

INTERNATIONAL MONETARY FUND

Fund-Supported Programs and Crisis Prevention

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Executive Summary

One fundamental purpose of the IMF is to make its resources available to members experiencing balance of payments difficulties to lessen the adjustment costs. In capital account crises, however, the magnitude and abruptness of the private capital outflows has often dwarfed available official financing, resulting in much sharper external adjustment than programmed (or warranted by debt sustainability considerations). This suggests a renewed emphasis on crisis *prevention* would be worthwhile—an ounce of prevention is worth a pound of cure.

This paper examines the theoretical foundations for, and empirical evidence of, Fund support in preventing capital account crises. At a theoretical level, Fund supported programs can lower the crisis probability in two ways. First, such programs provide the member with additional external reserves, making a run for the exit by private creditors less likely. Second, such programs induce and signal better economic policies, though this needs to be supported by conditionality.

Empirically, the paper finds that, at times of heightened vulnerability, Fund resources (either disbursed over the preceding year or accumulated drawing rights under an on-track precautionary arrangement) as a proportion of short-term debt (and the associated stronger policies) can lower the likelihood of a crisis. This effect is quantitatively important and empirically robust. A dummy variable for an on-track Fund arrangement, however, is not statistically significant, suggesting that “money matters.” However, policies and the signal to markets implicit in Fund support also matter because the Fund variable is statistically significant even when controlling for the member’s (gross) foreign exchange reserves. In addition, economic fundamentals (including policies) are crucial for the impact of Fund support on crisis prevention. When fundamentals are weak or insolvency risk is high, the crisis probability is high and the *marginal* impact of a Fund-supported program in lowering this crisis probability is small. When fundamentals are very strong, a Fund supported program further lowers the likelihood of a crisis, though this probability is already low to begin with. Therefore, Fund-supported programs for crisis prevention are especially interesting when a member’s economic fundamentals are in an intermediate range.

I. INTRODUCTION

1. One of the fundamental purposes of the Fund is to make its resources temporarily available to members experiencing balance of payments difficulties, easing the required balance of payments adjustment by attenuating it, and helping to “give confidence” by reconstituting gross international reserves. In a number of capital account crises, however, the magnitude and abruptness of the capital outflows has dwarfed available official financing, resulting in much sharper external adjustment than programmed (or than warranted by debt sustainability considerations) and significant economic dislocation.¹ But even if available official financing attenuated external adjustment only to a limited extent once confidence was lost, Fund support can still help avoid the collapse of exchange rates and economic activity in the first place through crisis *prevention*.

2. Responding to requests of Executive Directors,² this paper examines the theoretical foundations and empirical evidence of the role of Fund support in preventing capital account crises and their attendant economic dislocation.³ The traditional literature on the “catalytic effects” of Fund support defines it as a multiplier effect of Fund lending on official and private capital inflows (so that, for each dollar of Fund support, the country receives much more than one dollar in total net inflows). A growing body of this literature suggests that the catalytic effects are at best small for private flows (excluding FDI) once a capital account crisis has erupted.⁴ Rather than focusing on crisis resolution, this paper analyzes whether

¹ See “IMF-Supported Programs in Capital Account Crises” (OP 210) and “The Design of IMF-Supported Programs” (OP 241).

² “Directors called for further careful analysis of program design issues relating to capital account crises. In particular, they encouraged staff to undertake further analysis of the optimal mix between financing and adjustment as well as of the determinants of capital flows, which have tended to fall short of expectations, and of the catalytic effects of Fund-supported programs” (The Design of IMF-Supported Programs, Summing Up, PIN/05/16).

³ This paper draws on two recent working papers—a theoretical one by Jun Il Kim (2006) and an empirical one by Uma Ramakrishnan and Juan Zalduendo (2006).

⁴ Some researchers have examined the effects of Fund financial support on private capital flows; see Cottarelli and Giannini (2002) and Bird and Rowlands (2002) for a survey of the empirical literature. These studies find limited or no evidence of catalytic effects except on official financing sources. The IMF’s OP 210 and OP 241 (2002 and 2005) find that Fund-supported programs in capital account crises cases have a much smaller catalytic effect than anticipated. Other papers have looked at the effects on spreads. Here too the evidence is mixed. Haldane (1999) argues that the existence of a program increases spreads, while Eichengreen and Mody (2000) and Mody and Saravia (2004) find evidence that Fund-supported program reduce spreads on new issues of bonds. These various papers have not,

(continued...)

Fund lending can help prevent a crisis from erupting in the first place. “Catalytic effect” in the sense used in this paper means that one dollar of Fund support results in more than one dollar of *net* private inflows relative to the counterfactual in which private lenders would have exited; this is not the same sense in which the term has normally been used in the literature.

3. At a theoretical level, Fund support of the authorities’ economic program may help stave off a crisis in four ways: (i) by improving policies; (ii) by providing a means (namely, program conditionality) of solving time-inconsistency problems; (iii) by signaling these better policies and demonstrating the authorities’ continued commitment to them; and (iv) by augmenting liquidity. These channels are not independent of each other. For instance, the availability of conditional Fund financing may induce stronger policies; the strength of the Fund’s “seal of approval” signal to markets may be enhanced by the Fund putting its own resources on the line and the authorities demonstrating their commitment through compliance with program conditionality; and Fund financing may contribute to crisis prevention by improving various vulnerability indicators (such as reserves coverage of short-term debt).

4. Such bundling of adjustment, liquidity, and the credibility effects of Fund support is in fact a key feature of theoretical models and the empirical analysis below. While the theoretical literature on the Fund’s crisis prevention role is still largely in its infancy, it suggests a number of insights. First, an increase in the alternative rate of return available to investors (such as a rise in U.S. interest rates), or a reduction in the willingness of the country to undertake adjustment, can leave borrowing countries—especially those with high levels of indebtedness—more vulnerable to a crisis. Second, conditional Fund resources are especially useful for crisis prevention since they both enhance the country’s liquidity position and elicit a greater adjustment effort (stronger policies). The value of Fund support in crisis prevention, therefore, goes beyond the liquidity effects of its lending resources. Third, Fund support is most useful for reducing the likelihood of a crisis when the country faces higher adjustment costs, but its fundamentals are not so weak that solvency considerations make a crisis unavoidable. Finally, the credibility of the signal to the markets is enhanced by the Fund putting its own resources on the line.

5. Empirical evidence that Fund support may help crisis prevention is necessarily elusive. Beyond the inherent difficulties of identifying empirical regularities from a limited number of capital account crises, finding an effect of Fund support on crisis prevention depends on being able to establish the counterfactual scenario in which the country was at risk of a crisis, and then showing that Fund support lowered the crisis likelihood. This paper identifies episodes of high “market pressure” based on the behavior of foreign exchange reserves, real exchange rates, and sovereign bond spreads using cluster analysis in a panel data set of 27 emerging market countries over the period 1994-2004. This analysis yields

however, examined whether the Fund may have a catalytic role in crisis prevention situations.

32 episodes of high market pressure that are then categorized either as capital account crises or as control group cases (i.e. instances where the crisis was avoided despite intense market pressures). For this purpose, a capital account crisis is defined as a high market pressure event followed by at least two quarters of medium- or high-capital outflows over the next four quarters. This definition yields a list of 11 capital account crises, which corresponds closely to most commonly recognized cases,⁵ while the remaining 21 cases are classified as the control group. Both groups—crisis and control—have episodes with and without Fund arrangements.

6. The empirical research examines whether these high market pressure episodes turn into a capital account crisis based upon the country's fundamentals, including its policies and the availability of Fund financing in the run-up to the high market pressure episode. The econometric analysis suggests that—controlling for other factors—Fund support can indeed lower the likelihood of a crisis, confirming a role for Fund-supported programs in crisis prevention. Three aspects of the empirical results are noteworthy. First, Fund disbursements (over the preceding four quarters)—or their availability under an on-track precautionary program—lower the likelihood of a crisis beyond any purely signaling effects of Fund support of the authorities' program; in other words, "money matters" (as does implementation of the agreed policies). Second, Fund support lowers the likelihood of a crisis even controlling for the country's foreign exchange reserves as supplemented by the Fund. In other words, it is not just money that matters—beyond any liquidity effects, stronger policies and their credibility, as evidenced by the Fund's financial support, are also important. Third, economic fundamentals (including policies) are vital for crisis prevention. When fundamentals (including policies) are very weak, not only is the country starting from a high probability of a crisis, but the *marginal* effect of a Fund-supported program on lowering the crisis probability is also small. Therefore, unless complemented by substantially stronger policies, extremely large amounts of Fund financing would be required to help avert a crisis. In contrast, when fundamentals are very strong, Fund support further lowers the likelihood of a crisis, though this probability is already low to begin with. It is thus for an intermediate range of fundamentals that a Fund-supported program as a tool of crisis prevention becomes especially interesting, sharply reducing the likelihood of a crisis. In at least some of these cases, Fund financing had an appreciable impact on lowering the crisis probability and indeed the country was able to avert a crisis despite the high market pressure episode.

7. While these findings are certainly suggestive of an important role for Fund financial support—either disbursed or available under contingent or precautionary arrangements—in crisis prevention, it is also worth remembering the inherent limitations of trying to draw strong conclusions from just 32 high market pressure episodes, only a handful of which turned into

⁵ See, for example, "IMF-Supported Programs in Capital Account Crises" (OP 210).

full blown capital account crises.⁶ By the same token, it is also worth emphasizing that the Fund contributes to crisis prevention in numerous ways, including through its *surveillance work* and provision of *technical assistance* which, along with *Fund-supported programs*, can help foster stronger policies and lay the groundwork for a turning point in economic performance. The rest of this paper is organized as follows. Section II lays out some of the theoretical considerations for understanding how Fund support can help avert a financial crisis. Section III turns to the empirical evidence. Section IV offers some concluding remarks.

II. THEORETICAL CONSIDERATIONS

8. Conceptually, a Fund-supported program could help prevent crises in four ways: by providing readily available foreign exchange reserves, which gives confidence and reduces the likelihood of a liquidity “run”; by supporting stronger policies; by signaling these policies; and by enhancing their credibility via the conditionality underpinning Fund-supported programs. While the theoretical literature specifically on the role of Fund support in crisis prevention is still largely in its infancy, the broader literature on currency crises, as well as several recent studies, can provide some useful insights.⁷ In the typical setting considered by this literature, the country has short-term liabilities (short-term debt on a residual maturity basis or, in currency crisis models, the outstanding money stock) that are held by atomistic private agents. Since private creditors face a coordination problem, a liquidity crisis (or “run”) can occur even if solvency is not in question, with the likelihood depending positively on the alternative rate of return available to investors (e.g. U.S. interest rates) and negatively on the country’s foreign exchange reserves. Given costs of acquiring and holding reserves, the country has a desired level of reserves that trades off these costs

⁶ For example, the small sample precludes the assessment of non-linearities associated with threshold effects of high debt levels or of contagion effects across market pressure events.

⁷ See Flood and Marion (1998) for a survey of currency crisis models. Zettelmeyer (2000) shows that official crisis lending limited in size relative to potential outflows can have counterproductive short-run effects—financing, rather than forestalling, a run—a result which depends primarily on the existence of multiple equilibria. In Morris and Shin (2005), however, the “global games” framework allows for a unique equilibrium for the creditor coordination problem. By using this global games framework, Corsetti, Guimaraes, and Roubini (2004) find similar results to those of Morris and Shin; namely, Fund liquidity support has a (non-linear) catalytic effect and, under certain conditions, can encourage stronger policies. Penalver (2004) reaches a similar conclusion but focuses on the effect on longer-term capital flows of the Fund’s subsidized liquidity support. For a model of how Fund lending can reduce the probability of a crisis through a combination of providing liquidity and supporting stronger policies, see Kim (2006). A recent paper by Eichengreen et al. (2005) looks at the effects of Fund support in preventing sudden stops.

against the probability (and associated economic disruption) of a crisis.⁸ At any given moment, however, the country may find itself with a lower level of reserves than desirable, for instance because a shock has widened the current account deficit, depleting some of its reserves.⁹ Faced by this situation, national authorities would want to undertake at least some adjustment but, inasmuch as adjustment is costly, not necessarily enough to fully replenish reserves immediately—leaving the country in a state of heightened vulnerability.

9. How can Fund support lower the likelihood of a crisis? Most obviously, by providing—or, under a precautionary arrangement, making available—foreign exchange reserves that enhance the country’s liquidity position and supporting stronger economic policies that together give confidence and reduce the likelihood of a run. But the theoretical literature provides two further key insights. First, if Fund resources are provided unconditionally, then given costs of adjustment, the authorities might relax their macroeconomic policy stance relative to the situation in which there was no Fund lending.¹⁰ In other words, there is a risk of “debtor moral hazard” such that part of the benefit of the additional liquidity is offset by a weaker adjustment effort, and a dollar of unconditional liquidity support results in less than a corresponding increase in the country’s foreign exchange reserves. Second, *conditional* Fund resources can support *more* adjustment—and stronger policies more generally—than otherwise would be implemented. Thus a dollar of Fund support results in more than a dollar’s increase in the country’s holding of reserves, with a correspondingly greater reduction in the probability of a crisis. It bears emphasizing that, since national authorities always have the option of not seeking the Fund’s support, the

⁸ On the costs of holding reserves, see Dani Rodrick “The Social Costs of Foreign Exchange Reserves” (paper presented at the American Economics Association Meetings, January 2006). Rodrick estimates the cost of holding reserves at more than 1 percent of GDP, on average, for developing countries.

⁹ Alternatively, the desired level of reserves may increase—for example, because U.S. interest rates have risen, making an exit by creditors more likely and raising the likelihood of a crisis. In either case, as with most inventory-theoretic models, the country would not, in general, find it optimal to hold such a high level of reserves that the probability that its reserves dip below the optimal level would become negligible.

¹⁰ This risk of “debtor moral hazard” is likely to be greater in crisis prevention programs than in crisis resolution situations. In a capital account crisis (once it has erupted), the degree of external adjustment is often determined residually, given the withdrawal of private financing and the availability of official financing; see “IMF-supported Programs in Capital Account Crises” (OP210). In crisis prevention situations, by contrast, since private financing has not withdrawn, national authorities have greater latitude in determining how much adjustment to undertake—which gives rise to the greater possibility of debtor moral hazard.

larger adjustment (stronger policies) and financing provided under the program must be welfare enhancing for the member relative to a no-program situation.¹¹

10. In this regard, conditionality plays a crucial role of providing mutual assurances. Since the member may undertake less adjustment without conditionality (and the benefit of a lower crisis likelihood associated with Fund financing), conditionality provides the member the assurance that the disbursements will be forthcoming as long as policies are implemented. By the same token, the Fund is assured that the country will indeed undertake sound economic policies as it disburses its resources.¹² Finally, to help prevent a liquidity run, the private sector needs to be confident that the country will undertake requisite economic policies and have available the Fund resources if necessary.

11. In sum, economic theory points to a number of results. First, borrowing countries become more vulnerable to a crisis when world interest rates rise or when the adjustment costs are high. Second, Fund support may lower the likelihood of a crisis through a combination of increasing liquidity and promoting stronger policies. This implies that a Fund-supported program has an effect on crisis prevention beyond the pure liquidity effects of the gross international reserves it provides. While “money matters,” it is not only money that matters for crisis prevention—policies matter too. Third, a Fund-supported program is most effective in lowering the likelihood of a crisis when the country faces higher adjustment costs, but its fundamentals are also not so poor that it is insolvent. Finally, under certain circumstances, the strength of the Fund’s “seal of approval” signal—and hence the impact on lowering the crisis likelihood—is enhanced by the Fund putting its own resources on the line when it lends to member countries.¹³

III. EMPIRICAL ANALYSIS

12. Economic theory points to a number of ways in which Fund support can reduce the likelihood of a financial crisis. But is there evidence in practice? By its very nature, the effects of a Fund-supported program in crisis prevention are likely to be difficult to detect.

¹¹ Appendix I sketches a model, based on Kim (2006), in which a program with Fund financing and greater adjustment (relative to the no-program situation) will indeed be welfare enhancing for the member relative to not having a Fund-supported program, and results in a correspondingly lower likelihood of a crisis.

¹² For a discussion see “Review of the 2002 Conditionality Guidelines” (SM/05/81), para. 9.

¹³ As discussed in Kim (2006), the Fund’s signaling role is enhanced (and thus the likelihood of a crisis is further reduced) by the Fund putting its own resources on the line—especially when the Fund has an informational advantage over private creditors regarding the authorities’ policy intentions. For more general discussions, see “Signaling by the Fund—A Historical Review” (SM/04/251) and Cottarelli and Giannini (2002).

The analysis here proceeds in three steps.¹⁴ First, identifying episodes of heightened vulnerability; and second, classifying these episodes as either leading to a capital account crisis or in the “control” group where the crisis was averted. This, in essence, forms the dataset for the third step, which uses a logit specification to establish whether a Fund-supported program prior to the emergence of market pressures played a role in determining the outcome—crisis or no crisis—in the episode of heightened vulnerability.

A. Identifying Market Pressure Episodes and Classifying Outcomes

13. In order to identify episodes of heightened vulnerability, an index of “exchange market pressures” is defined as the average of the decline in foreign exchange reserves, the real exchange rate depreciation, and the increase of the sovereign bond spread in secondary markets.¹⁵ An increase in this index thus captures a weakening balance of payments position and difficulties in attracting capital inflows. This monthly index is created for a sample of 27 emerging market countries over the period 1994-2004.¹⁶ Cluster analysis is applied to this panel dataset to classify observations into one of five clusters according to the severity of the exchange market pressures facing the country. The technique avoids setting ad hoc thresholds, in effect assigning each observation to the appropriate cluster based on characteristics of the data rather than on subjective judgments.¹⁷ Since the focus of this analysis is on crisis prevention in the context of weakening balance of payments and a slowdown in capital inflows, “high market pressure” episodes are defined as those in cluster 1, which contains 32 observations.

14. The second step involves segmenting these 32 episodes into cases of capital account crises and the control group—that is, high market pressure events that did not turn into a capital account crisis. This is determined based on the behavior of net private capital flows

¹⁴ See Ramakrishnan and Zalduendo (2006) for a more detailed discussion.

¹⁵ Each of these terms in the index is standardized (mean equal to zero, standard deviation equal to one). A similar approach has been used in other studies that attempt to identify currency crises (see, e.g., Kaminsky and Reinhart (1999)).

¹⁶ The countries are: Algeria, Argentina, Brazil, Bulgaria, Chile, Colombia, Dominican Republic, Ecuador, Hungary, Indonesia, Korea, Malaysia, Mexico, Morocco, Pakistan, Panama, Peru, Philippines, Poland, Russia, South Africa, Thailand, Tunisia, Turkey, Ukraine, Uruguay, and Venezuela. Country coverage is based on data availability during 1994-2004.

¹⁷ In a nutshell, cluster analysis is a technique that minimizes differences within each cluster of data and maximizes those across different data clusters (see Everitt, 1993). While the number of clusters is arbitrary, five clusters give a reasonable span to capture a range between strengthening, neutral, and weakening pressures on the balance of payments.

(excluding FDI, as a percent of GDP). To this end, cluster analysis is applied to quarterly data on net capital flows using a total of five clusters, ranging from net large inflows to net large outflows. A capital account crisis is defined as at least two quarters (for persistence) of medium or large net capital outflows during the four quarters immediately following the onset of the market pressure event.¹⁸

15. Again, the advantage of a data-driven approach is that it avoids ad hoc judgments about what constitutes a “capital account crisis.” Nevertheless, the resulting 11 capital account crises correspond closely to most widely accepted lists of capital account crises, including the Asian crisis countries in 1997, Russia 1998, Brazil 1998, Turkey 2000, Argentina 2001, and Uruguay 2002 (Table 1). The one exception is Mexico 1994, which the procedure classifies in the control group, mainly because the net capital outflows, while large, were not sufficiently persistent. As discussed in Appendix II, however, the main empirical findings are robust to reclassifying Mexico 1994 as a capital account crisis rather than in the control group.

B. Market Pressures and the Determinants of Crises

16. So what determines whether a high market pressure episode turns into a capital account crisis? Before turning to the formal analysis, Figures 1 and 2 contrast the behavior of key macroeconomic variables for the crisis and control groups. Of course, once the crisis does or does not erupt, the behavior of these variables is likely to be quite different; of greater interest, therefore, are the differences between the groups in the run up (quarters $t-4$ to $t-1$) to the high market pressure episode.

17. From the Figures, crisis countries tend to have only marginally larger current account deficits, and both groups have a trend of declining external deficits, most likely indicating slowing economic growth and diminishing net capital inflows. Crisis countries also tend to have a more overvalued real exchange rate. Output growth is weaker and slowing in the group that eventually suffers a capital account crisis, though inflation rates are quite similar between both groups.

¹⁸ The cluster analysis identifies medium capital outflows to be in the range of 10 to 20 percent of GDP and large capital outflows to be over 20 percent of GDP.

Table 1. Classification of Capital Account Crises (KAC) and Control Group (CG) Episodes

Episode	Country	Identifying Market Pressures 1/						KAC and CG Episodes 2/					
		Beginning date		End date of market		Duration of pressures (in months) 3/	Number of months with pressures	Capital flow clusters 4/				KAC or control group (CG) 5/	
		of market pressures	pressures	pressures	pressures			t	t+1	t+2	t+3		
1	Argentina	2001	July	2002	May	11	6	4	3	4	4	KAC	
2	Brazil	1998	August	1999	January	6	3	4	3	4	2	KAC	
3	Bulgaria	1996	May	1996	May	1	1	4	4	3	4	KAC	
4	Ecuador	2000	January	2000	January	1	1	4	5	5	3	KAC	
5	Indonesia	1997	October	1998	January	4	3	4	5	3	4	KAC	
6	Korea	1997	October	1997	December	3	3	4	4	2	3	KAC	
7	Malaysia	1997	July	1998	January	7	5	5	2	4	3	KAC	
8	Russia	1998	August	1998	September	2	2	4	4	4	2	KAC	
9	Thailand	1997	July	1997	August	2	2	4	5	5	4	KAC	
10	Turkey	2000	November	2001	March	5	3	3	4	4	3	KAC	
11	Uruguay	2002	July	2002	July	1	1	5	2	2	5	KAC	
1	Argentina	1998	August	1998	August	1	1	2	2	2	4	CG	
2	Brazil	2002	July	2002	July	1	1	4	3	2	2	CG	
3	Bulgaria	1998	August	1998	August	1	1	2	2	2	2	CG	
4	Chile	1999	June	1999	June	1	1	5	2	2	2	CG	
5	Chile	2002	June	2002	June	1	1	2	2	2	2	CG	
6	Colombia	1998	April	1998	September	6	3	2	2	3	2	CG	
7	Colombia	2002	July	2002	August	2	2	2	2	3	3	CG	
8	Hungary	2003	June	2003	June	1	1	2	1	3	1	CG	
9	Indonesia	2004	January	2004	January	1	1	2	2	2	2	CG	
10	Mexico	1994	December	1995	March	4	3	3	4	3	3	CG	
11	Mexico	1998	August	1998	August	1	1	2	2	3	2	CG	
12	Peru	1998	August	1998	December	5	2	2	3	3	3	CG	
13	Philippines	1997	August	1998	August	1	1	1	3	2	1	CG	
14	Poland	1998	August	1998	August	1	1	2	3	2	2	CG	
15	South Africa	1996	April	1996	April	1	1	2	2	2	2	CG	
16	South Africa	1998	July	1998	July	1	1	2	2	2	1	CG	
17	South Africa	2001	December	2001	December	1	1	2	3	2	3	CG	
18	Turkey	1998	August	1998	August	1	1	4	1	2	2	CG	
19	Venezuela	1994	June	1994	June	1	1	4	1	3	3	CG	
20	Venezuela	1998	August	1998	August	1	1	3	3	3	3	CG	
21	Venezuela	2003	January	2003	January	1	1	3	3	4	3	CG	

1/ Market pressures identified by classifying monthly data into five clusters based on an index of market pressures that includes changes in REER, FX reserves, and spreads. The listed countries are in the cluster with the highest market pressures.

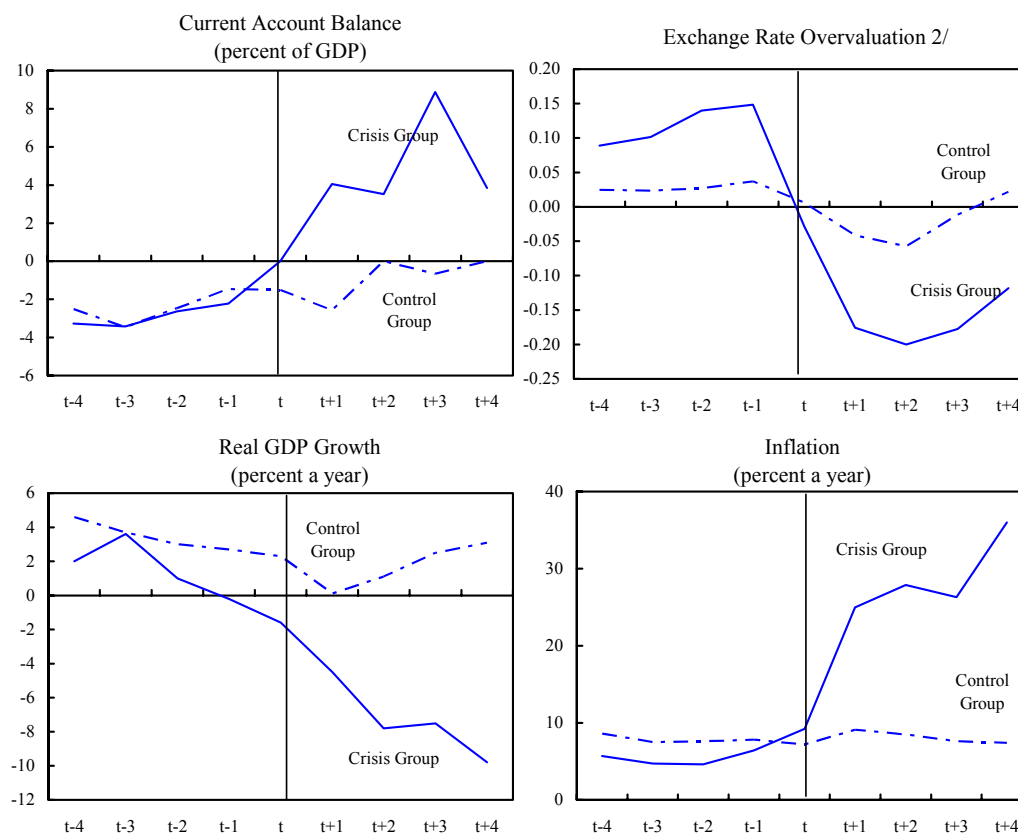
2/ Private capital flows (net of FDI) is used for distinguishing between KAC and CG episodes. See footnote 4 below.

3/ Numbers of months from the beginning to the end of each market pressure episode.

4/ Private capital flows (net of FDI) are classified into five clusters; high inflows, medium inflows, average flows, medium outflows (MO), and high outflows (HO).

5/ The classification into KAC and control group (CG) episodes is as follows: (i) a KAC event requires 2 quarters of either MO or HO in the 4 quarters that follow the build-up of market pressures; and (ii) all other episodes are in the control group (CG).

Figure 1. Selected Economic Indicators: Medians for Crisis and Control Group 1/



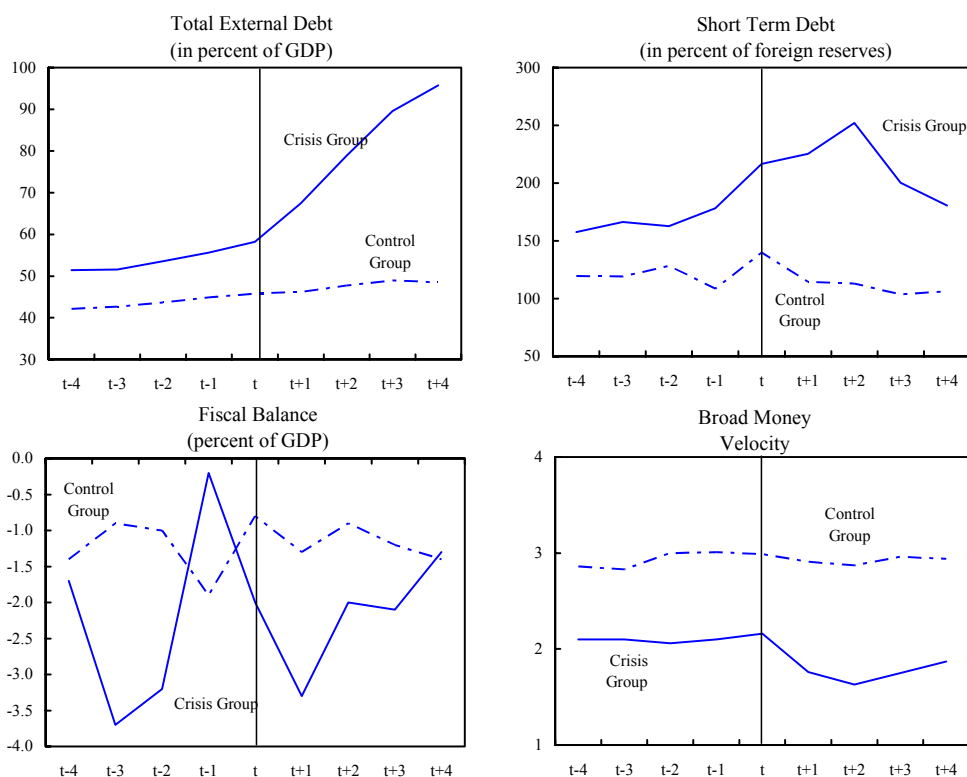
Sources: WEO, IFS, CEIC, EMDB databases; and IMF Staff estimates.

1/ A total of 11 KAC and 21 CG episodes are included.

2/ Measured as the difference between actual REER and the HP filter.

18. Perhaps more importantly, the crisis group has a higher level of external indebtedness (around 10 percentage points of GDP higher) and a higher ratio of short-term debt-to-reserves. The differences in fiscal performance between the two groups are sharper than those for the external balance, with the crisis countries having a weaker fiscal position except for a tightening in period $t-1$, which might reflect a late effort to prevent a crisis. (An alternative explanation is simply that the seasonal patterns in the fiscal and external sectors might be different, which could partly explain the volatility in fiscal balances.) Countries that subsequently suffered a capital account crisis also tend to have a somewhat higher degree of monetization (or lower ratio of GDP to broad money), implying a larger scope for capital flight.

Figure 2. Selected External and Policy Indicators: Medians for Crisis and Control Group 1/



Sources: WEO, IFS, CEIC, EMDB, and IMF Staff estimates.
 1/ A total of 11 KAC and 21 CG episodes are included.

19. Since the focus of the paper is on crisis *prevention*, the regression analysis concentrates on the four quarters *preceding* period t (the pre-crisis period) for each of the 32 episodes of intense market pressures. A value of one is assigned to the four quarters prior to t (i.e., $t-4$ to $t-1$) when a market pressure episode develops into a capital account crisis, and zero otherwise.¹⁹ This approach allows for greater variation in the explanatory variables in the run-up to the market pressure episode than would be possible using annual data on the 32 episodes. Appendix II, however, shows that this approach has no bearing on the main results beyond facilitating convergence of the maximum likelihood estimation—i.e., the 32 pressure episodes and 4 quarters of data result in a dataset of 128 observations, but the results with 32 observations are consistent. The sample is relatively well balanced between

¹⁹For example, in Argentina, the July 2001 market pressure event is classified as a KAC (i.e. 2001 Q3 (period t) = 1); hence, in the logit estimation, the dependent variable would be specified as 2001 Q2 = 1, 2001 Q1 = 1, 2000 Q4 = 1, and 2000 Q3 = 1. In contrast, the Argentina 1998 episode enters the regression with zeros because it is a control group.

crisis and control group episodes and between observations with and without a Fund-supported program (Table 2).

Table 2. Number of Observations in Each Group

	With a Fund-supported program	Without a Fund-supported program	Total
KAC episodes	17	27	44
CG episodes	22	62	84
Total	39	89	128

20. Table 3 reports the results of the logit estimates for alternative specifications. The regressors may be classified into four categories: initial conditions,²⁰ policy variables, exogenous and other factors,²¹ and Fund financing. For the latter, as explained below, this paper uses the ratio of available Fund financing (either disbursed or accumulated drawing rights in the case of precautionary arrangements) to short-term debt in the four quarters up to each period.²² This ratio also captures the cumulative impact of implementation of economic policies during the preceding four quarters.

²⁰ Growth and inflation performance (prior to the crisis) appear to differ between crisis and control group cases (Figure 1). However, adding these variables to the logit estimation does not alter the thrust of the conclusions presented in Table 3.

²¹ The estimations control for changes in terms of trade. Other international cyclical factors (e.g., US interest rates) were considered, but made the convergence of the maximum likelihood estimation more difficult and in the end had no bearing on the results.

²² More precisely, the Fund financing variable in period $t-1$ is calculated as the ratio of the sum of available Fund financing from $t-4$ to $t-1$ to short-term debt at end- $t-1$; the value in $t-2$ is calculated as the ratio of available Fund financing from $t-5$ to $t-2$ to short-term debt at end- $t-2$; and so on for earlier periods up to $t-4$. Since the sample includes only two precautionary arrangements, it is not possible to distinguish econometrically between the effects of disbursed Fund resource and those that are available (but not disbursed) under on-track precautionary arrangements. However, excluding these precautionary programs from the sample yields very similar results.

Table 3. Logistic Estimation Results 1/

Dependent variable: Crisis = 1, Control Group = 0	Regression			
	R1	R2	R3	R4
<u>Fund involvement</u>				
IMF financing (Fund resource ratio) 2/		-37.23 **	-40.25 **	-40.06 ***
IMF program dummy 3/	-1.11		0.46	
<u>Initial conditions</u>				
Debt/GDP	0.14 ***	0.18 ***	0.18 ***	0.19 ***
ST debt/Reserves	1.06 ***	1.06 ***	1.03 **	1.12 ***
Exchange rate regime 4/	-0.33	-0.56	-0.53	-0.67 *
Political stability 5/	-6.44 **	-6.14	-6.04 *	-6.05 *
Exchange rate overvaluation 6/	17.65 ***	25.22 ***	24.74 ***	26.29 ***
<u>Policy variables</u>				
Fiscal balance change 7/	-0.08 **	-0.03	-0.03	0.23 **
Fiscal balance interactive with Fund dummy 8/				-0.45 **
Interest rate change (real terms) 9/	-0.08 **	-0.07 *	-0.07 *	-0.03
Interest rate interactive with Fund dummy 10/				-0.07
<u>Exogenous factors</u>				
Terms of trade	-0.01	0.02	0.02	-0.00
<u>Other</u>				
Size of the economy 11/	0.77 ***	0.87 ***	0.88 ***	0.93 ***
Latin American dummy	-0.69	-1.49	-1.51	-1.98
Asian dummy	2.41	2.45	2.34	2.36
Constant	-5.92	-6.76	-6.98	-6.77
No. of observations	128	128	128	128
LR Chi-square	50.7 ***	25.7 ***	30.6 ***	65.8 ***
Pseudo R-square	0.53	0.59	0.59	0.61
Correctly classified (in percent)	83	87	87	87
Type I errors (in percent)	23	16	16	18
Type II errors (in percent)	14	12	12	11

***, **, and * indicate significance at the 1, 5, and 10 percent levels.

1/ Standard errors are adjusted for within cluster correlation (i.e., correlation at the level of each pressure episode). Logit regressions using random effects provide similar results.

2/ Cumulative sum of Fund financing (disbursed or available for disbursement under precautionary arrangements) relative to the short-term debt over the four quarters from $j-3$ to j , where j is any quarterly period between $t-4$ and $t-1$.

3/ Fund dummy equals 1 if Fund resources were available in any of the last four quarters.

4/ As classified under the eight-category scale of the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions; a higher score indicates a more flexible exchange rate regime.

5/ Refers to the democratic accountability component in the International Credit Ratings Guide Index. Higher index indicates a lower risk rating (or greater political stability).

6/ Exchange rate overvaluation is the deviation of the REER from the long-term trend (HP filter).

7/ Difference in the ratio of fiscal balance/GDP in period j over period $j-4$.

8/ Change in fiscal balance interactive with Fund dummy if disbursements took place in any of the last four quarters; intended to capture fiscal policy aspects of Fund-supported programs.

9/ T-bill rate or other short-term rate net of inflation.

10/ Change in interest rates interactive with Fund dummy if disbursements took place in any of the last four quarters; intended to capture monetary policy aspects of Fund-supported programs.

11/ GDP as a share of US GDP.

21. Most of the explanatory variables have the expected signs, though not all are statistically significant. Overall the logit regressions correctly classify 83 to 87 percent of the observations with a balanced distribution between false negative (type I) and false positive (type II) errors. A higher external debt-to-GDP ratio, a higher short-term debt-to-reserves ratio, a less flexible exchange rate regime, greater overvaluation of the real exchange rate, less political stability, or larger country size (measured as nominal GDP at market exchange rates relative to U.S. GDP) make it more likely that a high market pressure episode turns into a capital account crisis.²³ Monetary or fiscal tightening is associated with a lower probability of crisis, particularly when the latter is undertaken in the context of a Fund-supported program. Moreover, consistent with the theoretical discussion, macroeconomic policies tend to be stronger in countries receiving Fund support.²⁴

22. Turning to the effects of Fund-supported programs, the literature has typically used a dummy variable to indicate the existence of a Fund-supported program.²⁵ From Table 3, regression R1 shows that the mere existence of an on-track Fund-supported program—including the policies required to merit the Fund's support²⁶—does not have a statistically significant impact on reducing the likelihood of a crisis (although the point estimate of the coefficient is negative as expected).

23. By contrast, a variable that captures available Fund financing—defined as disbursements or accumulated drawing rights under an on-track precautionary program in the four previous quarters as a share of short-term debt—is negative and statistically significant

²³ Country size likely captures the country's financing needs in relation to funds available to emerging market countries.

²⁴ The improvement in the fiscal balance (median values) in the year prior to the high market pressure event is about $\frac{1}{4}$ percent of GDP in countries receiving Fund financing, compared to a deterioration of $\frac{1}{2}$ percent in countries without Fund financing. In terms of monetary tightening, real interest rates increase by 75 basis points among countries with Fund financing; the increase in countries without Fund financial support is 25 basis points.

²⁵ While some studies differentiate between on-track and off-track (and thus non-disbursing) programs, they generally do not take account of the amount of Fund financing disbursed (or available under an on-track precautionary program).

²⁶ Fiscal adjustment and monetary tightening in the year prior to the high market pressure event is greater in countries that had on-track Fund-supported programs than in countries without such programs. These policy variables may be capturing the stronger policies associated with a Fund-supported program, contributing to the lack of statistical significance of the dummy variable for the existence of a Fund-supported program.

(regression R2).²⁷ Because the regression controls for the country's holdings of (gross) foreign exchange reserves, Fund financing has an effect on crisis prevention beyond the liquidity contribution of Fund resources. Moreover, when both the dummy variable for an on-track program and the Fund financing variable are included (regression R3), or when monetary and fiscal policies under the program are included (regression R4), the Fund financing variable remains significant. An alternative formulation (not reported) where Fund financing is defined as the full amount of Fund resources that can be accessed over the life of the arrangement is not significant, suggesting that *disbursed* Fund financing (or accumulated drawing rights in the case of precautionary arrangements) is the key factor in crisis prevention.

24. While caution is required in trying to disentangle exactly the various channels—better policies, the signaling of these policies and of the authorities' commitment to them, and liquidity—through which a Fund-supported program may reduce the likelihood of a crisis, taken together these results suggest that:

- Stronger policies—tighter monetary policy (higher real interest rates) or greater fiscal adjustment (particularly in the context of a Fund-supported program) are significantly associated with a lower crisis likelihood.
- Fund disbursements (or accumulated drawing rights) are a significant factor in crisis prevention: the larger are the disbursed Fund resources (as a share of short-term debt), the lower is the crisis likelihood.
- An important liquidity effect of Fund support on crisis prevention exists. Fund disbursements (or their availability for drawing under an on-track precautionary program) matters, rather than just an on-track program or possible future drawings under the arrangement.
- The benefits of Fund support go beyond liquidity effects, however, since the Fund financing variable is significant even controlling for the country's foreign exchange reserves. Part of the effect must thus arise from a combination of stronger policies (i.e., beyond the fiscal balance and real interest rates included in the regressions) bolstered by conditionality and the “seal of approval” implicit in Fund disbursements. Moreover, since the Fund-supported program dummy is not statistically significant, but the Fund financing variable is strongly significant, the strength and the credibility of the Fund's signal appears to depend at least partially on the Fund putting its own resources on the line.

²⁷ The results remain robust to alternative definitions, such as Fund financing as a ratio to GDP.

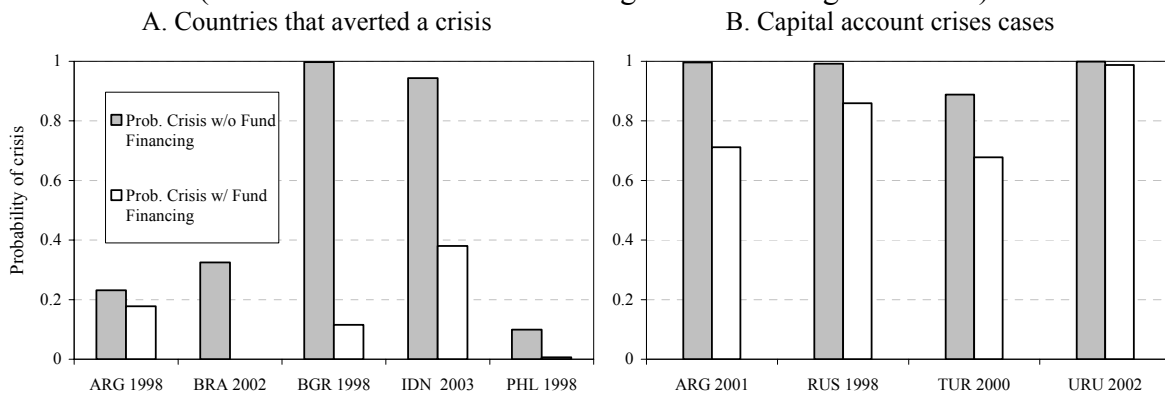
These findings are robust to various sample specifications, including data outliers (whether these are individual observations or specific market pressure episodes), and other technical considerations (Appendix II).

C. Fund-Supported Programs and Crisis Prevention

25. These results suggest that a Fund-supported program may be useful for crisis prevention, including by promoting stronger policies and by enhancing liquidity. But could such financing, in plausible amounts, have an appreciable impact on the likelihood of a crisis? This depends on the country’s “fundamentals” (the other covariates in the logit regression—such as the level of external debt, the exchange rate regime, short-term debt-to-reserves ratio, political developments, and monetary and fiscal policies)—and the amount of Fund financing. But the counterfactual exercises considered below, in which either the amount of Fund financing is varied parametrically (holding policies constant) or the policy adjustment is varied (holding Fund financing constant) need to be interpreted with extreme caution because—as stressed by the theoretical discussion in Section II—the country’s policy response (as well as other fundamentals) and Fund financing may be simultaneously determined.

26. With this important caveat in mind, Figure 3 contrasts the likelihood of a crisis with the Fund financing (and the country’s other covariates) available through the quarter preceding the high market pressure episode to the implied probability without any Fund financing. Within the group of countries that ultimately avoided a crisis (Figure 3, left panel), the model predicts that in the absence of Fund financing the likelihood of a crisis was over 50 percent. However, with Fund support (in the amounts actually made available), this probability was more than halved. In other cases, while the crisis probability was below 50 percent, Fund financing helped reduce this probability to negligible levels. Conversely, while the model suggests that Fund financing contributed to lower crisis probabilities in some countries that ultimately faced a capital account crisis (Figure 3, right panel), the model also shows that the probability of a crisis remained high nevertheless.

Figure 3. Estimated Probability of a Crisis with and without Fund Financing (KAC and CG countries receiving Fund financing at time t-1)



27. Overall, the results suggest that, in some instances, disbursements of Fund resources have had an appreciable impact in lowering the likelihood that a high market pressure event would turn into a crisis. In fact, on average, for countries that received Fund support and averted a crisis, the reduction in the likelihood of a crisis associated with Fund financing was 20 percentage points. Moreover, the welfare gains are not negligible, with some simple back-of-the-envelope calculations putting the expected welfare gain from this average *lower probability of a crisis* at some 5 percent of GDP for these countries.²⁸

28. As emphasized above an important contribution of the Fund-supported program in crisis prevention is to promote stronger policies. It is therefore interesting to ask the nature of the policy strengthening needed to achieve a similar reduction in the likelihood of a crisis (i.e. a 20 percent reduction). Parametrically varying policies in the estimated regression (R4), but now keeping constant the available Fund financing, shows that a combined fiscal adjustment of about 4.5 percent of GDP and higher real interest rates of about 4.5 percentage points would be required. This highlights the difficulties of avoiding a crisis through such policies alone once the other covariates have made the country vulnerable. By contrast, reducing the overvalued exchange rate by about 6 percentage points would achieve a similar reduction in crisis probability. This result underscores the importance of avoiding overvalued exchange rates and of maintaining adequate reserve to short-term debt cover.²⁹

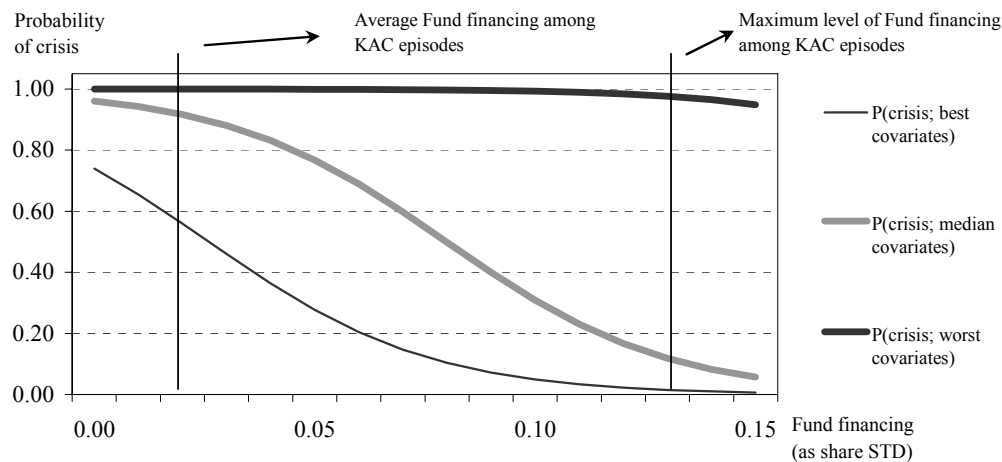
29. Even if the country's other fundamentals (including its policies) do not change as a result of changes in Fund financing, the marginal effect of that financing depends upon the average level of those fundamentals. By way of illustration, Figure 4 shows how the probability of a crisis as function of Fund financing (in percent of short-term debt) varies with different levels of the country's fundamentals among countries that ended up with a capital account crisis. For example, taking the case with the best fundamentals (the lowest curve in Figure 4), Fund financing in the amount of 5 percent of short-term debt (equivalent to one and one-half times the average amount of financing provided (through $t-1$) under Fund-supported programs) would have roughly halved the estimated crisis probability from 70 percent to 35 percent. For the median case, a similar increase in financing would have lowered the crisis probability from around 95 percent to about 80 percent, while for the worst case (the highest curve in Figure 4), the much worse fundamentals mean that increased financing would have had a negligible impact on reducing the likelihood of a crisis. These

²⁸ See Appendix III for details of this calculation.

²⁹ Further regressions (not reported) indicate that overvaluation in the context of a pegged exchange rate regime makes the country especially vulnerable to a crisis. While this underscores the importance of avoiding overvalued fixed exchange rates, it also means that implementing even a relatively modest correction may not be straightforward with potentially significant costs in terms of the credibility of the regime or arising from balance sheet exposures of the private and public sectors if the exchange rate overshoots in the process of exiting the regime.

curves underscore that when fundamentals are weak, not only is the country at high risk of a crisis, but the marginal effect of Fund financing on lowering the crisis probability is also small.

Figure 4. Marginal Impact of Fund Financing, Given Country Fundamentals 1/



1/ Based on regression 4 in Table 3. Fund financing is defined as the cumulative disbursements over 12 months as a share of short-term debt. The figure reflects the probability of a crisis for different countries based on the covariate contributions (CC) at time $t-1$. Vertical lines are also measured at $t-1$ and represent, respectively, the average and maximum level of Fund financing among crises episodes.

30. It is also possible to ask the amount of Fund financing required to lower the likelihood of a crisis (from an average probability of 0.85 in $t-1$ for the capital account crisis countries) to some “acceptable threshold”. Using 25 percent as an illustrative threshold, Table 4 calculates the requisite Fund financing (actually provided or additionally required); in most cases, this amounts to the equivalent of 5 to 20 percent of the country’s short-term debt. While this would require exceptional access (i.e., more than 100 percent of quota on an annual basis)—typically in the order of 300-350 percent of quota³⁰—these amounts are not out-of-line with the financial resources subsequently provided in some capital account crises, suggesting that the crisis might have been averted had there been a Fund-supported program with adequate financing in place prior to its onset. However, as stressed above, the

³⁰ The average access to lower the probability of a crisis to 25 percent would be 345 percent of quota. Lowering this probability to 10 percent and 5 percent respectively would require, respectively, 410 and 460 percent of quota, revealing a non-linear relationship between access and crisis probabilities. These calculations keep constant policies (and other covariates) although, in practice, policies would be stronger under a Fund-supported program with higher access, therefore contributing to a lower likelihood of a crisis. Within these averages, the amounts needed relative to quota vary across countries in part because quotas do not always correlate closely with the economic circumstances of the country.

availability of additional Fund financing could itself alter the country's fundamentals, including its policy response. Moreover, this counterfactual exercise would also need to take account of the deterioration in the other fundamentals typically observed as the country enters a crisis.³¹ Accordingly, one cannot necessarily conclude that such a Fund-supported program would have averted the crisis.

Table 4. Fund Financing Relative to Fund Quota among KAC Countries 1/

KAC group	Period t-1	Actual Fund financing at t-1 (bill. US\$) 2/	Actual probability of a crisis at t-1 (incl. Fund financing)	Additional Fund financing needed to reduce P(crisis) to 0.25 (bill. US\$)	Short-term debt (bill. US\$)	Fund financing (at P=0.25)/quota (in percent) 3/
Argentina	2001-Q2	4.69	0.71	2.0	40	227
Brazil	1998-Q2	0.00	0.96	8.5	79	281
Bulgaria	1996-Q1	0.00	0.86	0.1	2	20
Ecuador	1999-Q4	0.00	0.79	0.1	2	35
Indonesia	1997-Q3	0.00	1.00	9.0	36	435
Korea	1997-Q3	0.00	0.94	7.7	81	694
Malaysia	1997-Q2	0.00	0.74	0.7	14	64
Russia	1998-Q2	2.02	0.86	1.9	27	66
Thailand	1997-Q2	0.00	1.00	9.9	51	1,238
Turkey	2000-Q3	1.39	0.68	1.9	42	248
Uruguay	2002-Q2	0.74	0.99	1.3	10	483

1/ Based on quotas of member countries at the time of the crisis using regression 4 of Table 3.

2/ Cumulative total for the 4 quarters prior to t, in billions of U.S. dollars.

3/ Refers to the total IMF disbursement (actual plus additional) that would have been required to lower the probability of a crisis to 25 percent. The model would have no Type I errors at a cutoff probability of 8 percent.

IV. CONCLUSIONS

31. The Fund can help avert crises in many ways, including through surveillance work and Fund-supported programs that lay the groundwork for better policies. This paper has a narrower focus: it examines whether a Fund-supported program may be useful in crisis prevention at times of heightened vulnerability. The theoretical literature suggests that a Fund-supported program can contribute to a lower likelihood of a crisis in two ways. First, it provides the country with additional liquidity, making a run for the exit by private creditors less likely. Second, it induces better policies (more adjustment), though this needs to be supported by conditionality which plays an important role of providing mutual assurances to the member country and to the Fund.

32. The empirical evidence presented indicates that a Fund-supported program can play a crisis prevention role. In particular, at times of heightened vulnerability, when there are incipient exchange market pressures, Fund resources (either disbursements or their

³¹ In fact, fundamentals typically deteriorate significantly during the crisis (from period *t* onwards), but these effects are not included in the econometric estimation.

availability under on-track precautionary arrangements) and associated stronger policies can lower the likelihood that a crisis will develop. The effect of Fund resources on lowering the crisis probability goes beyond the pure liquidity benefits of unconditional resources (the country's foreign exchange reserves) and reflects both better policies and the stronger market signal that Fund financing elicits. At the same time, success of a Fund-supported program in preventing a crisis depends on the fundamentals. As fundamentals worsen the marginal benefit of a Fund-supported program diminishes.

33. While preliminary, and subject to the various caveats noted above, these findings carry important implications for the possible role of the Fund in crisis prevention in emerging market countries. But they also raise questions about the design of "crisis prevention" programs. In particular, the results suggest that, while "money matters," it is not just "money" that matters—policies matter as well. In crisis prevention situations—where the country is not forced to adjust by the withdrawal of private finance—the benefits of greater unconditional liquidity may be offset by "debtor moral hazard."

34. The analysis suggests that crisis prevention programs would therefore typically need to be supported by conditionality to help ensure that disbursements (or rights to drawings under precautionary arrangements) enhance liquidity and support sound crisis prevention policies.

A Model of Fund Support, Policy Adjustment, and Crisis Prevention

As noted in the text, relatively little theoretical work to date has examined explicitly the Fund’s possible role in crisis prevention. Kim (2006), building on Morris and Shin (2005), Corsetti, Guimaraes, and Roubini (2004) and Penalver (2004), develops a theoretical framework that shows (1) Fund financial support can lower the likelihood of a crisis; (2) the benefits of unconditional support may be (partially) offset by a weaker policy effort; (3) conditional support can strengthen policies and enhance liquidity—both of which serve to reduce the likelihood of a crisis—while being welfare superior from the perspective of the country relative to the no-program situation. This appendix outlines the model and derives these results.

In Kim’s model (as with others of this genre), the likelihood of a liquidity crisis depends positively on the alternative rate of return available investors (e.g. U.S. interest rates) and negatively on the country’s holding of foreign exchange reserves. Given costs of holding reserves, the country chooses a desired level of reserves, R^{**} that trades off these costs against the probability (and associated disruption) of a crisis.

Suppose that the country starts with a level of reserves, R_0 below R^{**} ; this could be because a current account shock has depleted some of the country’s reserves or because a rise in U.S. interest rates has made the probability of a crisis more likely (for a given level of reserves) so that the new desired level of reserves is higher than previously. In the absence of Fund lending, the country can acquire additional reserves through external adjustment, A , but this is assumed to be costly. Therefore, national authorities, trading off the risks of a crisis against the costs of adjustment, will choose an optimal amount of adjustment, A_0 , resulting in reserves $R_1 = R_0 + A_0$, with an associated probability of a crisis, π_1 . In general, this level of reserves may be below R^{**} because of the costs of undertaking adjustment.

What happens if the country now receives some *unconditional* liquidity support, e.g. from the Fund, in the amount L ? Since adjustment is costly, in general, national authorities will use part of this to augment reserves (thus lowering the likelihood of a crisis) but also part to offset the necessary adjustment. Hence, the increase in reserves (relative to no Fund resources) will be less than the amount provided by the Fund:

$$\partial A_0 / \partial L < 0, \partial R_1 / \partial L < 1$$

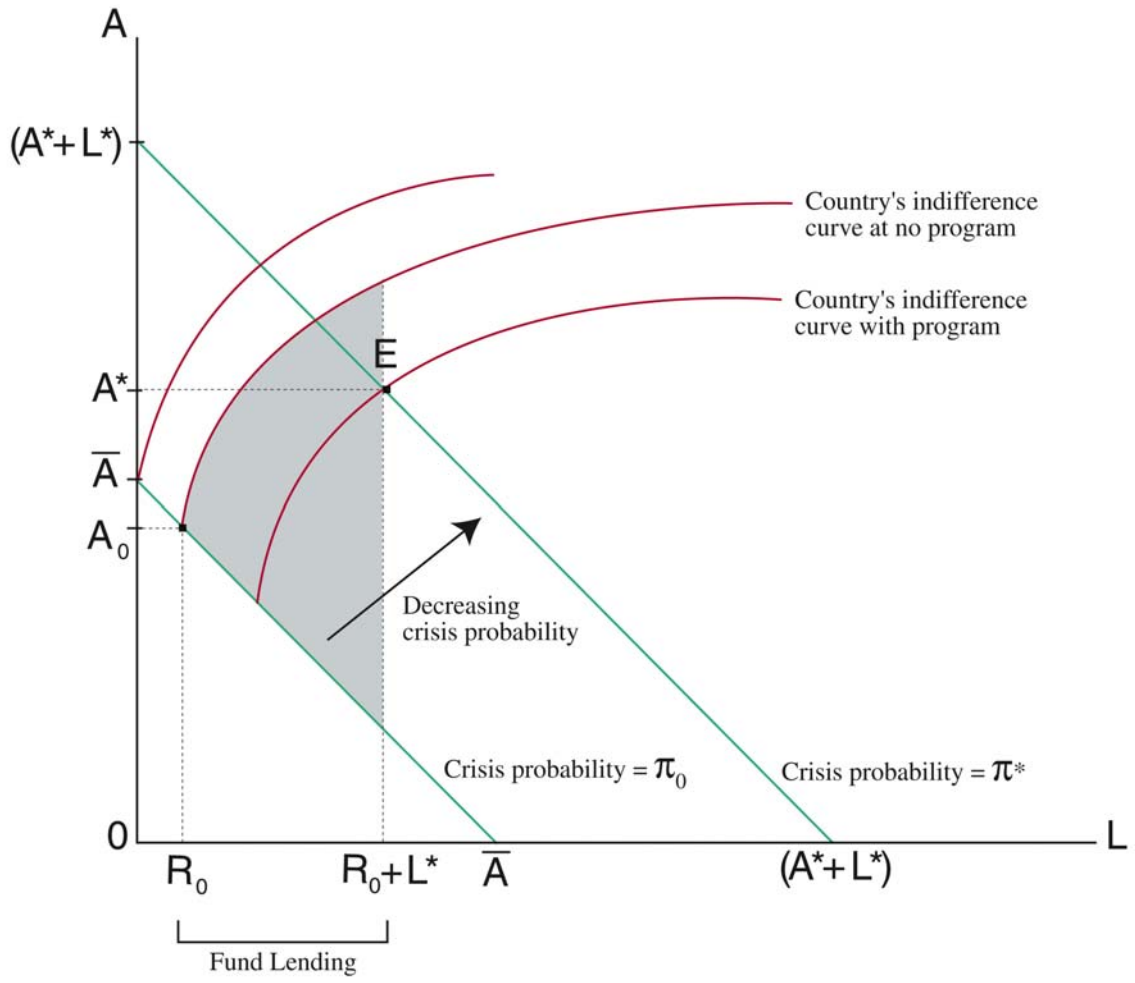
This is depicted in the Figure by the straight line \overline{AA} for the simplest (and most extreme) case considered by Kim (2006), where Fund resources are provided as pure grant (i.e. do not need to be repaid) and adjustment costs are linear. The line \overline{AA} is also an iso-probability line, so that along that line the likelihood of a crisis is constant. As shown by Kim, in this case, the offset—or “debtor moral hazard”—is full, with $\partial A_0 / \partial L = -1, \partial R_1 / \partial L = 0$, so that unconditional resources do not lower the probability of a crisis because they are fully offset by weaker adjustment. More generally, when Fund resources have to be repaid and/or

adjustment costs are convex, this offset will not be full and at least part of the Fund financing will be used to augment reserves.

Now consider conditional Fund financing. Since the country benefits from a lower likelihood of a crisis but faces costs of undertaking adjustment, its indifference curves are as depicted in the Figure—along the indifference curve, a lower likelihood of a crisis (an outward shift of the iso probability line) compensates for the costs of greater adjustment. In particular, therefore, if Fund financing is denoted by L^* , then the shaded area denotes possible welfare-improving programs. The program given by the point E, for example, entails adjustment A^* (which is greater than A_0 , the adjustment in the absence of a program), Fund financing in the amount L^* , and resulting in reserves $R_1^* = R_0 + A^* + L^*$. Therefore:

$$\partial A^* / \partial L > 0, \partial R_1^* / \partial L > 1$$

With a correspondingly lower likelihood of a crisis, $\pi_1^* < \pi_1$. In more elaborate versions of the model, Fund resources can be modeled explicitly as loans (i.e. subject to repayment), and the amount of Fund lending endogenized, without changing these main results.



Robustness of Empirical Results

The small number of capital account crises (KAC) makes it difficult to detect empirical regularities. The tack taken here is to examine 27 emerging market economies and to rely on a data partition technique (cluster analysis) to narrow down the sample to intense market pressure episodes. This approach has many advantages. In particular, it serves to establish a control group of countries that, though at risk of suffering a KAC, have managed to avoid such an outcome. It also provides a more balanced sample of capital account crises and control group cases. Still, the number of market pressure events of the highest intensity are not many—only 32 market pressure episodes are identified, of which one-third are capital account crises cases and the rest are part of the control group in this paper.

In this context, a logit specification is estimated where the dependent variable is a one for a capital account crisis episode and zero otherwise. Since the focus is on crisis *prevention*, the estimation is based on the four quarters *preceding* period *t* (pre-crisis period); accordingly, ones or zeros are assigned to the four quarters prior to *t* (i.e. *t*-4 to *t*-1) based on whether period *t* itself was a one or a zero.³² Thus, the 32 pressure episodes and 4 quarters of data prior to period *t* result in 128 observations. This approach allows for greater variation in the explanatory variables and has one additional advantage: namely, it facilitates convergence of the maximum likelihood estimation as regressors are added to the estimation.

Appendix Table. Estimation Results, Reduced and Full Sample

Dependent variable: Crisis=1, Control Group=0	Regression	
	Reduced sample	Full sample
<u>Fund involvement</u>		
IMF financing disbursement ratio	-25.36 **	-20.58 **
<u>Initial conditions</u>		
Debt/GDP	0.16 ***	0.13 ***
ST debt/Reserves	0.87 ***	0.75 ***
Exchange rate regime	-0.52	-0.40
Political risk	-5.46	-5.26
<u>Exogenous factors</u>		
Terms of trade	0.08	0.04
<u>Other</u>		
Size of the economy	1.16 ***	1.01 ***
Latin American dummy	-1.43	-1.15
Asian dummy	2.71	2.35
Constant	-5.49	-4.69
No. of observations	32	128
LR Chi-square	20.2 **	30.6 ***
Pseudo R-square	0.51	0.48
Correctly classified (in percent)	81	80
Type I errors (in percent)	36	11
Type II errors (in percent)	10	13

***, **, and * indicate significance at the 1, 5, and 10 percent levels of significance.

Does this approach influence the paper’s results regarding the role of Fund money for crisis prevention? The answer is no. As shown in the table a regression with 32 observations that is based on the simple average of right-hand-side variables for *t*-4 to *t*-1 provides the same conclusion than a regression based on 128 observations: Fund money has a crisis prevention role. The results are also similar in terms of fit—the estimation based on a reduced sample correctly classifies 81 percent of all 32 observations (compared to 80 percent in the full

³² For example, in Argentina the July 2001 market pressure event is classified as a capital account crisis (i.e. 2001-Q3 (period *t*) = 1); hence, in the logit estimation, the dependent variable would be specified as 2001-Q2 =1, 2001-Q1=1, 2000-Q4 =1, and 2000-Q3 =1.

sample), the pseudo- R^2 are similar, and the distribution of type I and type II errors are practically the same across all the estimated logit regressions.

Although the use of 128 quarterly observations (rather than just the 32 episodes) does not affect the results on the Fund's role in crisis prevention, it is still possible that these are affected by sample characteristics. In addition, the results could be sensitive to the presence of other regressors or subject to the influence of data outliers. Numerous tests are carried out to check the robustness of the findings regarding the role of Fund financing. The results were robust to these tests. These tests include:

Episodes that might be incorrectly classified by cluster analysis. The first of these episodes is Mexico 1994, which has typically been thought of as a KAC. In fact, the logit model also predicts this to be the case. Likewise, the model predicts Turkey (1998) as a KAC. Yet, in both cases, cluster analysis classifies these episodes as a CG. Estimating regression R3 of the main body with these episodes as KACs has no effect on the result regarding Fund financing.

Episodes not identified as intense market pressure events. Argentina experienced in early 1995 significant capital outflows following the “tequila” crisis and, even though the country in the end weathered the storm quite successfully, this was at the time judged to be a KAC. However, cluster analysis does not even identify this event as a market pressure episode. Re-estimating regression R3 with this episode as a KAC—i.e. a 33rd event—does not affect the result regarding the role of Fund financing in crisis prevention.

Dropping one time KAC cases in Asia. Many Asian countries appear in the dataset of 32 episodes only once, and in some cases only as a KAC without Fund financing. Thus, these countries may be biasing the results in favor of Fund money. Korea, Malaysia, and Thailand are dropped from the sample to test this hypothesis; Indonesia and Philippines are kept because they are not always KACs. The role of Fund financing does not change.

Possible spillover effects in countries with more than one market pressure event. The sample has some countries that repeat themselves as either a KAC or a control group — i.e. these countries have numerous market pressure events of high intensity. To control for possible spillover effects, the estimation is carried out after controlling for country repeat episodes by adding a dummy variable for repeat countries. Still, the result on the significance of Fund money in crisis prevention remains unchanged.

Sensitivity of empirical work to the inclusion or exclusion of regressors. This is a usual concern of any empirical work. A test for the sensitivity of the role of Fund financing is carried out by dropping one at a time all other regressors in the regression R3. In addition, a more parsimonious model—i.e. one that includes only statistically significant regressors—is estimated. In both cases the role of Fund financing in crisis prevention remains unaffected.

Data Outliers. A technique known as *dfbetas* is used to check for the effects of outliers in individual observations. This technique calculates a scaled measure of the change in the coefficient estimate for Fund financing by deleting one observation at a time. The outliers in

the data are then dropped and R3 is re-estimated. The role of Fund financing in crisis prevention, however, is unaffected by these changes in the sample. An alternative is to assess the effects of episode outliers; namely, does any one market pressure episode drive the results? As was the case for outliers in individual observations, the Fund's crisis prevention role does not change as single episodes are dropped from the econometric estimation.

Welfare Gains from Lowering the Likelihood of a Capital Account Crisis

Evaluating the welfare gains of averting a crisis by providing Fund financing is inevitably an arbitrary exercise, requiring assumptions on growth in the absence of an intense market pressure event and on the expected decline in crisis probability that can be argued to arise from the provision of Fund financing. One possible calculation suggests that the Fund's crisis prevention role could save member countries some 5½ percent of pre crisis GDP during the three years that follow a KAC. This result is derived by assuming that the expected decline in crisis probability from Fund financing is equal to the average decline in crisis probability (due to Fund support) that is observed among control group countries that received Fund financing (i.e. a decline in crisis probability of 0.21). Such a decline multiplied by the difference in discounted output flows of KAC (35½ percentage points of GDP over the first three years) and control group (8½ percentage points of GDP) countries over the first three years that follow a market pressure event provides a rough calculation of the welfare gains from lowering the probability of a crisis.

It is important to note that this calculation represents in all likelihood a lower bound for the welfare gains that can be expected from averting a capital account crisis as the difference in output flows are quite high. In addition, the declines in crisis probability among KAC countries might be higher than is the case for the control group being used as a benchmark.

Appendix Table. Welfare Gains 1/

	Period				3-year total	Period				3-year total
	t-4:t-1	t+1:t+4	t+5:t+8	t+9:t+12		t-4:t-1	t+1:t+4	t+5:t+8	t+9:t+12	
	Capital account crises episodes					Control group (CG) episodes				
<u>Y potential</u>										
Output	100.0	105.1	110.5	116.2	331.8	100.0	103.8	107.8	112.0	323.7
Growth rates 2/		5.1	5.1	5.1			3.8	3.8	3.8	
PV output (A) 3/	100.0	105.1	105.0	104.9	315.0	100.0	103.8	102.4	101.1	307.4
<u>Y actual</u>										
Output	100.0	93.2	98.2	103.2	294.6	100.0	100.8	104.9	108.9	314.6
Growth rates 4/		-6.8	5.3	5.1			0.8	4.1	3.8	
PV output (B) 3/	100.0	93.2	93.3	93.2	279.6	100.0	100.8	99.6	98.3	298.8
Output difference within each group (C=B-A)					-35.4					-8.6
Output difference across groups (D)					-26.8					
Difference in crisis probability among CG countries (E) 5/					0.21					
Lower bound welfare gains (F=D*E; in percent of t-4:t-1 GDP)					-5.6					

1/ Calculations based on simple average of quarterly growth rates.

2/ Potential growth rates based on average growth rates since early 1990s until the first episode of intense market pressures.

3/ Assumes a discount rate of 5 percent.

4/ Actual growth rates constructed assuming period t+9:t+12 returns to the long-run growth rate described in footnote 2.

5/ Reflects the average decline in the probability of crisis among CG countries receiving Fund financing in the t-4 to t-1 period.

References

- Corsetti, Giancarlo, Bernardo Guimaraes, and Nouriel Roubini, 2003, "International Lending of Last Resort and Moral Hazard: A Model of IMF's Catalytic Finance," NBER Working Paper 10125 (Cambridge, MA: National Bureau of Economic Research).
- Cottarelli, Carlo, and Curzio Giannini, 2002, "Bedfellows, Hostages, or Perfect Strangers? Global Capital Markets and the Catalytic Effect of IMF Crisis Lending," *IMF Working Paper*, WP/02/193 (Washington, DC: International Monetary Fund).
- Eichengreen, Barry, and Ashoka Mody, 1998, "What Explains Changing Spreads on Emerging-market Debt: Fundamentals or Market Sentiment?," NBER Working Paper 6408 (Cambridge, Massachusetts: National Bureau of Economic Research).
- , Kenneth Kletzer, and Ashoka Mody, 2005, "The IMF in a World of Private Capital Markets," IMF Working Paper, WP/05/84 (Washington, DC: International Monetary Fund).
- , Poonam Gupta, and Ashoka Mody, 2005, "Sudden Stops and IMF Programs," prepared for the Inter-American Seminar on Macroeconomics, Rio de Janeiro, December 3-4, 2005.
- Everitt, B. , 1993, *Cluster Analysis*, Third edition, London, Edward Arnold.
- Flood, Robert and Nancy Marion, 1998, "Perspectives on the Recent Currency Crisis Literature," NBER WP 6380.
- Ghosh, Atish, Timothy Lane, Marianne Schulze-Ghattas, Aleš Bulíř, Javier Hamann, and Alex Mourmouras, 2002, "IMF-Supported Programs in Capital Account Crises," IMF Occasional Paper No. 210. (Washington: International Monetary Fund).
- Ghosh, Atish, Charis Christofides, Jun Kim, Laura Papi, Uma Ramakrishnan, Alun Thomas, and Juan Zalduendo, 2005, "The Design of IMF-Supported Programs," IMF Occasional Paper No. 241. (Washington: International Monetary Fund).
- Haldane, Andy, 1999, "Private Sector Involvement in Financial Crises: Analytics and Public Policy Approaches," *Financial Stability Review*, November.
- International Monetary Fund, 2002, "What Is the International Monetary Fund?," website link <http://www.imf.org/external/pubs/ft/exrp/what.htm#glance>.
- International Monetary Fund, 2004, "Signaling by the Fund—A Historical Review," SM/04/251.
- International Monetary Fund, 2005, "Review of the 2002 Conditionality Guidelines," SM/05/81.
- International Monetary Fund, 2006, "Precautionary Arrangements: Purposes and Performance", mimeo (Washington: International Monetary Fund).

- Kaminsky, Graciela, and Carmen Reinhart, 1999, "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems," *American Economic Review*, Vol. 89, Number 3, pp. 473-501.
- Kim, Jun Il, 2006, "Fund-Supported Programs and Crisis Prevention: An Analytical Framework," mimeo (Washington: International Monetary Fund).
- Mody, Ashoka, and Diego Saravia, 2003, "Catalyzing Private Capital Flows: Do IMF Programs Work as Commitment Devices," IMF Working Paper, WP/03/100 (Washington, DC: International Monetary Fund).
- Morris, Stephen and Hyun Song Shin, 2005, "Catalytic Finance: When Does It Work?," revised version of Cowles Foundation Paper No. 1400 (New Haven: Yale University).
- Penalver, A., 2002, "How can the IMF Catalyze Private Capital Flows? A Model," Bank of England, unpublished.
- Ramakrishnan, Uma and Juan Zaldueño, 2006, "The Role of Fund Support in Crisis Prevention," mimeo (Washington: International Monetary Fund).
- Rodrick, Dani, 2006, "The Social Costs of Foreign Exchange Reserves," prepared for the American Economics Association Meetings, January 2006.
- Zettelmeyer, Jeronimo, 2000, "Can Official Crisis Lending be Counterproductive in the Short Run?," *Economic Notes*, Vol. 29, Number 1, pp. 13-29.