets—these explanations are not completely satisfying because they rely on market imperfections, irrationality, or inability to exploit profit opportunities. Another possibility is that the emerging market crises were the result of moral hazard—an example is the "insurance crisis" model of Dooley (1997). These issues are explored more fully below. It is argued that models with multiple equilibria (in which investors also recognize the possibility of jumps, so that they form their expectations rationally) can introduce volatility into financial markets that substantially exceeds that of the macroeconomic fundamentals, and as a result square better with the stylized facts of global financial markets.

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[2] For a discussion of this episode and the resulting loss of confidence in the Mexican authorities, see Agénor and Masson (1999).

Such models in particular allow investors' expectations to be self-fulfilling. This gives a prominent role to what is commonly called "market sentiment" in the determination of asset prices, or, in the economic literature, "sunspots," that is irrelevant variables that nevertheless coordinate investors' expectations. For many economists this is troubling, since it introduces indeterminacy where mainstream models had come to precise predictions. For instance, the contribution of "first generation" speculative attack models (Krugman, 1979) was to show how the timing of a speculative attack, which seemed to be random, could in fact be predicted when the fundamentals were deteriorating at a predictable rate. Clearly, multiple equilibria models acknowledge that asset prices are less predictable than implied by unique equilibrium models, but recent experience suggests that this corresponds to reality rather than being a inconvenient property of a theoretical model. The resistance to "second generation" crisis models (Obstfeld 1986, 1994), where the authorities' decision to devalue is endogenous and can be provoked by a sufficiently strong speculative attack, was no doubt in part related to this (an example is Krugman, 1996).

Another objection is based on political economy; governments are always keen to deny that it is their policies which are out of line, and multiple equilibria models allow them to blame attacks on wicked speculators rather than putting the blame where it belongs. It is not true however that multiple equilibria models completely absolve policymakers, since a clear implication of most of such models is that only for a certain range for the economic fundamentals are multiple equilibria possible (Jeanne, 1997). It is therefore up to the policymaker to avoid the "crisis zone," for instance by limiting indebtedness, particularly short-term foreign currency borrowing (Cole and Kehoe, 1996).

A related point is that the two types of models may in some cases be observationally equivalent. If we observe a change in monetary policies after a devaluation, we cannot distinguish between two hypotheses, one that the change was anticipated, and hence that the single (devaluation) equilibrium was the only one, and another that the attack triggered the change in monetary policy, so that a no-attack equilibrium would have been validated by a tighter monetary policy (Garber, 1996). In such circumstances, one may have to be guided by the plausibility of each of the two models rather than a statistical test of one against the other.

This paper, rather than attempting to provide new theories or econometric evidence, discusses in an informal way the plausibility of multiple equilibria models and their usefulness as a modeling technique. Section II gives a non-rigorous survey of some of the models that permit multiple equilibria in financial markets, with a distinction made between those that emphasize macroeconomic factors, bank runs, or the evaluation of imperfect information. Section III discusses issues of contagion of crises, arguing that multiple equilibria models allow a rich way of modelling contemporaneous crises even when macroeconomic linkages are not strong enough to explain them. In Section IV, stylized facts concerning international capital markets are presented, and are used to evaluate existing theories of contagion. Finally, Section V turns to the implications of multiple equilibria models for crisis prediction and prevention.

II. WHAT SORTS OF FINANCIAL MODELS PRODUCE JUMPS BETWEEN MULTIPLE EQUILIBRIA?

Without trying to present a formal taxonomy or an exhaustive survey, this section presents three different types of models that produce multiple equilibria for financial asset prices. These include macroeconomic feedback models, where adverse expectations of a particular event (typically a devaluation) make that event more likely (typically, by raising borrowing costs or wages); liquidity, or bank run models; and models of fads and herding where the process of inferring information that feeds into the expectations leads to an arbitrariness in the relationship between observed fundamentals and the prevailing equilibrium.

There is also an earlier literature on multiple equilibria in macro models that focussed not on financial markets but on real investment, overlapping generations models, and seigniorage and the demand for money (Azariadis 1981; Boldrin and Woodford 1990; Chiappori and Guesnerie 1991; Durlauf 1991). Rather than explaining high frequency fluctuations, the motivation for some of these models was to explain how the economy could be persistently stuck in a situation of low investment and animal spirits, or higher-than-optimal inflation. However, the focus here is on financial markets, and, as argued above, the notion that jumps between equilibria add volatility to asset prices has its own appeal. Hence, no further mention is made of the earlier literature.

A. Macroeconomic Feedback Models

In these sorts of models, a higher domestic interest rate, triggered by fears of devaluation or default, feeds back in an adverse way on the economy's prospects, making a devaluation or default more likely. The linkages producing this positive feedback between expectations of devaluation and the possibility of its occurrence are various. In so-called first-generation models, the decision to devalue is triggered when a particular variable, normally foreign exchange reserves, falls below a certain threshold. Higher interest rates can make reaching this threshold more likely because they increase the economy's foreign debt servicing (as in Masson, 1999b) or because higher interest rates trigger a run on the banking system, an expansion of domestic liquidity, and an outflow of reserves (Chang and Velasco, 1998).

In "second generation" speculative attack models, the government's decision to devalue is endogenous, which widens the set of relevant macro fundamentals that are affected by investors' devaluation expectations and that can positively affect the devaluation probability. In Obstfeld (1994), two examples are given, one in which exchange rate expectations worsen the unemployment/inflation tradeoff, another where inflation expectations increase the burden of servicing government debt. In the former, the expectation of devaluation raises inflation expectations and wage demands, making it more likely that the authorities will give in to those demands and devalue in order to avoid unemployment. In the latter, higher interest rates reflect increased fears that the authorities will inflate away outstanding debt, raising the burden of that debt and hence the likelihood that the inflation option will be chosen. In both cases, therefore, shifts in expectations are to some extent self-fulfilling, and there are several rational expectations equilibria.

A general equilibrium model with optimizing private sector agents has been developed by Cole and Kehoe (1996). In this model, the key variable influencing vulnerability to self-fulfilling attacks is the amount of short-term government debt. The authors argue that Mexico's exposure put it into a crisis zone of multiple equilibria, and the crisis of 1994/95 corresponded to such a self-fulfilling attack.

An objection that can be made to the interpretation of crises as jumps between multiple equilibria in macroeconomic feedback models is that the linkages involved typically take time to operate. Thus, a defense of a currency through high interest rates will only make a dent in the budget or the balance of payments if it is sustained for an extended period of time; the existence of multi-period debt further reduces vulnerability. In the meantime, expectations need to be coordinated on the "bad" equilibrium; how expectations are coordinated is usually not modeled. Indeed, models of self-fulfilling attacks fit most comfortably in a world with a large speculator (a possibility considered by Krugman, 1996), not atomistic agents. When there are many agents, it needs to be explained why they all shift at the same time between equilibria.

Indeed, introducing the heterogeneity of agents may in fact remove the possibility of multiple equilibria in such macroeconomic feedback models (Herrendorf et al., 1998). The intuition is that a continuum of values for preference parameters or technology may remove the discontinuity embodied in multiple equilibria. This is an area deserving greater theoretical and empirical attention.

B. Models of Liquidity and Bank Runs

In this type of model, lenders/depositors need to form expectations of what other depositors are doing: if others run, then it is optimal for a given individual to run too, if the amount of liquid assets available to the bank is less than demand deposits outstanding. In the formalization of Diamond and Dybvig (1983), it is a realization of a shock that determines whether each individual wants to consume now rather than later. However, even those wanting to consume later may want to withdraw their money if they think a bank run will occur, and if they do, the bank run exhausts the bank's liquid assets. Depending on whether depositors coordinate on the run or no-run equilibrium, a crisis does or does not occur.

This model has led to a number of variants and applications. In the area of international lending, an early paper by Sachs (1984) shows that if international indebtedness to a large number of domestic bank creditors is within a certain range relative to a country's income, then panics can occur, that is, "... if each bank believes that all other banks will stop lending, *all* banks will stop lending... It is precisely because panics occur only at high levels of debt that they are so difficult to distinguish from other forms of default. In every true liquidity crisis, it will seem to some observers that the problem really lies with the risk of debt repudiation or insolvency rather than with the supply of credit." (Sachs 1984, p. 32). This raises the problem of collective action, because typically it will be in the creditors' interest to coordinate on a no-crisis equilibrium, but they may not be able to commit credibly not to run, even if the country's problem is one of liquidity, not solvency, an issue discussed in

Detragiache (1996). Sachs, Tornell and Velasco (1996) model the Mexican crisis as a self-fulfilling panic, while Radelet and Sachs (1998) argue that a run by international creditors played a role in the Asian crisis. Chang and Velasco (1998) develop a model where domestic bank runs and international crises are linked.

Interestingly enough, such liquidity models rely crucially on the existence of many uncoordinated agents—in direct contrast to the macroeconomic feedback models. However, a criticism of this model of liquidity is that it depends on sequential servicing of withdrawals, making it desirable to run before others do so. In this context, it would therefore be easy to eliminate runs by altering the "first-come, first-served" assumption (Rogoff, 1999).

Another objection of the simple Diamond-Dybvig model is that runs do not occur out of the blue; they come when the banking system is under severe stress. Allen and Gale (1998) thus argue that the evidence rejects "sunspot" models in favor of "business cycle" models of bank runs. More general models however do not involve such a dichotomy. In the Sachs version of the model, it is clear that macroeconomic fundamentals do matter in influencing the possibility of multiple equilibria, even if this is not explicitly the case in the Diamond-Dybvig model. Clearly, the state of the cycle should matter for the vulnerability to a jump from a no-run to a run equilibrium, and in general it is hard to distinguish between fundamental and self-fulfilling causes, as the above quote from Sachs highlights.

C. Models of Information Acquisition and Expectations Formation

A quite different reason for the absence of a unique relationship between macroeconomic fundamentals and the equilibrium are models of expectations formation in the context of imperfect and asymmetric information.[3] These models explain how herding behavior among investors and fads can be rational (Banerjee 1992; Bikchandani et al. 1992; Caplin and Leahy, 1994; Lee, 1997; Chari and Kehoe, 1998). If each individual investor has some private information (and knows that others do too), then observing the actions of others gives some clues as to what they know (assuming that they cannot credibly share their information), making it rational to imitate them. Depending on the sequence of "signals" received, the equilibrium asset price can take one of several values. Moreover, a new signal that tips the balance of sentiment from optimism to pessimism can provoke a "cascade" or "avalanche" of sell orders and a large change in price. Thus, such models provide some justification for the apparent coordination, in macroeconomic feedback models discussed

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[3] Strictly speaking, these models yield a unique set of expectations, but they are sensitive to initial conditions. Thus, this class of models can be seen as providing explanations for the seemingly arbitrary formation of expectations. These expectations in turn may be consistent with one or another of the macroeconomic equilibria described under II.A or II.B above, and hence be self-fulfilling.

above, on one or another equilibrium.[4] Calvo and Mendoza (1996) present a model of herding behavior by international investors that is applied to the Mexico crisis; Calvo (1998) uses a model with informed and uninformed investors to try to understand contagion from Russia.

Morris and Shin (1998) show that models that do not depend on a sequence of actions may be very sensitive to the information structure, and in a counter-intuitive way. In particular, if instead of common knowledge about the distribution of the shock received by all agents there is some additional uncertainty, then the possibility of multiple equilibria disappears, and it is rational for all agents to attack. The generality of this particular result is unclear.

III. MODELING CONTAGION AS JUMPS BETWEEN MULTIPLE EQUILIBRIA

In another paper (Masson 1999a) I propose a taxonomy of reasons why crises in developing countries might be contemporaneous in time. They include a common cause affecting all developing countries, for instance because of a change in U.S. monetary policy (monsoonal effects); macroeconomic linkages among developing countries themselves, mainly through trade flows (spillovers); and other causes, not related to the country's macroeconomic fundamentals (pure contagion). I go on to argue that the first two channels do not seem sufficient to explain the tequila and Asian crises, and that the third type of contagion therefore is relevant. Moreover, it is desirable to allow for the possibility by building macroeconomic models that permit multiple equilibria, that is, depart from a unique mapping of the macroeconomic fundamentals onto financial asset prices. In such a framework, contagion might occur because a jump between equilibria was triggered by an attack elsewhere.

A. Other Models of Pure Contagion

There are at least three other explanations for contagion unrelated to a change in a country's macroeconomic fundamentals that deserve mention. One of them is that a crisis elsewhere provides new information about the seriousness of problems in the home country: this is the "wake up call" hypothesis (Goldstein, 1998). As applied to Asia, problems with banks and other financial intermediaries and the evils of crony capitalism in Thailand made investors recognize that the "Asian miracle" was an "Asian mirage," leading to a reevaluation of the desirability of investing in Indonesia, Korea, and Malaysia, not to mention Hong Kong and Singapore. While there is some plausibility to this explanation in the case of Asia, it does not provide a convincing general explanation of "pure" contagion. It is true that we as economists and investors are now much more sensitive to banking sector problems and sceptical of the

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[4] In a forthcoming paper, Arifovic and Masson (1999), we consider boundedly rational agents who imitate others as well as experimenting in forming their expectations. Simulations replicate boom and bust cycles in lending to emerging market countries, and associated currency crises.

Asian model of development. Nevertheless, it seems likely that to some extent the change in beliefs is overdone, perhaps for reasons related to the models of "fads" mentioned above. Already, one sees a shift in sentiment toward investing in Asia, though many of the problems originally identified are still there. So that rather than a wake-up call, it seems more plausible to suppose that there are shifts in sentiment, some of which are not related to learning about a country's true fundamentals. Moreover, when applied to the Mexican crisis and the tequila effect on other countries of Latin America, it is not clear what similarities among the countries investors "woke up" to (since the Mexican economy was very different from that of Argentina or Brazil, for instance), or why, by 1996, they had fallen asleep again, and were investing record amounts in emerging markets in Latin America and Asia.

A second explanation is that of portfolio rebalancing, the existence of a common creditor or cross-market hedging (Kaminsky and Reinhart, 1998; Kodres and Pritsker, 1999). Major global financial institutions facing a loss in one market turn to other markets in order to realize liquidity, so that a crisis in one emerging market triggers crises in others (Valdés 1996). Mutual funds that are specialized in a region, which face redemptions as a result, say, of a crisis in Thailand, may be forced to liquidate in a number of countries to meet those redemptions. Hedge funds may be highly leveraged, so that losses in one market lead to a write down of capital that requires shrinking the portfolio size, for a given leverage ratio, and this leads to liquidation of their holdings in a number of markets. In addition, a crisis may provoke a reexamination of the riskiness of investing in emerging markets, and bring about a voluntary decline in the leverage ratio. Both effects may have operated after the Russian default in August 1998, as some investment banks and hedge funds suffered important losses on their investment in Russian bonds. Though a plausible story concerning short-run pressures on asset prices, a persistence of such effects denies the importance of other investors who, seeing the fundamentals unchanged, take advantage of the buying opportunity created by a few institutions in trouble, or requires that herding behavior be so pervasive that all investors are similarly affected. Either way, it seems that one needs to appeal to the types of phenomena described above that permit multiple equilibria and self-fulfilling expectations.

A third explanation links the boom in lending to (and investment in) emerging markets and the subsequent occurrence of crises to government guarantees and moral hazard. Dooley (1997) adapts the first-generation, Henderson-Salant/Krugman/Flood-Garber speculative attack model to an attack on the resources available to the emerging market government to provide guarantees of various kinds—e.g., deposit insurance or the commitment to bailout banks.[5] Dooley argues that the boom in lending to emerging market countries in the early 1990s corresponded to an exogenous rise in their net worth due to lower world (read U.S.) interest rates and debt write-downs. Clever investors found ways to appropriate this net worth through capital inflows; when they judged that those resources had been depleted, they pulled

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[5] Corsetti, Pesenti and Roubini (1998) and Irwin and Vines (1999) offer models that similarly stress the role of government incentives and guarantees in leading to unprofitable investment. See Marion (1999) for an interesting discussion of the Dooley model.

their money out, triggering a crisis. On the face of it, such a model seems not to explain contemporaneous crises, since countries' net worths are unlikely to begin at the same level, nor to be depleted at the same time. Dooley argues, however, that investors' perceptions of the amount of *international* resources available for any given country would be reduced by a bailout elsewhere, making a crisis more likely in the former and leading to apparent contagion.

This model is based on a simple view of the *solvency* of a country—based on a stock of assets rather than, for instance, the power of a government to raise future resources through taxation. It also gives no role to *liquidity*, which for many observers was key to understanding the vulnerability to attack of Mexico and Korea, with their large short-term, foreign currency liabilities. Finally, it requires a great deal of foresight by investors, who are assumed to have anticipated the possibility of international bailouts in Asia and also to have estimated the point when net worth went to zero.

B. How Are Crises Transmitted in Multiple Equilibria Models?

There are several ways in which crises may be transmitted in models with multiple equilibria; these are detailed in Masson (1999b). In a single country model, jumps between equilibria are typically modelled using a Markov transition matrix, with constant transition probabilities; moreover, there is a particular region for the fundamentals where multiple equilibria can occur. Contagion could occur for the following reasons. (1) The transition probabilities could depend on the occurrence of a crisis elsewhere, so that the probability of moving from a non-crisis to a crisis state in country a would be greater if there was a crisis in country b. (2) Expectations of a crisis in country b could raise expectations of a crisis in a, because for instance a devaluation in b, if it occurred, would worsen the competitiveness of a (i.e., appreciate its real exchange rate). Here it is not spillovers, but expected spillovers, that would explain why interest rate spreads might increase in several emerging market countries, because they would each reflect expected devaluation. (3) A devaluation in b might worsen the fundamentals of a enough to put it into the "crisis" (i.e., multiple equilibrium) region, even if before it was not in the region. Then, though not certain, a crisis might occur in a if triggered by a random event, or sunspot.

The regime-switching estimation techniques of Hamilton (1988, 1994) provide a useful framework for the estimation of multiple equilibria models. As shown in Jeanne and Masson (1999), a canonical second-generation speculative attack model can be written in a form that it can be estimated as a two-regime model, where the two regimes differ only in their intercept terms. As discussed above, such a model does a good job in capturing fluctuations in French franc/deutsche mark exchange rate expectations over 1987-93.

Applications to currency crises in Latin America and Asia are less straightforward. When such a model is applied separately to monthly data on interest rates for Argentina and Brazil over 1994-98, using the real exchange rate, the trade balance, the output gap, and time as the set of fundamental variables, jumps between regimes are estimated to be relatively infrequent, and countries remain in each state for extended periods. Therefore, testing

whether the occurrence of a crisis state (i.e., high interest rates) in one country is associated with the occurrence of a similar state in the other (or with a crisis in Mexico, for instance) is difficult. Cerra and Saxena (1998) actually estimate a regime switching model for the Asian crisis countries in which the transition probabilities depend on variables in another country, but they find no statistically significant effects. Thus, this idea, though promising, thus does not deliver any insights here. The problem seems to be that the significant variation in the data is across countries rather than over time, making cross-section or panel estimation techniques most useful. Most countries face few or no crises, so that pooling of countries is needed. An alternative may be to use higher frequency data, and to examine not crises per se, but just large asset price movements; for instance, both Kaminsky and Schmukler (1998) and Baig and Goldfajn (1999) use daily data on financial asset prices, and actual announcements of economic news. It may be easier with such data to test hypotheses concerning contagion, even if the relevant macroeconomic data are only available monthly or quarterly and there are still few crises.

IV. IS THERE EVIDENCE OF SELF-FULFILLING ATTACKS AND MULTIPLE EQUILIBRIA?

The case for formulating financial models with multiple equilibria would seem to rest in large part on the observation that the macroeconomic fundamentals do not exhibit enough volatility to explain the volatility in financial asset prices. There is a long literature, pioneered by Robert Shiller (see, for instance, Shiller 1989), that examines the volatility of various asset prices in relation to the volatility of their underlying value, for instance equity prices relative to dividends or earnings. Though there are difficult conceptual issues in such tests, including how to measure the discount factor used to value future earnings (which may itself be quite variable, introducing volatility into the fundamental valuation), this literature generally does support the idea that financial markets are excessively volatile in some sense.

It is interesting to consider the cross-country correlation of stock market price indices and each country's economic fundamentals, for a set of emerging market countries for which reasonably long time series are available (Table 1). Except for Turkey, the rates of change of equity prices (in real terms) are more highly correlated than either real dividend or GDP growth rates. It is interesting to note that Mexico's share prices are positively correlated with those of other countries, though dividends and GDP are generally not. The efficient markets model would imply that dividends are the relevant fundamental, but the first principal component explains 55 percent of equity price growth, but only 38 percent of dividend growth.[6]

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[6] Discounted dividends, not contemporaneous dividends, should explain equity prices but lack of observations precluded doing this calculation. In any case, at an annual frequency dividends are already fairly smooth. See Shiller (1989), chapter 10, who finds excess co-movement between United States and United Kingdom stock price indexes.

Table 1. Selected Emerging Market Economies: Cross-Country Correlations
(1988-1999)

Real Equity Price Index[1] Growth

	Hong Kong	Korea	Malaysia	Mexico	Philippines	Singapore	South Africa	Taiwan, POC	Thailand	Turkey
Hong Kong	1	0.60	0.84	0.54	0.58	0.78	0.40	0.38	0.58	-0.01
Korea		1	0.72	0.25	0.65	0.90	0.32	0.54	0.61	-0.01
Malaysia			1	0.54	0.77	0.88	0.39	0.25	0.87	0.09
Mexico				1	0.54	0.40	0.61	0.38	0.39	-0.27
Philippines					1	0.78	0.52	0.46	0.72	-0.24
Singapore						1	0.52	0.42	0.65	0.01
South Africa							1	0.65	0.05	0.14
Taiwan, POC								1	0.07	-0.11
Thailand									1	0.25
Turkey										1

Real Dividend[1] Growth

	Hong Kong	Korea	Malaysia	Mexico	Philippines	Singapore	South Africa	Taiwan, POC	Thailand	Turkey
Hong Kong	1	0.09	0.75	-0.46	0.48	0.15	-0.07	0.09	0.76	0.21
Korea		1	0.22	-0.05	0.15	0.14	0.18	0.36	0.14	0.30
Malaysia			1	-0.67	0.65	0.51	0.20	-0.15	0.76	0.23
Mexico				1	-0.80	-0.21	0.01	-0.10	-0.14	0.11
Philippines					1	0.46	-0.16	0.03	0.43	0.10
Singapore						1	0.09	-0.05	0.59	-0.10
South Africa							1	0.48	-0.05	0.45
Taiwan, POC								1	-0.16	-0.20
Thailand									1	0.25
Turkey										1

Real GDP[1] Growth

	Hong Kong	Korea	Malaysia	Mexico	Philippines	Singapore	South Africa	Taiwan, POC	Thailand	Turkey
Hong Kong	1	0.86	0.90	-0.09	0.42	0.83	0.24	0.66	0.76	0.10
Korea		1	0.94	-0.24	0.53	0.81	0.36	0.55	0.89	0.04
Malaysia			1	-0.15	0.53	0.84	0.28	0.60	0.87	0.12
Mexico				1	-0.13	-0.13	-0.35	0.06	-0.28	-0.19
Philippines					1	0.60	0.87	0.34	0.44	0.04
Singapore						1	0.49	0.72	0.79	0.03
South Africa							1	0.21	0.24	-0.09
Taiwan, POC								1	0.59	-0.26
Thailand									1	-0.04
Turkey										1

Sources: Primark Datastream and International Monetary Fund, World Economic Outlook.

[1] All indices are in local currency.

The Table thus provides suggestive evidence of excessive correlation of stock market prices relative to the fundamentals underlying a country's stock market.[7] Other asset prices give similar results either of excessive volatility or excessive co-movement, and this suggests that it may be necessary to introduce additional noise into asset valuation models. However, simply adding a normally distributed error does not do the job, since shocks to financial asset prices also seem to be characterized by occasional very large changes, that is, to be drawn from a distribution with fat tails. Moreover, observations do not seem to be clustered around a single point but rather correspond to discrete regimes. Jumps between multiple equilibria, between "euphoria" and "gloom", seem to be a useful way to capture that phenomenon. An interesting alternative approach is to assume that the distribution of shocks is bi-modal (for whatever reason), and try to estimate its parameters from the data (Lim and Martin, 1998). Both alternatives seem to characterize the data better than a single linear relationship with an additive error term drawn from a unimodal distribution—fat-tailed or not.

Another relevant stylized fact is that the fundamentals suggested by economic theory do not seem to explain asset price movements. For instance, Flood and Rose (1995) find no evidence that there is a linear relationship between exchange rates and a set of plausible macroeconomic fundamentals. This finding is destructive of our usual linear (or nearly linear) econometric models with unique equilibria, but not necessarily of models with substantial nonlinearity in some form or another. One way of introducing a large amount of nonlinearity is through jumps between equilibria.

Indeed, Jeanne and Masson (1999) find that the relationship between macro variables and exchange rate expectations (captured as the interest differential between short-term French franc and deutsche mark assets) comes through much more significantly when a two-state model is estimated than when only a single linear relationship is imposed on the data. In particular, a canonical second-generation speculative attack model implies that the expected probability of devaluation can be approximated by a linear relationship with fundamentals, plus an intercept that takes on one of two values. As shown in Jeanne and Masson (1999), the statistical significance of the coefficients on the macro fundamentals (the French trade balance, real effective exchange rate, and the unemployment rate) and time is much stronger when the relationship is allowed to include a different constant term (but the same slope coefficients) in two regimes, than in a single regime model. The two-regime model successfully captures several periods of turbulence, while the single regime model yields a smooth, though somewhat curved, downward trend in the interest differential. Moreover, though testing the null hypothesis of a single regime versus the alternative of two regimes is not straightforward (since some of the parameters are not defined under the null), even an

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[7] All indices are in local currency, so the co-movement of exchange rates (relative for instance to the dollar) in emerging market crises are not the source of the excess correlation of stock prices.

overly conservative criterion (allowing fully for the number of additional parameters in the degrees of freedom calculation) suggests that the increase in likelihood is significantly greater for the two-state model: 106.58 compared to a $\chi^2(4)$, whose 1% critical value is 13.28.

As mentioned above, it does not seem possible in general to distinguish conclusively models with multiple equilibria from unique-equilibrium models, since the former depend on unobserved expectations which may legitimately be assumed to depend on other considerations than the macroeconomic fundamentals. This is the tack taken by Krugman (1996), who argues that political fundamentals were shifting in the 1992-93 period in France. This would explain why the speculative attack on the franc's ERM parity, repulsed in September-November 1992, revived in the spring of 1993 (as unemployment rose), culminating in widespread loss of confidence and flight from the franc (and other non-German currencies) in July, and forcing a widening of the ERM bands. However, as argued in Jeanne and Masson (1996), this explanation raises as many questions as it provides answers. In particular, the June-July 1993 crisis immediately followed the sharp *narrowing* of differentials and appreciation of the franc in May, when in fact French rates went below German ones and there was talk of the franc taking over leadership of the ERM from the deutsche mark. The proximate political event triggering the crisis was not domestic concerns (the new government had received a large majority of seats in the National Assembly) but rather a tiff between the French and German finance ministers, and the notion that a relatively minor event could trigger a large crisis is if anything suggestive of shifts in self-fulfilling expectations rather than fundamental causes.

Another stylized fact that is supportive of the idea of multiple equilibria is the alternation of periods of overlending and capital outflow in emerging market countries, the latter precipitating major crises. As documented by many studies (see, for instance, Schadler et al., 1993) an initial period of euphoria brings about a narrowing of spreads and lack of concern for credit quality, as capital flows indiscriminately to many emerging markets. This is often followed by a sudden withdrawal of confidence and the occurrence of crises in a number of countries at the same time. Rather than stable capital flows which reflect a sober assessment of the economic reality of emerging market countries, we see periods of over-optimism and over-pessimism suggestive of arbitrary swings in market sentiment.

Wolf (1999) emphasizes two other stylized facts relative to the contemporaneous occurrence of crisis, or contagion: 1) emerging market asset price co-movements increase dramatically in a crisis, and 2) the increased co-movement is particularly pronounced within regions. However, these stylized facts do not go unchallenged. First, Forbes and Rigobon (1999) correct correlation coefficients for bias introduced by focusing on periods when *variances* of asset prices are high: they conclude that corrected for this bias, the co-movements of stock prices during the 1987 stock market crash, the 1994 Tequila crisis and the 1997 East Asian crises were no greater than in normal times. Second, the regional aspect of crises, which emerged strongly in Latin America after Mexico 1994 and in Asia after Thailand 1997, and which has been studied by, among others, Glick and Rose (1998), has been thrown into question by the Russian default of August 1998, which did not most strongly affect

neighboring countries, but rather had global repercussions extending even to U.S. mortgage-backed securities and junk bonds.

Table 2 presents the stylized facts discussed above and some of the theories that have been advanced to explain them.[8] The table first highlights the failure of first-generation speculative attack models to provide insights into the identified phenomena. The assessments made of the success of the various other theories to account for the stylized facts are admittedly subjective—their proponents would in some cases no doubt argue that a minor extension would allow them to explain more. What I think is hard to disagree with is the following: 1) there are many puzzles related to capital flows to emerging markets; and 2) no single theory does a fully convincing job of explaining all, or even most, of them.

The explanation that seems to come closest is 4, but this is not so much a theory as an assumption that a market imperfection (regional limits on portfolios of selected financial institutions, for instance) is empirically important relative to other investors which are not so constrained and can trade on the basis of economic fundamentals, and this assumption does not square well with some other evidence.[9] Though there is some support for the hypothesis that institutional constraints may be important at some points in time (Van Rijckeghem and Weder, 1999, who look at common bank creditors as explanations of crises hitting several emerging market countries), clearly much more empirical work needs to be done to establish the plausibility of this particular channel. What is striking from the data on bank lending to emerging-market countries is that banks in the mature-market countries are so diversified, arguing against the regional contagion story (Table 3). European banks have roughly equal exposures to Asia, Latin America, and the rest of the emerging markets; while North American banks are more concentrated in Latin America, and Japanese banks in Asia, both have substantial exposures in other parts of the world.

I would further suggest that there is a potentially useful role for explanations based on multiple equilibria, bank runs, and herding (2c and 3b) though here again more empirical work is needed. In addition, an interesting avenue for theoretical research would be to link the asymmetric information models of fads and herding, which provide microeconomic explanations for sharp shifts in expectations, to the jumps between macroeconomic equilibria.

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[8] This is a modified version of a table I used to focus discussion of a paper by Holger Wolf (1999), at a conference at the World Bank on Capital Flows, Financial Crisis and Policies, April 15-16, 1999. Rather than providing another survey of the relevant theories, the interested reader is referred to Wolf (1999).

[9] For instance, the Investment Company Institute (1998) estimated that at the end of 1996, U.S. open-end emerging market equity mutual funds that invested primarily in Asia constituted only 0.8 percent of the value of these stock markets.

Table 2. International Capital Markets: Theories and Stylized Facts

Theories	Stylized Facts					
	Contemporaneous booms of capital inflows	Contemporaneous busts (crises)	"Excessive" co-movement of asset prices in crises (relative to fundamentals)	Crises tend to be regional	Home bias	More frequent and global crises in 1990s
1. First generation speculative attack models	No	No	No	No	No	No
2. Multi-country transmission: a) Spillovers through trade and economic activity	No	Yes	No	Yes	No	Possibly
b) Monsoons (US monetary policy , $/yen, oil price)	Yes	Yes	No	No	No	No
c) Correlated jumps between equilibria	Yes	Yes	Yes	No	No	No
3. Models of incomplete and asymmetric information: a) Demonstration effects ("wake-up calls")	Possibly	Yes	Possibly	Possibly	Yes	No
b) Rational fads and herding due to private information	Yes	Yes	Possibly	Possibly	Yes	No
c) Fundamentalists vs. noise traders	Possibly	Possibly	Yes	No	No	No
4. Institutional constraints and portfolio rebalancing	Yes	Yes	Possibly	Possibly	Possibly	Possibly
5. Insurance crises and moral hazard	Yes	Yes	Possibly	No	No	Possibly
6. Capital account liberalization and technological advances	No	No	No	No	No	Yes

Table 3. Regional Distribution of Bank Lending to Emerging Markets,
December 1998

(In billions of U.S. dollars)

Region of Borrowers	Total	European banks	North American banks	Japanese banks	Other banks
Asia	299	150	26	86	37
Latin America	288	180	74	14	20
Middle East	63	40	6	4	13
Africa	57	45	5	2	5
Central and Eastern Europe	122	103	7	4	8
Total	829	518	118	110	83

(As a percent of bank exposure)

Region of Borrowers	Total	European banks	North American banks	Japanese banks	Other banks
Asia	36.1	29.0	22.0	78.2	44.6
Latin America	34.7	34.7	62.7	12.7	24.1
Middle East	7.6	7.7	5.1	3.6	15.7
Africa	6.9	8.7	4.2	1.8	6.0
Central and Eastern Europe	14.7	19.9	5.9	3.6	9.6
Total	100	100	100	100	100

(As a percent of lending to the region)

Region of Borrowers	Total	European banks	North American banks	Japanese banks	Other banks
Asia	100	50.2	8.7	28.8	12.4
Latin America	100	62.5	25.7	4.9	6.9
Middle East	100	63.5	9.5	6.3	20.6
Africa	100	78.9	8.8	3.5	8.8
Central and Eastern Europe	100	84.4	5.7	3.3	6.6

V. IMPLICATIONS FOR CRISIS PREDICTION AND PREVENTION

Existing, single equilibrium models suggest that a fairly benign view of capital flows and asset price volatility is appropriate. Models with multiple equilibria in financial markets are consistent with a more nuanced view of the benefits of capital account liberalization, and have been used by some as an argument for limiting capital flows and regulating markets. In this section, I will take a fairly agnostic stance on these issues, but attempt to marshall the arguments and try to make sense of them.

If we believe that financial market valuations fluctuate around their equilibrium levels, even if occasionally with large swings, we will probably look more favorably on financial markets than if we think that there are arbitrary regime changes that are not dictated by fundamental economic factors but rather are the result of self fulfilling expectations driven by "sunspots." Of course, there is not necessarily a clear welfare ranking between the two views of financial volatility: if there is a single equilibrium but large variance around it, this could be worse than multiple equilibria that are close together and possibly yield a higher level of per capita consumption. Another possibility is that the range of fundamentals where multiple equilibria occur is quite narrow and seldom is reached. But one suspects that the proponents of self-fulfilling crises have a presumption that the equilibria are very different, fundamentals are frequently in the multiple equilibria region, and that a crisis involves large welfare costs.

The **first** implication of the multiple equilibria view is clearly that crises may be difficult to predict. This makes it less likely that we can correctly anticipate when crises will occur, though it may still be possible to gauge the relative *vulnerability* of countries to crises (see discussion of early warning indicators of crises in Berg and Pattillo, 1998). Vulnerability in such models, as described above, depends on the relevant fundamentals being in certain ranges, so that only certain countries are likely to be affected.

A **second** implication drawn by some economists (e.g., Wyplosz, 1998) is that capital flows should be subject to international regulation. One possible form this might take is Tobin taxes, and Bensaïd and Jeanne (1996) explicitly analyze their effect on multiple equilibria; they show that an appropriate level of the tax can eliminate the possibility of multiple equilibria, and therefore eliminate this form of financial market volatility. Of course, Tobin taxes and capital controls generally are open to the criticism that they may be difficult to enforce, lose effectiveness over time as ways around them are found, and impair economic efficiency.

A **third** implication, related to the second, is that arguments in favor of capital account liberalization that emphasize the disciplining effects on governments of being open to capital flows are somewhat less compelling. If valuations solely reflect economic fundamentals, then governments are well advised to respect the signals of the market. However, if attacks on the market reflect the whims of investors then rather than bowing to them, governments may well prefer to insulate themselves from them. Again, this dichotomy is not a clean one; economic fundamentals (in particular, the stance of economic policies) have their role even in models with multiple equilibria. In addition, the *effectiveness* of capital controls also needs

to be considered. Calvo and Reinhart (1999), for instance, conclude that capital controls may be able to influence the composition of flows, but are unlikely to be the solution to the recurring problem of capital flow reversal.

Fourth, the view taken on multiple equilibria in global financial markets—and of the source of multiple equilibria—may well influence views on reform of the international monetary system. By analogy with the analysis of domestic financial markets (Diamond and Dybvig, 1983), certain institutions may prevent the occurrence of welfare-deteriorating bank runs or creditor panics, but this analysis addresses only one type of multiple equilibria—those related to liquidity and runs. Also, the analogy with domestic banks, which have a clear role in providing liquidity by maturity transformation, is not obvious for international lending, suggesting that measures to discourage short-term borrowing may be a solution which would have little cost. If the source of multiple equilibria is one of the other two—macroeconomic feedbacks or herding behavior—then the solutions are different. For the former, it will be important to reduce macroeconomic vulnerability, avoid foreign currency exposure, and build up reserves. Problems of herding and asymmetric information are best addressed by increasing the transparency of government policies and data, and increasing disclosure requirements on financial institutions.

The literature has focussed on four types of institutions that may help to prevent international crises or mitigate their effects: (1) a lender of last resort; (2) deposit insurance (more generally, guaranteed repayment of debts); (3) suspension of convertibility (or a stay of creditor action) in a crisis; and (4) modifications to the terms of loan contracts (including sharing agreements or majority voting) or the way bonds are auctioned (to limit unsustainable borrowing). The literature on this issue is too vast to be surveyed here, but various authors have shown that these institutional features may help eliminate multiple equilibria and achieve a good equilibrium.

However, proposals for international monetary reform are necessarily strongly influenced by what might be feasible as well as desirable. For instance, Sachs (1995) has called for an international lender of last resort, but in the current "architecture" there is no institution playing the same role as a national central bank, which can create money in the national currency. The recent creation of the Contingent Credit Line is intended to pre-approve the availability of IMF resources to countries with strong economic fundamentals but that may be the object of contagion, and in this way ward off a crisis. However, the resources of the IMF are relatively small compared to the size of international claims and potential capital movements. In contrast, central banks can create an unlimited amount of liquidity to counter domestic panics and bank runs. Furthermore, there is no international regulator of financial institutions or private and public borrowers that parallels domestic regulators, which have the job of preventing reckless lending in the first place.[10]

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[10] Rogoff (1999) also notes that even the domestic case for a lender of last resort is less than completely convincing, since it neglects the moral hazard problem and could be made

Another proposal for reform concerns insuring international claims by charging a small insurance premium on all borrowers (Soros, 1998). Again, such a proposal would require for its implementation a quite different legal and regulatory framework than that which exists today. Without a treaty binding all countries, there would be no way to oblige borrowers to comply, and, instead there might be some self-selection of debtors that might signal to lenders their desire to cash in on the insurance, i.e., to default.

Rather than attempting to eliminate multiple equilibria entirely, a more realistic lesson for the international monetary system might be that ways need to be found to coordinate on the "good" (non-crisis) equilibrium by establishing the confidence of creditors without exacerbating moral hazard, and ways found to minimize the damage done by crises when they occur. Confidence-enhancing measures would include a track record of consistent and sustainable policies, increased "transparency," and making available adequate data and other information on government policies. Involving private creditors in sharing the cost of crises could lead to their quicker resolution and help to limit excessive lending in the first place. Whether because of a belief in multiple equilibria or just a generalized concern for volatility, these avenues are already being actively explored in various fora, for instance the G-10 and the G-22, and by various authors such as Sachs (1995), Minton-Beddoes (1995), Eichengreen and Portes (1995), and Eichengreen (1998). In any case, further research on the fundamental reasons for multiple equilibria (some of which were sketched above) and the causes of jumps between equilibria will help to make progress in these areas.

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unnecessary by other institutional changes, such as allowing banks to suspend redemption of deposits temporarily.

REFERENCES

Agénor, Pierre-Richard, and Masson, Paul (1999). "Credibility, Reputation and the Mexican Peso Crisis," *Journal of Money, Credit and Banking* 31 (February):70-84.

Allen, Franklin and Gale, Douglas (1998). "Optimal Financial Crises," *Journal of Finance* 53 (August):1245-1284.

Arifovic, Jasmina and Masson, Paul (1999). "Heterogeneity and Evolution of Expectations in a Model of Currency Crisis," mimeo, IMF.

Azariadis, C. (1981). "Self-fulfilling Prophecies," *Journal of Economic Theory* 25:380-96.

Bacchetta, Philippe, and Van Wincoop, Eric (1998). "Capital Flows to Emerging Markets: Liberalization, Overshooting, and Volatility," mimeo (March).

Baig, Taimur, and Goldfajn, Ilan (1999). "Financial Market Contagion in the Asian Crisis," IMF *Staff Papers* 46 (June):167-95.

Banerjee, Ajiz (1992). "A Simple Model of Herd Behavior," *Quarterly Journal of Economics* 107 (August):797-817.

Bensaïd, Bernard, and Jeanne, Olivier (1996). "Fragilité des systèmes de change fixe et contrôle des capitaux," *Economie et Prévision*, No. 123-124.

Berg, Andrew, and Pattillo, Catherine (1998). "Are Currency Crises Predictable? A test," IMF Working Paper WP/98/154 (November).

Bikchandani, Sushil, Hirshleifer, David and Welch, Ivo (1992). "A Theory of Fads, Fashion, Custom, and Cultural Change as Informational Cascades," *Journal of Political Economy* 100 (5):992-1026.

Boldrin, M., and Woodford, M. (1990). "Equilibrium Models Displaying Endogenous Fluctuations and Chaos," *Journal of Monetary Economics* 25 (March):189-222.

Calvo, Guillermo (1998). "Understanding the Russian Virus (with special reference to Latin America)," paper presented at the Deutsche Bank's conference on "Emerging Markets: Can They be Crisis Free?" Washington D.C., October 3.

Calvo, Guillermo, and Mendoza, Enrique (1996). "Mexico's Balance-of-Payments Crisis: A Chronicle of a Death Foretold," *Journal of International Economics* 41:235-64.

Calvo, Guillermo, and Reinhart, Carmen (1999). "When Capital Inflows Come to a Sudden Stop: Consequences and Policy Options," mimeo, University of Maryland.

Caplin, Andrew and Leahy, John (1994). "Business as Usual, Market Crashes, and Wisdom After the Fact," *The American Economic Review* 84 (June):548-65.

Cerra, Valerie, and Saxena, Sweta (1998). "Contagion, Monsoons, and Domestic Turmoil in Indonesia: A Case Study in the Asian Currency Crisis," mimeo (IMF and University of Washington).

Chang, Roberto, and Velasco, Andrés (1998). "The Asian Liquidity Crisis," NBER Working Paper No. 6796. Cambridge, Mass.: National Bureau of Economic Research.

Chari, V.V., and Kehoe, Patrick (1998). "Hot Money," mimeo (Research Department, Federal Reserve Bank of Minneapolis, April).

Chiappori, P.-A., and Guesnerie, R. (1991). "Sunspot Equilibria in Sequential Markets Models." In Werner Hildenbrand and Hugo Sonnenschein, eds., *Handbook of Mathematical Economics*, Vol. IV pp. 1683-762. Amsterdam: North-Holland.

Cole, Harold, and Kehoe, Timothy J. (1996). "A Self-Fulfilling Model of Mexico's 1994–95 Debt Crisis," *Journal of International Economics* 41:309-30.

Cooper, Richard N. (1989). "International Cooperation in Public Health," in R.N. Cooper, Barry Eichengreen, C. Randall Henning, Gerald Holtham, and Robert D. Putnam, eds., *Can Nations Agree? Issues in International Economic Cooperation*, pp. 178-254. Washington, D.C.: Brookings.

Corsetti, Giancarlo, Pesenti, Paolo, and Roubini, Nouriel (1998). "Paper Tigers? A Model of the Asian Crisis," NBER Working Paper No. 6783. Cambridge, Mass.: National Bureau of Economic Research.

Detragiache Enrica (1996). "Rational Liquidity Crises in the Sovereign Debt Market: In Search of a Theory," IMF *Staff Papers* 43 (September):545-70.

Diamond, Douglas, and Dybvig, Philip (1983). "Bank Runs, Deposit Insurance, and Liquidity," *Journal of Political Economy* 91:401–19.

Dooley, Michael (1997). "A Model of Crises in Emerging Markets," NBER Working Paper No. 6300. Cambridge, Mass.: National Bureau of Economic Research.

Durlauf, S.N. (1991). "Multiple Equilibria and Persistence in Aggregate Fluctuations," NBER Working Paper No. 3629. Cambridge, Mass.: National Bureau of Economic Research.

Eichengreen, Barry (1998). *Toward A New International Financial Architecture: A Practical Post-Asia Agenda*. Washington, D.C.: Institute for International Economics.

Eichengreen, Barry, and Portes, Richard, eds. (1995). *Crisis? What Crisis? Orderly Workout for Sovereign Debtors.* London: Centre for Economic Policy Research.

Flood, Robert, and Rose, Andrew (1995). "Fixing Exchange Rates: A Virtual Quest for Fundamentals," *Journal of Monetary Economics* 36 (August):3-37.

Forbes, Kristin, and Rigobon, Roberto (1999). "No Contagion, only Interdependence: Measuring Stock Market Co-movements," NBER Working Paper No. 7267. Cambridge, Mass.: National Bureau of Economic Research.

Garber, Peter (1996). "Comment on Krugman," *NBER Macroeconomics Annual 1996.* Cambridge, Massachusetts: MIT Press.

Goldstein, Morris (1998). *The Asian Financial Crises: Causes, Cures, and Systemic Implications*, Policy Analyses in International Economics 55. Washington, D.C.: Institute for International Economics.

Hamilton, J.D. (1988). "Rational-Expectations Econometric Analysis of Changes in Regime: An Investigation of the Term Structure of Interest Rates," *Journal of Economic Dynamics and Control* 12:385-423.

——— (1994). *Time Series Analysis.* Princeton New Jersey: Princeton University Press.

Herrendorf, B., Valentinyi, A., and Waldmann, R. (1998). "Ruling out Indeterminacy: The Role of Heterogeneity," University of Southhampton, Department of Economics, Working Paper 9803.

Investment Company Institute (1998). *Perspective* (Washington, D.C.) 4 (June):1-11.

Irwin, Gregor and Vines, David, "A Krugman-Dooley-Sachs Third Generation Model of the Asian Financial Crisis," mimeo, University of Oxford.

Jeanne, Olivier (1997). "Are Currency Crises Self-Fulfilling? A Test," *Journal of International Economics* 43 (3/4):263-86.

Jeanne, Olivier, and Masson, Paul (1996). "Was the French Franc Crisis a Sunspot Equilibrium?" mimeo (June).

Jeanne, Olivier, and Masson, Paul (1999). "Currency Crises, Sunspots and Markov-Switching Regimes," *Journal of International Economics.*

Kaminsky, Graciela, and Reinhart, Carmen (1998). "On Crisis, Contagion, and Confusion," paper presented at the Duke University conference "Globalization, Capital Market Crises, and Economic Reform," November.

Kaminsky, Graciela, and Schmukler, Sergio (1998). "What Triggers Market Jitters? A Chronicle of the Asian Crises," *Journal of International Money and Finance* 18(4):537-60.

Kodres, Laura, and Pritsker, Matthew (1999). "A Rational Expectations Model of Financial Contagion," mimeo, IMF and Board of Governors of the Federal Reserve System.

Krugman, Paul (1979). "A Model of Balance of Payments Crises," *Journal of Money, Credit, and Banking* 11:311-25.

—— (1996). "Are Currency Crises Self-fulfilling?" *NBER Macroeconomics Annual*, Cambridge: MIT Press.

Lee, In Ho (1997). "Market Crashes and Informational Avalanches," paper presented at a CEPR/ESRC/GEI conference on The Origins and Management of Financial Crises (Cambridge, United Kingdom: July 11-12).

Lim, G.C., and Martin, Vance (1998). "Forecasting Exchange Rate Crises with an Application to the Asian Currency Meltdown," mimeo (September).

Marion, Nancy (1999). "Some Parallels Between Currency and Banking Crises," mimeo, IMF.

Masson, Paul (1999a). "Contagion: Monsoonal Effects, Spillovers, and Jumps Between Multiple Equilibria." In P.R. Agénor, M. Miller, D. Vines, and A. Weber, eds., *The Asian Financial Crisis: Causes, Contagion and Consequences*. Cambridge, U.K., Cambridge University Press.

_____ (1999b). "Contagion: Macroeconomic Models with Multiple Equilibria," *Journal of International Money and Finance* 18(4):587-602.

Minton-Beddoes, Zanny (1995). "Why the IMF Needs Reform," *Foreign Affairs* 74 (May/June):123-33.

Morris, Stephen, and Shin, Hyun Song (1998). "Unique Equilibrium in a Model of Self-Fulfilling Attacks," *American Economic Review* 88 (June):587-97.

Obstfeld, Maurice (1986). "Rational and Self-fulfilling Balance of Payments Crises," *American Economic Review* 76:72-81.

—— (1994). "The Logic of Currency Crises," *Cahiers Economiques et Monétaires* No. 43:189-213. Paris: Banque de France.

Radelet, Steven, and Sachs, Jeffrey (1998). "The East Asian Financial Crisis: Diagnosis, Remedies, Prospects," *Brookings Papers on Economic Activity* 1:1-90.

Rogoff, Kenneth (1999). "International Institutions for Reducing Global Financial Instability," NBER Working Paper No. 7265. Cambridge, Mass.: National Bureau of Economic Research.

Sachs, Jeffrey (1984). "Theoretical Issues in International Borrowing," *Princeton Studies in International Finance*, No. 54 (July).

Sachs, Jeffrey (1995). "Do We Need an International Lender of Last Resort?" Frank D. Graham Lecture, Princeton University, April 20.

Sachs, Jeffrey, Tornell, Aaron and Velasco, Andrés (1996). "The Mexican Peso Crisis: Sudden Death or Death Foretold?" *Journal of International Economics* 41:265-83.

Schadler, Susan, Carkovic, Maria, Bennett, Adam and Kahn, Robert (1993). "Recent Experiences with Surges in Capital Inflows," IMF Occasional Paper 108.

Shiller, Robert (1989). *Market Volatility*. Cambridge Mass.: MIT Press.

Soros, George (1998). *The Crisis of Global Capitalism: Open Society Endangered.* New York: PABS/Public Affairs.

Valdés, Rodrigo (1996). "Emerging Market Contagion: Evidence and Theory," mimeo, MIT.

Wolf, Holger (1999). "International Asset Price and Capital Flow Co-movements During Crisis: the Role of Contagion, Demonstration Effects, and Fundamentals," mimeo, Georgetown University.

Wyplosz, Charles (1998). "Speculative Controls and Capital Mobility," paper presented to the Fourth Dubrovnik Conference on Transition Economics, June 24-26.