



WP/06/75

# IMF Working Paper

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## The Role of IMF Support in Crisis Prevention

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## IMF Working Paper

Policy Development and Review Department

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Authorized for distribution by Atish Ghosh

March 2006

#### Abstract

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This paper examines the role of IMF-supported programs in *crisis prevention*; specifically, whether, conditional on an episode of intense market pressures, IMF financial support helps prevent a capital account crisis from developing and, if so, through what channels. In doing so, the paper distinguishes between the seal of approval inherent in IMF support and its financing, evaluates the interaction of IMF support with economic policies, and assesses whether IMF financing has a different impact on the likelihood of a crisis than other forms of liquidity. The main result is that IMF financing helps prevent crises through the liquidity provided (i.e., money matters). However, since the effect holds even after controlling for (gross) foreign exchange reserves, stronger policies and the seal of approval under an IMF-supported program must also play a role. Finally, the results suggest that IMF financing as a crisis prevention tool is most effective for an intermediate range of economic fundamentals.

JEL Classification Numbers: F33, F34, N20, O19

Keywords: IMF financing, lender of last resort, capital account crisis, cluster analysis

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<sup>1</sup> We wish to thank Rex Ghosh, Russell Kincaid, and members of the Policy Review Division at the IMF for numerous discussions held during the preparation of this paper. Comments from participants at two IMF seminars are greatly appreciated. The usual disclaimers apply.

Contents	Page
I. Introduction .....	3
II. Background .....	4
III. Identifying Capital Account Crises Episodes .....	5
IV. Estimation and Results .....	15
A. Results .....	18
B. Robustness Tests .....	22
V. IMF Support and Crisis Prevention .....	23
A. The Role of IMF Financing in Crisis Prevention .....	24
B. Welfare Gains from Crisis Prevention .....	26
VI. Concluding Remarks .....	27
 Tables	
1. Classification of Capital Account Crises (KAC) and Control Group (CG) Episode.....	9
2. Descriptive Statistics on IMF Financing.....	17
3. Logistic Regression Results.....	20
4. Model Classification of KAC and CG Episodes in $t-4$ to $t-1$ .....	21
5. Welfare Gains .....	27
 Figures	
1. Identification of the Two Sample Groups.....	8
2. Selected Financial Market Indicators (Medians for Crisis and Control Groups) .....	11
3. Selected Macroeconomic Indicators (Medians for Crisis and Control Groups).....	12
4. Selected External Sector Indicators (Medians for Crisis and Control Groups) .....	13
5. Selected Solvency and Liquidity Indicators (Medians for Crisis and Control Groups) .....	14
6. Probability of a Crisis With and Without IMF Financing .....	24
7. Marginal Impact of IMF Financing; Given Country Fundamentals.....	25
 Appendix Tables	
1. Descriptive Statistics.....	29
2. Simple Correlations .....	29
 References.....	 30

## I. INTRODUCTION

This paper examines the role of IMF-supported programs in *crisis prevention*; specifically, whether, conditional on an episode of intense market pressures, IMF financial support can help prevent a capital account crisis. While there are a number of studies on the catalytic effects of IMF-supported programs, this literature uses the term “catalytic” to describe a situation in which IMF financing has a multiplier effect on official and private capital inflows (so that, for each dollar of IMF support, the country receives more than one dollar in total inflows) and, in general, finds mixed evidence of such effects. This paper, by contrast, focuses on whether IMF lending helps to prevent a crisis from erupting in the first place. This can be termed a catalytic effect inasmuch as one dollar of IMF support results in more than one dollar of *net* inflows relative to the counterfactual in which private capital would have exited.

If IMF support helps prevent crises, the next question is how. The literature on the signaling role of IMF financing provides some clues.<sup>2</sup> This literature emphasizes four channels through which an IMF-supported program may reduce the likelihood of a run; more precisely, (i) by providing liquidity; (ii) by supporting stronger policies; (iii) by signaling these better policies to financial markets; and (iv) by enhancing their credibility via program conditionality.

Empirical evidence that IMF support may help prevent a crisis is necessarily elusive. Beyond the inherent difficulties of identifying empirical regularities from a limited number of capital account crises, finding an effect of IMF 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 IMF support lowered the crisis likelihood. The tack taken in this paper is first to identify—using a statistical technique known as cluster analysis—episodes of intense market pressures and then to segment these according to whether or not they later developed into a capital account crisis (KAC). This allows a counterfactual (i.e., a control group—CG) to be established: countries at risk of suffering a KAC but that managed to avoid such an outcome.<sup>3</sup> A logit specification is then applied to examine the role of IMF financing in crisis prevention—that is, whether an episode of intense market pressure develops into a KAC or a CG—after controlling for initial conditions, changes in economic policy, and exogenous and other factors.

The paper has three key results. First, the availability of IMF resources (either through disbursements or resources available to a country under an on-track precautionary program) lowers the likelihood of a crisis. The second result, however, is that IMF support lowers the likelihood of a crisis even after controlling for (gross) foreign exchange reserves. In other words, even though money matters, stronger policies and the credibility of these policies evinced through the IMF’s financial support are also important to avoid abrupt private capital

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<sup>2</sup> See “Signaling by the IMF—A Historical Review” for a detailed discussion (IMF, 2004).

<sup>3</sup> The episodes in the KAC and CG groups might or might not be associated with IMF financing (i.e., the distinction is only in terms of the intensity and persistence of private capital outflows).

outflows. Finally, the results suggests that IMF financing as a crisis prevention tool is most effective for countries with an intermediate range of economic fundamentals.

The paper is organized as follows. Section II reviews the literature. Section III discusses the methodology for identifying episodes of intense market pressure and their classification into KAC and CG cases. Section IV turns to the role of IMF-supported programs in crisis prevention. Section V discusses some of the implications of our findings. Section VI concludes.

## II. BACKGROUND

The IMF provides financial support to assist member countries in addressing their balance of payments needs. In exchange, the member country commits to implement policies and reforms that would help in restoring external viability. The hope is that IMF support has a catalytic role, either by restoring confidence and supporting the return of private capital or by serving as a framework for the provision of bilateral and multilateral official financing.<sup>4</sup> A number of studies examine the catalytic role of IMF financing in helping to restore confidence and a resumption of private capital flows following a crisis, generally finding mixed results.<sup>5</sup> Given the focus on resumption of private capital flows, this literature can be viewed as focusing on *crisis resolution*. As noted above, *crisis prevention*—the focus in this paper—is rather different, not least because it refers to what does *not* (rather than on what does) happen to private capital flows. Still, the existing literature provides a useful point of departure since some channels through which IMF support may help restore capital inflows following a crisis are likely similar to those through which it may help prevent outflows in the first place.<sup>6</sup>

One question, for example, is whether it is the existence of an IMF-supported program or the amount of financing (or both) that matters. Most studies focus on the existence of an IMF-supported program (a dummy variable-based approach), though there are exceptions. For example, Mody and Saravia (2004) examine the impact of IMF resource commitments on the issuance spreads of bonds by emerging market economies, and Eichengreen et al. (2005) use a regressor that is based on IMF resource commitments. Both of these papers find some evidence of catalytic effects. Still, none of the existing papers looks at available IMF resources, which is the approach in this paper, nor do they focus on the IMF's crisis prevention role.<sup>7</sup>

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<sup>4</sup> Precautionary arrangements are a special case of IMF-supported programs in which the member country does not face an immediate financing need. In such cases, the member accumulates drawing rights and is allowed to draw these resources if needed.

<sup>5</sup> Cottarelli and Giannini (2002) provide a survey of the empirical literature on the catalytic effects of IMF lending.

<sup>6</sup> Many of the econometric challenges in identifying the impact of IMF support are likely to be similar; see Cottarelli and Giannini (2002) for a discussion of the econometric issues involved.

<sup>7</sup> A recent paper by Eichengreen et al. (2005) looks at the effects of IMF support in preventing sudden stops.

Like the empirical literature, most theoretical studies focus on the catalytic effects of IMF financing in a *crisis resolution* context. For example, Penalver (2004) presents a model which shows that when there is a financial crisis, the incentives for the debtor country could be tipped in favor of adjustment if the IMF can provide financing at below market interest rates. With this incentive, the debtor avoids default and private capital flows are catalyzed. By contrast, 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.

There are a handful of theoretical papers, however, that shed light on the link between financing and the likelihood of a crisis, which is the question examined empirically in this paper. For example, Morris and Shin (2006) and Corsetti et al. (2004) model the creditor coordination problem within the framework of global games, which allows them to identify a unique equilibrium. Morris and Shin provide arguments for a catalytic role for the IMF when there is no debtor moral hazard and the economy has intermediate fundamentals. Kim (2006) articulates a model of financing, adjustment, and the role of IMF support in crisis prevention. He shows that IMF financing can help lower the likelihood of a crisis both by providing the country with more liquidity and by inducing better policies. The key implication is that IMF financing matters beyond the pure signaling effect of IMF support (so money matters). Furthermore, IMF financing is more effective in crisis prevention than unconditional liquidity.

### III. IDENTIFYING CAPITAL ACCOUNT CRISES EPISODES

Empirical evidence that IMF support may help prevent a crisis is necessarily elusive. Finding such evidence requires establishing a counterfactual scenario in which a country was at risk of having a crisis and then showing that IMF support lowered the crisis likelihood. The tack taken in this paper is first to identify episodes of intense market pressures and then to segment these according to whether or not they later developed into a capital account crisis.

Although a capital account crisis is characterized—indeed defined—by the large and persistent outflows of private capital, identifying such a crisis is a rather arbitrary process, often requiring ad-hoc thresholds on financial market developments and capital flows. This paper proposes a less arbitrary alternative by relying on a data partition technique known as cluster analysis.<sup>8</sup> In a nutshell, this technique minimizes the differences within each cluster and maximizes those across clusters. The key advantage is the allocation of observations to different clusters based on data characteristics rather than on ad-hoc thresholds. Cluster analysis still requires a decision on

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<sup>8</sup> Cluster analysis is an iterative process that assigns individual observations into  $k$  distinct data clusters. The process begins by guessing the mean of each of the  $k$  clusters and assigning each observation to one of these clusters. The means of each cluster are then calculated and, if needed, individual observations are reallocated to the cluster with the closest mean. This iterative process continues until there are no changes in the allocation of individual observations. Different algorithms can be chosen to trigger the iterative process (e.g., medians in lieu of means). The use of alternative algorithms does not affect the paper's main results.

the number of clusters to be used. The literature suggests either choosing as many clusters as necessary to facilitate the interpretation of the data or using specific tests to determine the optimal number of clusters (though at the cost of making their interpretation less transparent). This paper follows the former approach and assumes that datasets are classified into five clusters, which provides a reasonable span to capture a range between strengthening, neutral, and weakening pressures on the balance of payments.

More precisely, a two-step process is applied. In the first step, episodes of intense market pressures are identified. In the second, KAC episodes are identified from among those that experienced the most intense market pressures by examining the severity of net private capital outflows (excluding FDI, as a percent of GDP). The details of the methodology are as follows.

**Step 1:** As a first step, all the relevant financial market developments that typically underpin a capital account crisis are assessed. To this end, an index of market pressures (IMP) is constructed.<sup>9</sup> A rise in the index represents intensifying market pressures; in other words, heightened vulnerability and a weakening balance of payments position. This approach is similar to that of authors that have attempted to identify currency and banking crises—for example, see Kaminsky and Reinhart (1999). The index used in this paper is defined as:

$$IMP_{i,t} = -\ln(FX_{i,t} / FX_{i,t-1}) - \ln(REER_{i,t} / REER_{i,t-1}) + \ln(S_{i,t} / S_{i,t-1}) \quad (1)$$

where  $i$  represents each country. Based on monthly data from 1994 to 2004 for 27 emerging market economies<sup>10</sup>, the index includes the real exchange rates (REER), foreign exchange reserves (FX), and secondary market spreads (S) on sovereign bonds (vis-à-vis the 10-year U.S. Treasury bill).<sup>11</sup> For each country, the terms in equation (1) are standardized—that is, their mean is set equal to zero and standard deviation is equal to one. The interpretation of the index is straightforward. An increase in foreign exchange reserves suggests a decline in adverse

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<sup>9</sup> While cluster analysis can be applied concurrently to several economic indicators, its results might vary depending on the trade-offs that occur among these variables. For example, exchange rates might not change as a result of hefty central bank interventions in the foreign exchange market; still, the market pressure is a clear and present danger. This paper opts for constructing an index of market pressures and applying cluster analysis to this index.

<sup>10</sup> The definition is based on data availability and includes 27 emerging market economies—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.

<sup>11</sup> The most common components used in the construction of these indices are the nominal or real effective exchange rate, foreign exchange reserves, and monetary aggregate ratios.



market pressures. Similarly, an appreciation of the currency reveals that adverse market pressures decline.<sup>12</sup> Higher spreads suggest an increase in market pressures.

Based on the clusters identified from the above index, which vary in intensity from 1 to 5 and where 1 represents the highest intensity of market pressures, a total of 32 market pressure episodes are identified (cluster 1; see Figure 1-A (i)). These episodes constitute the universe of KAC and control group events among emerging market economies over the period 1994-2004. Table 1 lists these pressure events together with information on the timing (beginning and end dates for each pressure event) and duration of each of these market pressure events.<sup>13</sup>

**Step 2:** This step involves segmenting the high market pressure events identified in step 1 into KAC episodes and CG episodes, the latter being cases that did not turn into a crisis. This is done by assessing differences in private capital flows. To this end, cluster analysis is applied on net private capital flows data (excluding FDI, as a percent of GDP; quarterly data from 1994 to 2004).<sup>14</sup> As before, five clusters are used; for example, cluster 1 represents high inflows (HI=1) and cluster 5 represents high outflows (HO=5), with intermediate flows being classified into clusters 2 thru 4. It is assumed that a KAC episode exists when a pressure event is followed by at least two quarters (for persistence) of medium or high capital outflows during the four quarters that begin in the quarter the market pressure event took place (clusters 4 or 5, see Figure 1-A (ii)). Table 1 identifies the cluster membership for each quarter of capital flow data from the beginning of the market pressures (referred as period  $t$ ) and for a total of 4 quarters.

The rules specified above result in 11 capital account crisis cases and 21 cases where the severe market pressure event did not result in a capital account crisis. The latter group constitutes the

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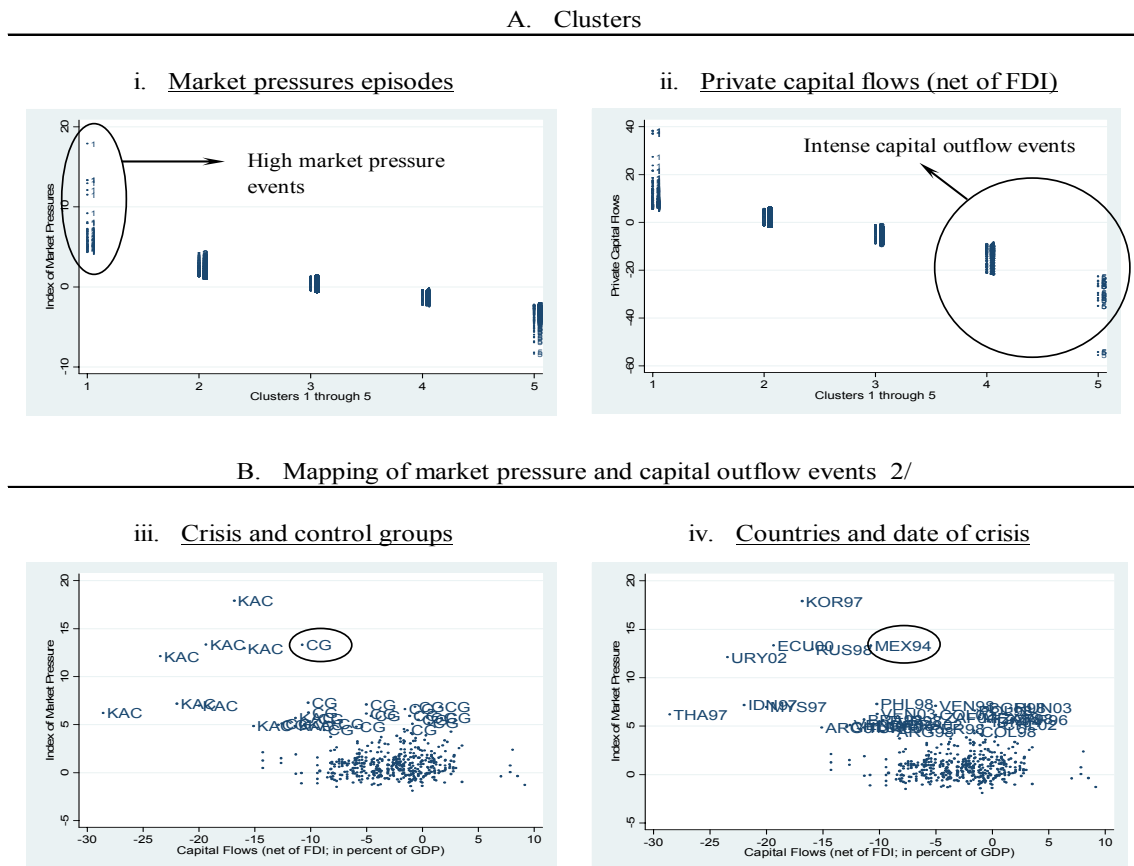
<sup>12</sup> The interpretation of shifts in the REER assumes no knowledge regarding a country's equilibrium exchange rate. For example, an appreciation could reveal both a build-up of overvaluation pressures or a reduction in undervaluation relative to a country's equilibrium rate. Either way, the fact that appreciation occurs means that market pressures are easing.

<sup>13</sup> The duration is measured by the number of months from beginning to end of each market pressure event. As is customary in the literature that identifies events, a "tranquil" period (in this paper 12 months) is needed in between pressure episodes to consider these as different events. Five countries have pressure episodes within less than 12 months of each other: Brazil, October 1997 and August 1998; Mexico, April 1994 and December 1994; Philippines, July 1997 and August 1998; South Africa, July 1997 and July 1998; and Turkey, October 1997 and August 1998. In each case the least severe market pressure was dropped (the first of the identified dates). Also, Ecuador was affected by a protracted period of market pressures that ended with the introduction of a currency board (January 2000); only this last event is kept. Similarly, in Brazil, where the episodes in August 1998 and April 2000 shared some common data for outer quarters, the April 2000 episode was dropped because it was less severe.

<sup>14</sup> Quarterly data for private capital flows is limited to 20 emerging market economies. The World Economic Outlook (WEO) definition of private capital flows is used in the paper, but is applied to quarterly International Financial Statistics (IFS) data.

control group. Figure 1-B represents the KAC and CG episodes, as well as the country and timing of each episode presented in Table 1. The list of KAC cases corresponds closely to the most widely accepted list of KAC cases and their timing (including the Asian crisis countries in 1997, Russia 1998, Brazil 1998, Turkey 2000, Argentina 2001, and Uruguay 2002). Similarly, control group episodes come as no surprise, except perhaps for Mexico 1994—this episode is not classified as a KAC but as a CG episode, mainly because Mexico’s capital outflows were less severe than was the case in other countries. The speed and size with which Mexico’s financial assistance package was put together might have made Mexico’s capital outflows short-lived, thus explaining its classification as a CG event.<sup>15</sup> As shown later, however, its potential misclassification appears to have no bearing on the paper’s main conclusions.

Figure 1. Identification of the Two Sample Groups



1/ Definition of clusters is described in Table 1.

2/ See footnote in Table 1 for a description of KAC and CG episodes.

<sup>15</sup> An alternative definition of step 2 would involve looking at private capital flows plus errors and omissions and applying cluster analysis to this aggregated data series. Such a definition would take into account developments in errors and omissions during KAC episodes. This definition results in a different classification for two market pressure episodes—Mexico 1994 and Venezuela 2003 would be categorized as a KAC—but does not affect the paper’s results.

The characteristics of the two identified sample groups merit closer examination to identify similarities and differences. Figures 2 through 5 show some stylized facts across these two groups of intense market pressure episodes. The figures show movements in the financial and economic indicators for nine quarters centered around time  $t$ , where  $t$  is the onset of each intense market pressure event. Of course, once the crisis does or does not erupt, the behavior of these variables is likely to be quite different; of greater interest for the purposes of this paper,

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 of market pressures		End date of market pressures		Duration of pressures (in months) 3/	Number of months with pressures	Capital flow clusters 4/				KAC or control group (CG) 5/
		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 (i.e., cluster 1 in Figure 1.A).

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 (HI=1), low inflows (LI=2), low outflows (LO=3), medium outflows (MO=4), and high outflows (HO=5).

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).

therefore, are the differences between the groups in the run up (quarters  $t-4$  to  $t-1$ ) to the high market pressure episode. The highlights (based on the medians for each group) are:<sup>16</sup>

- **Market/Financial Indicators (Figure 2):** The index of market pressures peaks at time  $t$  in both groups, though the index is higher among the KAC events. The spreads of the latter are also higher in level terms, and the gap widens after period  $t$ . Interest rates are higher during  $t+i$  ( $i=1$  to 4) for the KAC cases, perhaps reflecting an attempt to stem capital outflows. The REER index dips for both groups in the post- $t$  period, albeit to a larger extent for the KAC group. Foreign exchange reserves start out at about the same level (10 percent of GDP), but the KAC cases experience a significant drop in period  $t$ , which recovers a few quarters after the onset of the capital account crisis.
- **Macroeconomic Indicators (Figure 3):** Real GDP growth is somewhat stronger in the control group, and this difference widens after the onset of the market pressures. Still, both groups reveal a “V-shape” economic recovery pattern. Inflation spikes in the KAC group after period  $t$ , most probably reflecting the currency devaluation that affects these cases. The current account balance is broadly the same in both groups during the quarters that precede period  $t$ . However, as should be expected, the current account adjustment after market pressures erupt is much stronger among KAC events. The fiscal balance is worse among KAC episodes prior to the onset of intense market pressures than is the case among CG episodes; yet, the fiscal balance in the KAC group peaks at time  $t-1$ , perhaps reflecting a late (and ultimately unsuccessful) effort to avoid a KAC.<sup>17</sup> The velocity of money is quite stable in both groups prior to period  $t$ . While monetary policy appears to loosen up among the KAC group in the aftermath of the crisis, this is short-lived and may also reflect the effects of sharp decelerations in output.<sup>18</sup>
- **External Indicators (Figure 4):** The exchange rate regime data (based on the IMF’s Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) suggest that the control group had a slightly more flexible exchange rate regime than the crisis group.<sup>19</sup> Still, the exchange rate regime does not differ clearly between KAC and CG cases. More interestingly, the CG episodes appear to have a less overvalued exchange rate than the countries in the crisis group.<sup>20</sup> The level of private capital flows as a percent of GDP are similar in both groups until period  $t$ ,

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<sup>16</sup> The discussion is based on the medians for each of the two groups; stylized facts derived using average values are broadly similar to those presented here for median data.

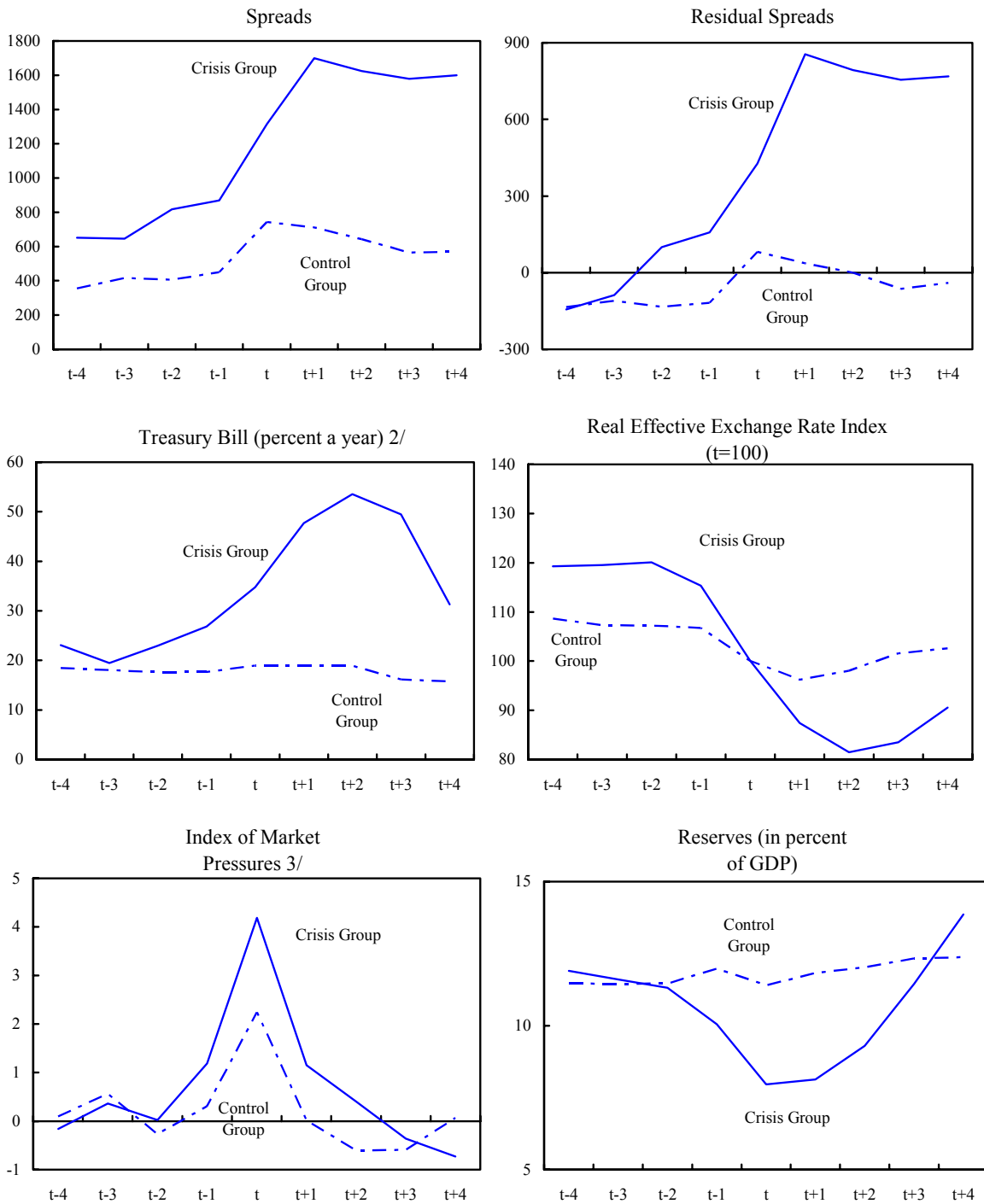
<sup>17</sup> The fiscal balance figures also reflect the strong seasonal pattern of fiscal quarterly data.

<sup>18</sup> An increase in the velocity of money implies that the money growth rate is less than the growth rate in nominal GDP, thus implying a tightening of monetary aggregates.

<sup>19</sup> The AREAER ranks exchange rate regimes from 1 to 8, with 1 being an exchange rate arrangement with no separate legal tender and 8 being an independently floating regime.

<sup>20</sup> Exchange rate overvaluation is defined as the difference between the REER and the trend value of REER, the latter derived by applying the Hodrick-Prescott filter on the REER data.

Figure 2. Selected Financial Market Indicators (Medians for Crisis and Control Groups) 1/



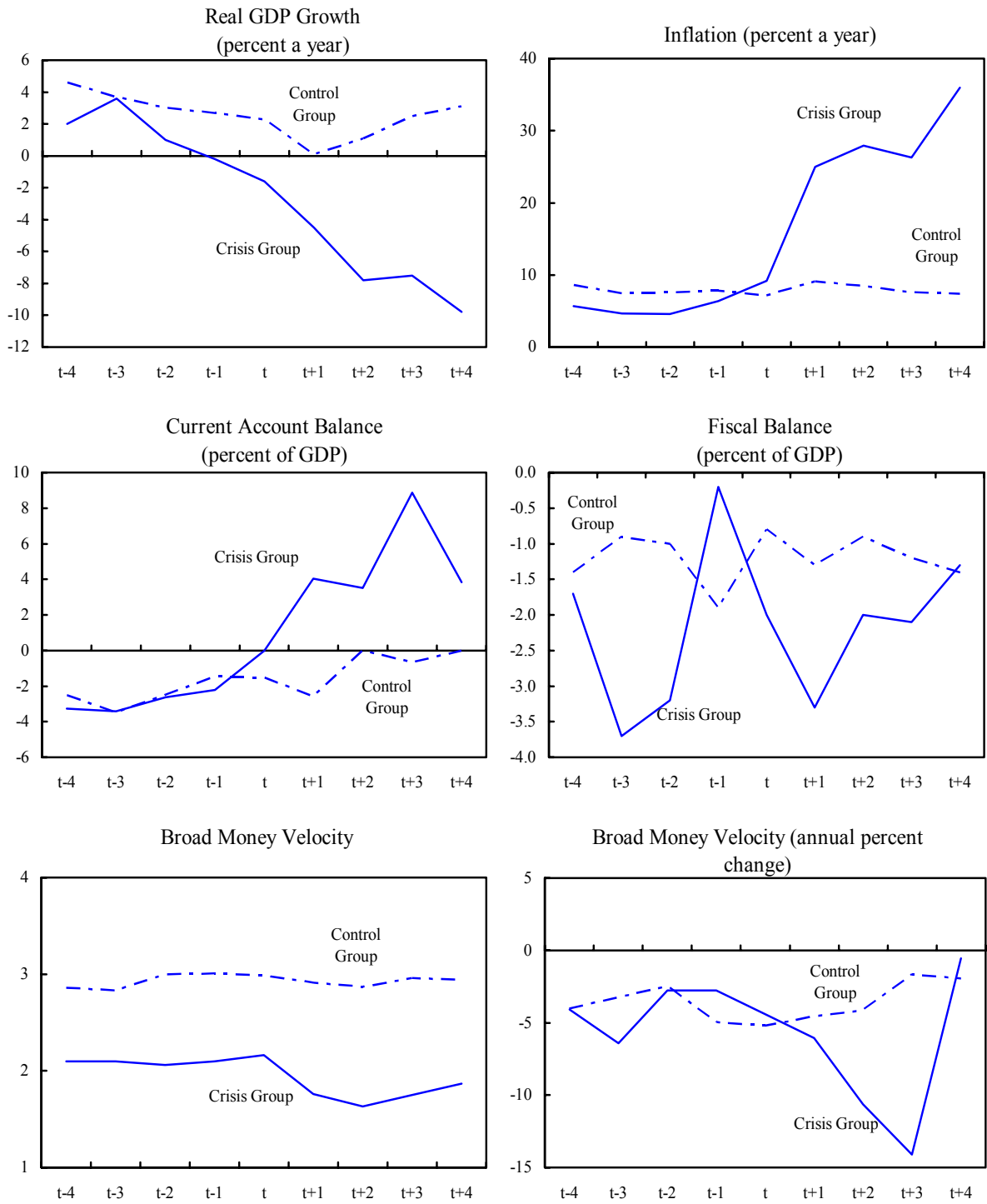
Sources: WEO, IFS, CEIC, EMDB databases; and IMF Staff estimates.

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

2/ Interpolated when not available from other short-term interest rate data.

3/ Index composed with changes in spreads, FX reserves, and REER.

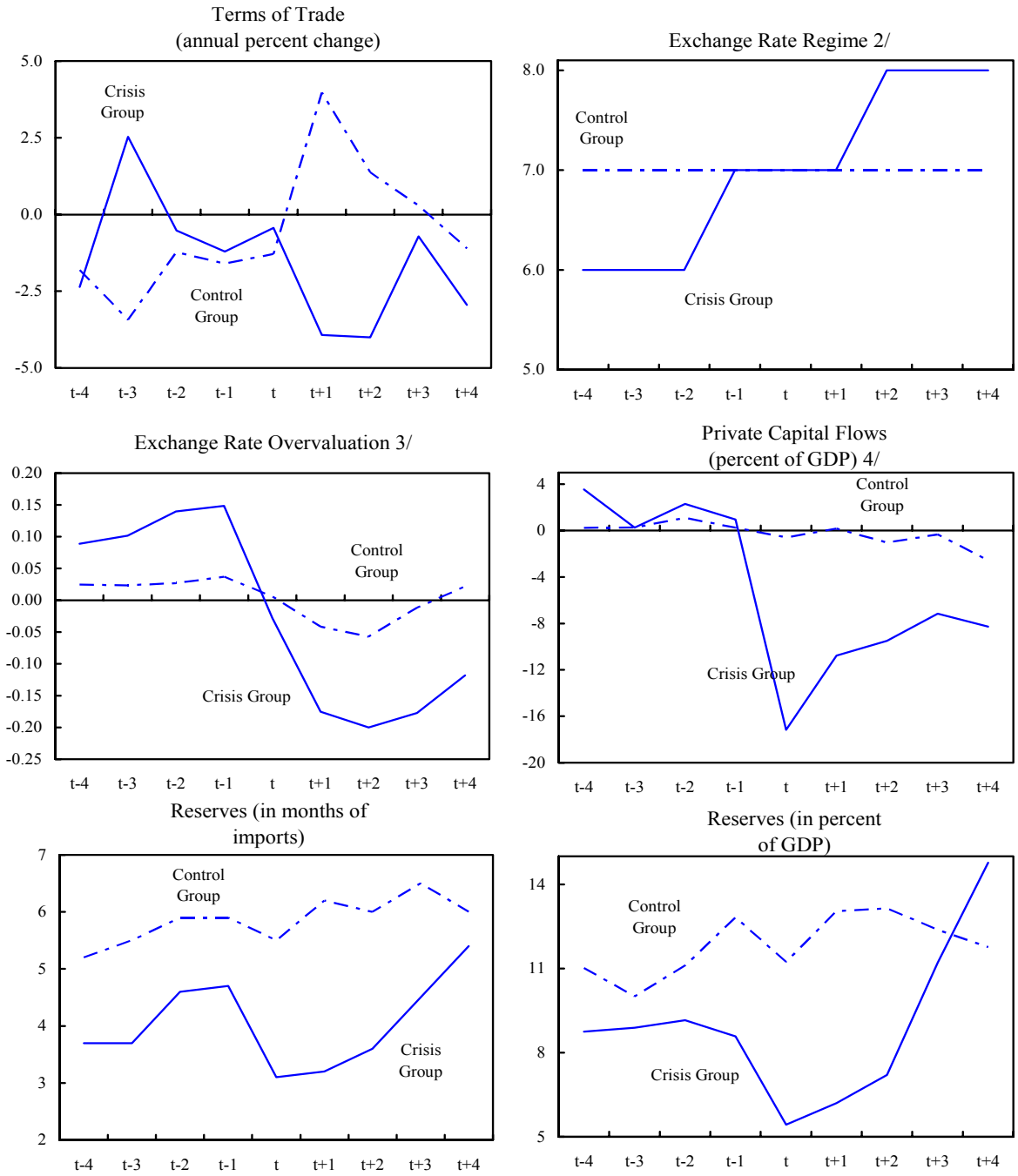
Figure 3. Selected Macroeconomic Indicators (Medians for Crisis and Control Groups) 1/



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

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

Figure 4. Selected External Sector Indicators (Medians for Crisis and Control Groups) 1/



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

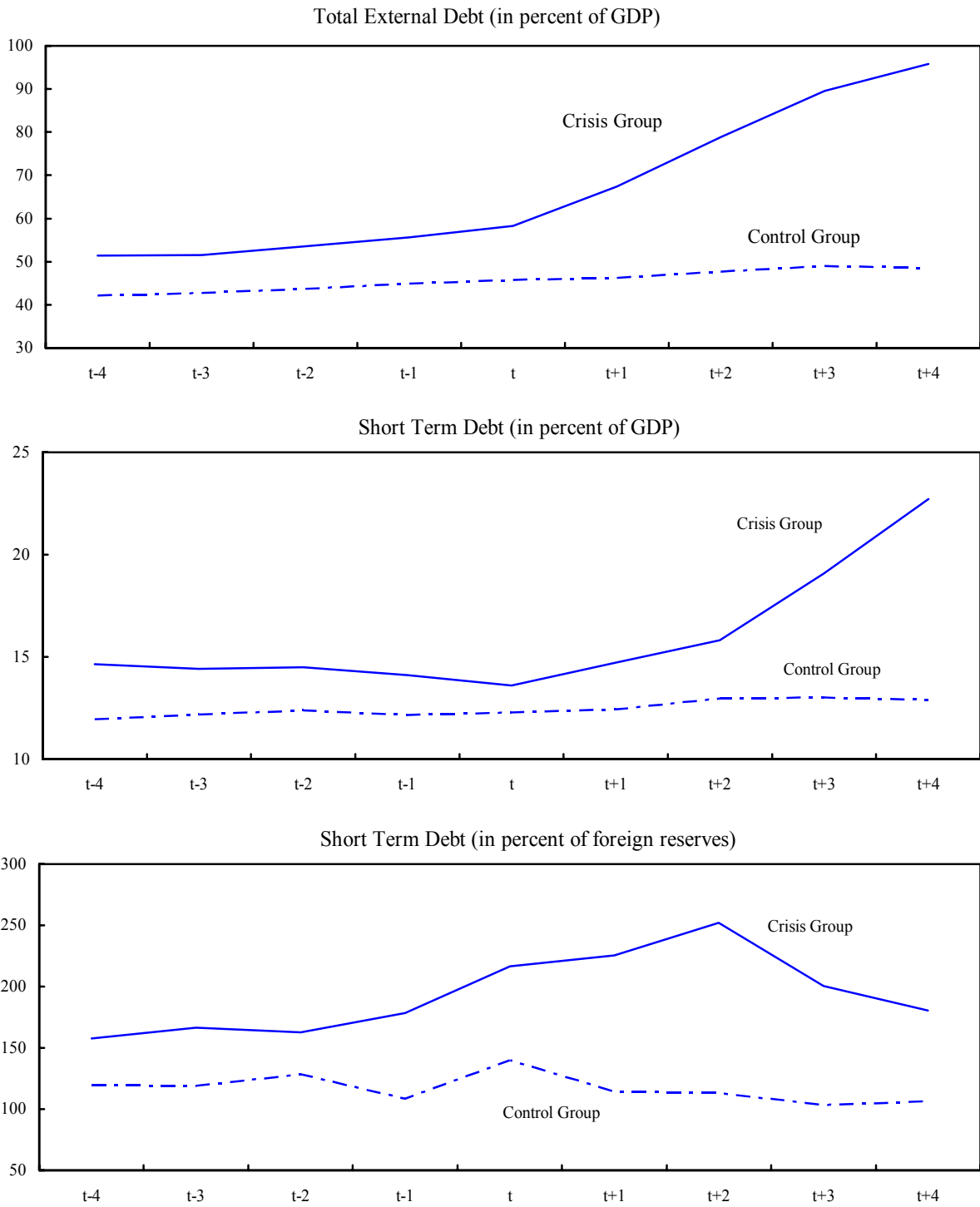
1/ A total of 11 KAC and 21 CG episodes are included.

2/ The exchange rate regime classification follows the IMF's Annual Report on Exchange Rate Arrangements and Exchange Rate Restrictions.

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

4/ Excluding foreign direct investment.

Figure 5. Solvency and Liquidity Indicators (Medians for Crisis and Control Groups) 1/



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

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



when capital outflows increase among the KAC events (this is, of course, by definition, as a KAC is identified in the paper based on the intensity of private capital outflows).

- **External Debt Indicators (Figure 5):** Total external debt as a share of GDP is higher in the crisis group compared with the control group—about 55 percent in the KAC cases, slightly over 10 percentage points higher than is the case among CG episodes. The gap between the two groups widens after the onset of severe market pressures owing in part to the fall in nominal GDP in U.S. dollar terms for the KAC countries. Except for a small spike precisely in the quarter in which market pressures intensify, the ratio of short-term debt to reserves is quite stable among CG events. By contrast, the ratio rises sharply among KAC events from period  $t-1$  to period  $t+2$ , mainly because reserves begin to decline when countries intervene in the foreign exchange market in an attempt to stabilize their currency. The ratio enters a declining phase in period  $t+3$ .

#### IV. ESTIMATION AND RESULTS

What determines whether or not an episode of intense market pressure develops into a capital account crisis? And does IMF support play a role in the outcome? These are the two key empirical questions examined in this paper. Given that there are differences between the CG and the KAC episodes in the run up to each episode of intense market pressures, assessing the role of IMF financing requires to control for differences in fundamentals, economic policy adjustment, exogenous and other factors, and political developments.

Conceptually, IMF support may contribute to crisis prevention by engendering sound policies (and signaling these to markets) and by increasing the liquidity available to the country. Our approach is not to prejudge which of these may be empirically important. We do, however, implicitly control for whether or not the program was on-track given that the focus is on IMF available resources (i.e., resources that are either disbursed or accumulated drawing rights under precautionary arrangements), as that should matter for either channel, and allow for the level of IMF financing to have an impact on the likelihood of a crisis. We also attempt to explain why the financing level might be important. By contrast, most of the empirical literature has focused only on whether an IMF arrangement is in place, regardless of the amount disbursed or whether the program is off-track, and of the handful of studies that look at IMF financing, all have been limited to IMF lending *commitments* rather than “available” resources.

A logit econometric specification is estimated where the dependent variable is a one or a zero depending on whether the episode under consideration was identified to be a KAC or a control group episode in period  $t$ . Again, period  $t$  is the onset of the market pressure event. Since the focus of the paper is on crisis *prevention*, the regression analysis focuses on the four quarters *preceding* period  $t$  (or the pre-crisis period); that is, 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.<sup>21</sup> The focus on pre-crisis information is motivated by the need to identify how many quarters prior to a crisis can the model predict this occurrence. It is shown later that this approach has no bearing on the paper's results beyond facilitating convergence of the maximum likelihood estimation—that is, the 32 pressure episodes and 4 quarters of data result in a dataset of 128 observations, but the results with 32 observations are similar.

The regressors are categorized into four groups:<sup>22</sup>

- **Initial Conditions:** This group reflects the state of the economy in the pre-crisis period, and includes: (i) information on solvency (total external debt-to-GDP ratio) and liquidity (short-term debt-to-reserves ratio)—higher debt and lower liquidity increase the crisis probability; (ii) the exchange rate regime prior to period  $t$ —a less flexible exchange rate regime implies a higher crisis probability; (iii) the exchange rate overvaluation as a proxy for exchange rate deviations from equilibrium—high overvaluation, high crisis probability; and (iv) the level of political stability—greater stability, lower crisis probability. The latter is based on the ICRG index, which assesses political stability and has the purpose of controlling for the effects of the underlying political climate.<sup>23</sup>
- **Policy Adjustment:** A country's policy adjustments could affect the likelihood an episode of market pressure develops into a full blown crisis. For example, a larger fiscal adjustment in the period preceding an intense market episode could lead to a lower crisis probability. Likewise, a similar result could be expected from a tightening in monetary policy, which is measured in this paper by the change in short-term real interest rates.
- **Exogenous/Other Factors:** There may be a number of potentially important exogenous factors that could influence the crisis probability; for example, movements in the terms of trade, the size of the economy, and geographical (regional) location.<sup>24</sup>
- **IMF Financing:** The paper focuses on the IMF money that is available (disbursed or accumulated drawing rights in the case of precautionary arrangements) as recorded in the IMF's

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<sup>21</sup> 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 2001Q2 = 1, 2001Q1 = 1, 2000Q4 = 1, and 2000Q3 = 1. By contrast, the Argentina 1998 episode has zeros as the dependent variable because the period  $t$  episode is in the control group.

<sup>22</sup> Detailed definitions for each regressor are provided in the footnotes to Table 3.

<sup>23</sup> The ICRG index prepared by the Political Risk Services Group.

<sup>24</sup> Other international cyclical factors (e.g., U.S. 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 regarding the role of IMF financing.

Finance Department database.<sup>25</sup> Unlike a dummy variable constructed based on the existence of a IMF-supported program, which as noted is the approach typically used in the empirical literature on IMF-supported programs, this paper uses the ratio of available resources to short-term debt in the four quarters up to each period.<sup>26</sup>

Table 2 provides summary statistics of the IMF financing variable for the precrisis period.<sup>27</sup> The sample of 32 episodes is quite balanced between KAC and CG episodes and between observations with and without IMF financing. Specifically, about one-third of all observations are KACs and two-thirds are in the control group. Also, about 40 percent of KAC episodes have IMF resources available prior to the emergence of intense market pressures (i.e., before period  $t$ ), compared to slightly over 25 percent among the market pressure episodes in the control group. Since the focus of this paper is on crisis *prevention*, it is worth noting that IMF arrangements approved from period  $t$  onwards are excluded from the sample under study.

Table 2. Descriptive Statistics on IMF Financing 1/

		If IMF financing exists		Full sample	
		All	LAC	All	LAC
		episodes	region	episodes	region
KAC episodes	Mean	0.055	0.050	0.021	0.025
	Median	0.048	0.045	0.000	0.004
	Std. Dev.	0.038	0.042	0.036	0.038
	Min. (Uruguay; 2001Q4) 2/	0.008	0.008	0.000	0.000
	Max. (Russia; 1997Q3) 2/	0.120	0.118	0.120	0.118
	Obs.	17	8	44	16
Share of the full sample of KACs		39	50		
CG episodes	Mean	0.085	0.065	0.022	0.013
	Median	0.052	0.028	0.000	0.000
	Std. Dev.	0.072	0.073	0.052	0.042
	Min. (Argentina; 1998Q2) 2/	0.008	0.008	0.000	0.000
	Max. (Brazil; 2002Q2) 2/	0.234	0.234	0.234	0.234
	Obs.	22	10	84	48
Share of the full sample of CGs		26	21		

1/ Defined as a share of short-term debt (STD).

2/ Identified country and period refers to the all episode column when IMF financing exists.

<sup>25</sup> The sample has only two precautionary arrangements; hence, distinguishing these econometrically from nonprecautionary programs is not possible. Excluding altogether precautionary arrangements from the sample does not affect the results in this paper.

<sup>26</sup> More precisely, the level of IMF financing in period  $t-1$  is calculated as a sum of available IMF resources from  $t-4$  to  $t-1$  as a ratio of short-term debt in  $t-1$ ; the financing in  $t-2$  is calculated as a sum of available IMF resources from  $t-5$  to  $t-2$  to short-term debt in  $t-2$ ; and so on for earlier periods.

<sup>27</sup> Appendix Table 1 and Appendix Table 2 provide, respectively, descriptive statistics and simple correlations for all the regressors in the paper.

## A. Results

The econometric results based on alternative specifications are presented in Table 3. Before presenting the results, the differences between each reported regression are discussed. Specifically, regressions 1 and 2 (R1 and R2) examine the impact of IMF financing (without controlling for policy adjustment) using different sample sizes. While R1 shows the results for an estimation with 32 observations based on the simple average of quarterly data from  $t-4$  to  $t-1$ , R2 is estimated using one observation for each of these periods. The purpose of R1 is to show that the results in this paper are not dependent on the decision to expand the dataset to 128 observations. Indeed, as noted earlier, the motivation for using 128 observations is driven primarily by the need to examine how early a crisis can be predicted. It also facilitates convergence in estimations that include additional regressors. Regression 3 through 5 (R3, R4, and R5) differ only on the definition of IMF involvement. R3 uses a dummy variable constructed based on the existence of an “on-track” IMF-supported program. R4 adds to such a dummy the IMF financing regressor previously described, and R5 is based solely on the latter. These three regressions include fiscal and monetary policy adjustments in the period from  $t-4$  to  $t-1$ —changes in the fiscal balance and real interest rates—and the extent of overvaluation in the exchange rate relative to trend. Regression 6 (R6) provides estimations that control for the interaction of changes in fiscal and monetary policy with the existence of an on-track IMF-supported program dummy.<sup>28</sup> The IMF financing regressor is based on available resources.

What are the main results? The coefficients estimates for regressors introduced as controls have the expected signs, but are not always statistically significant. They are nevertheless kept in the estimation to reduce the risk of omitted variable bias; it is later shown that a more parsimonious specification does not weaken the conclusion regarding the importance of IMF resources for capital account crises prevention. More precisely, a high ratio of external debt to GDP (solvency threat) increases the vulnerability to a crisis. Likewise, if the ratio of short-term debt to FX reserves is high (liquidity threat), then the crisis probability is high. Both of these regressors are statistically significant. In addition, exchange rate overvaluation is a quite important determinant of crisis probability.<sup>29</sup> Similarly, the size of the economy contributes significantly to whether a country is more or less prone to a crisis. This might reflect the high resource needs of large countries relative to total resources available for emerging market economies. The coefficient on the political stability suggests that higher political stability leads to a lower crisis probability, but is not always significant. The results for the other controls usually have the right signs but are rarely significant. For example, a more flexible exchange rate regime only makes a small contribution to a lower crisis probability, and the point estimate is statistically significant only in one case. A country’s terms of trade has the right sign, but is not statistically significant in any of the estimated regressions. Finally, neither of the two regional dummies is significant.

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<sup>28</sup> Growth and inflation performance pre-crisis differ between KAC and CG cases (Figure 2). Adding these variables to the estimation does not alter the thrust of the results in this paper.

<sup>29</sup> The exchange rate overvaluation is excluded from R1 since the regression fails to converge due to its small sample size. It is also dropped from R2 for comparability with R1.

As for the policy variables, the regressions suggest that monetary and fiscal tightening lower the probability of crisis, although only the monetary variable is significant at the 10 percent significance level. Moreover, in R6, the fiscal adjustment interactive dummy is negative and significant, suggesting that greater fiscal adjustment in countries receiving IMF financing helps a country in turning away from the brink of a crisis. Still, the estimated coefficient is small, suggesting that there is a limit to how much can be achieved by policy adjustment alone over a short period of time. Notice that even though the non-interacted fiscal adjustment coefficient in R6 is positive and significant, the combined fiscal adjustment term—with and without interaction—for program countries is negative (and jointly significant with the noninteracted regressor). The change in interest rates in R6—with and without interaction—is not significant.

Turning to the crisis prevention effects of IMF financing, the estimated logit model reveals that IMF money matters. The coefficient on the IMF financing to short-term debt regressor is negative and statistically significant across all the specifications. Indeed, the coefficient on a program dummy is consistently not significant, suggesting that the signal is not related to the existence of an on-track program, but to the size of the IMF financing<sup>30</sup>—or, in other words, while an on-track program is important, IMF resources dominate the relationship.<sup>31</sup>

It has to be recognized, however, that it is not possible to fully disentangle from an indicator based on IMF financing all the channels through which a IMF-supported program helps to prevent a capital account crisis. For example, the IMF financing regressor might remain statistically significant because of stronger policies under a IMF-supported program that are not controlled for (or captured) by other policy regressors. In addition, given that the estimation controls for gross reserves, then it has to be the case that IMF financing provides more than liquidity (and, in fact, that IMF financing is more useful than other financing sources).

In sum, while caution is needed in trying to unscramble exactly the various channels of IMF signaling role, the main results of the estimations can be summarized as follows:

- Stronger policies—tighter monetary policy (higher real interest rates) or greater fiscal adjustment (particularly in the context of a IMF-supported program)—are associated with a lower crisis likelihood and this association is statistically significant.
- IMF disbursements (or accumulated drawing rights) are a significant factor in crisis prevention: the larger are the disbursed IMF resources, the lower is the crisis likelihood.

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<sup>30</sup> Typically, a dummy variable for the existence of a IMF-supported program is used in the literature. By itself, this does not allow to control for the existence of an “on-track” program. However, this paper finds that an indicator dummy variable constructed based on the existence of an “on-track” IMF-supported program also proves not to be statistically significant.

<sup>31</sup> An alternative specification (not reported) where the IMF financing is defined as the amount of money *committed* over the life of the IMF-supported program is also not significant.

Table 3. Logistic Regression Results 1/

Dependent variable: Crisis=1, Control Group=0	Regression					
	R1 2/	R2	R3	R4	R5	R6
<b>IMF involvement</b>						
IMF financing (resource ratio) 3/	-25.36 **	-20.58 **		-37.23 **	-40.25 **	-40.06 ***
IMF program dummy 4/			-1.11		0.46	
<b>Initial conditions</b>						
Debt/GDP	0.16 ***	0.13 ***	0.14 ***	0.18 ***	0.18 ***	0.19 ***
ST debt/Reserves	0.87 ***	0.75 ***	1.06 ***	1.06 ***	1.03 **	1.12 ***
Exchange rate regime 5/	-0.52	-0.40	-0.33	-0.56	-0.53	-0.67 *
Political stability 6/	-5.46	-5.26	-6.44 **	-6.14	-6.04 *	-6.05 *
Exchange rate overvaluation 7/			17.65 ***	25.22 ***	24.74 ***	26.29 ***
<b>Policy variables</b>						
Fiscal balance change 8/			-0.08 **	-0.03	-0.03	0.23 **
Fiscal balance interactive with Fund dummy 9/						-0.45 **
Interest rate change (real terms) 10/			-0.08 **	-0.07 *	-0.07 *	-0.03
Interest rate interactive with Fund dummy 11/						-0.07
<b>Exogenous factors</b>						
Terms of trade	0.08	0.04	-0.01	0.02	0.02	-0.00
<b>Other</b>						
Size of the economy 12/	1.16 ***	1.01 ***	0.77 ***	0.87 ***	0.88 ***	0.93 ***
Latin American dummy	-1.43	-1.15	-0.69	-1.49	-1.51	-1.98
Asian dummy	2.71	2.35	2.41	2.45	2.34	2.36
Constant	-5.49	-4.69	-5.92	-6.76	-6.98	-6.77
No. of observations	32	128	128	128	128	128
LR Chi-square	20.2 **	30.6 ***	50.7 ***	25.7 ***	30.6 ***	65.8 ***
Pseudo R-square	0.51	0.48	0.53	0.59	0.59	0.61
Correctly classified (in percent)	81	80	83	87	87	87
Type I errors (in percent)	36	34	23	16	16	18
Type II errors (in percent)	10	13	14	12	12	11

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

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/ Based on 32 observations corresponding to the simple average of data for periods  $t-4$  to  $t-1$ .

3/ Cumulative sum of IMF 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  $t-1$ .

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

5/ 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.

6/ Refers to the democratic accountability component in the International Credit Ratings Guide Index. Higher index indicates a lower risk rating.

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

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

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

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

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

12/ GDP as a share of US GDP.

- An important liquidity effect of IMF support on crisis prevention exists. IMF disbursements (or their availability under an on-track precautionary program) matters, rather than just an on-track program or possible future drawings under the arrangement.
- The benefits of IMF support go beyond liquidity effects, however, since the IMF 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 IMF disbursements. Moreover, since the IMF-supported program dummy is not statistically significant, but the IMF financing variable is strongly significant, the strength and the credibility of the IMF's signal appears to depend, in part, on the IMF putting its own resources on the line.

Table 4. Model Classification of KAC and CG Episodes in  $t-4$  to  $t-1$  1/

Country	Beginning date of market		KAC and CG episodes				
			Classification in the four quarters preceding the crisis				KAC or control group (CG) at time $t$
			$t-4$	$t-3$	$t-2$	$t-1$	
Argentina	2001	July	KAC	KAC	KAC	KAC	KAC
Brazil	1998	August	KAC	KAC	KAC	KAC	KAC
Bulgaria	1996	May	KAC	KAC	KAC	KAC	KAC
Ecuador	2000	January	KAC	CG	CG	KAC	KAC
Indonesia	1997	October	KAC	KAC	KAC	KAC	KAC
Korea	1997	October	KAC	KAC	KAC	KAC	KAC
Malaysia	1997	July	CG	CG	CG	KAC	KAC
Russia	1998	August	CG	KAC	KAC	KAC	KAC
Thailand	1997	July	KAC	KAC	KAC	KAC	KAC
Turkey	2000	November	CG	KAC	CG	KAC	KAC
Uruguay	2002	July	KAC	KAC	KAC	KAC	KAC
Argentina	1998	August	CG	CG	CG	CG	CG
Brazil	2002	July	CG	CG	CG	CG	CG
Bulgaria	1998	August	KAC	CG	CG	CG	CG
Chile	1999	June	CG	CG	CG	CG	CG
Chile	2002	June	CG	CG	CG	CG	CG
Colombia	1998	April	CG	CG	CG	CG	CG
Colombia	2002	July	CG	CG	CG	CG	CG
Hungary	2003	June	CG	CG	CG	CG	CG
Indonesia	2004	January	KAC	KAC	KAC	CG	CG
Mexico	1994	December	CG	KAC	KAC	KAC	CG
Mexico	1998	August	CG	CG	CG	CG	CG
Peru	1998	August	CG	CG	CG	CG	CG
Philippines	1998	August	CG	CG	CG	CG	CG
Poland	1998	August	CG	CG	CG	CG	CG
South Africa	1996	April	CG	CG	CG	CG	CG
South Africa	1998	July	CG	CG	CG	CG	CG
South Africa	2001	December	CG	CG	CG	CG	CG
Turkey	1998	August	CG	CG	KAC	KAC	CG
Venezuela	1994	June	CG	CG	CG	CG	CG
Venezuela	1998	August	CG	CG	CG	CG	CG
Venezuela	2003	January	CG	CG	CG	CG	CG
Correctly classified KAC episodes (number of quarterly episodes)?							37
Number of KAC episodes wrongly classified as CG in $t-4$ to $t-1$ (Type I error):							8
Number of KAC episodes wrongly classified as CG in $t-1$ (Type I error):							0
Correctly classified CG episodes (number of quarterly episodes)?							74
Number of CG episodes wrongly classified as KAC in $t-4$ to $t-1$ (Type II error):							9
Number of CG episodes wrongly classified as KAC in $t-1$ (Type II error):							2
Correctly classified (in percent)							87

1/ Classification based on the regression 6 of Table 3

All regressions perform well in terms of fit. Regression R6 has the highest pseudo R-squared and correctly classifies 87 percent of the observations (Table 4). In addition, R6 correctly classifies all KAC episodes at least one quarter prior to the onset of the intense market pressures (i.e., no type I errors in period  $t-1$ ).<sup>32</sup> As for type II errors (i.e., control group events classified as a KAC), there are two instances where the model incorrectly classifies an event as a KAC in period  $t-1$ —Mexico in 1994 and Turkey in 1998. The first case is not entirely surprising; indeed, Mexico 1994 is typically viewed as a KAC event. In fact, if cluster analysis had been applied on private capital flows plus errors and omissions, then this would have been its classification. It is later shown, however, that such a reclassification does not alter the results.

## B. Robustness Tests

This paper examines a broad group of countries over a relatively long period of time (27 countries during the period 1994-2004) and the data partition technique narrows the sample to 32 intense market pressure episodes. This sample has two main advantages. First, all 32 episodes are intense market pressure events. This is an advantage of the data partition technique as it helps to establish a counterfactual in which countries are at risk of suffering a KAC, but have managed to avoid such an outcome. Second, the sample of KAC and CG episodes is quite balanced. Thus, even though the paucity of data on crisis episodes has hampered researchers' efforts looking for empirical regularities, this paper proposes an approach that identifies market pressure events and distinguishes among them between KAC and CG cases.

But could the described results be dependent on the sample? Could data outliers drive the conclusions regarding IMF resources? The robustness tests below are intended to test whether sample features or data outliers explain the findings regarding the role of IMF financing.

***Reclassifying episodes that might be incorrectly classified by cluster analysis.*** The first of these episodes is Mexico 1994, which has typically been viewed as a KAC event. 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 event. Estimating the logit regressions with these episodes as KACs does not alter the results on IMF financing.

***Adding episodes not identified as intense market pressure events.*** Argentina experienced in early 1995 significant private capital outflows (excluding FDI) 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 event. However, cluster analysis does not even identify this event as a market pressure episode. Re-estimating the regression with this episode as a KAC—that is, as a 33rd event—does not affect the result regarding the role of IMF resources in crisis prevention.

***Dropping one time KAC cases in Asia.*** Many Asian countries appear in the dataset of 32 episodes only once, and in many of these cases only as a KAC that did not receive IMF

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<sup>32</sup> The model prediction is based on the default cutoff probability of 0.5—a crisis probability greater than 0.5 is classified as a KAC and, if less than 0.5, it is classified as a control group.



financing. Thus, these countries may be biasing the results in favor of IMF resources. Korea, Malaysia, and Thailand are dropped from the sample to test this hypothesis; Indonesia and Philippines are kept because they are not classified as a KAC or appear more than once in the sample of 32 intense market pressure events. The results on IMF resources do not change.

***Controlling for possible spillover effects in countries with more than one market pressure event.*** The sample has some countries that have more than one market pressure event. Although “windowing” techniques similar to those used in the literature (e.g., Kaminsky and Reinhart, op. cit.) were applied to control for possible spillover effects (once a market pressure event begins, it is assumed that at least 12-months must pass before a new market episode can be identified), a dummy variable was added to control for countries with “repeat” episodes. The result on the importance of IMF resources for crisis prevention is not affected by this addition.

***Examining the sensitivity of empirical work to the inclusion or exclusion of other regressors.*** This is a usual concern of any empirical work. A test for the sensitivity of the role of IMF resources is carried out by dropping one at a time all other regressors in the regressions. In addition, a more parsimonious model—i.e., including only statistically significant regressors—is estimated. In both cases the role of IMF resources in crisis prevention remains robust.

***Controlling for data outliers.***<sup>33</sup> A technique known as *dfbetas* is used to check for the effects of data outliers. This technique calculates a scaled measure of the change in the coefficient estimate for IMF resources by deleting one observation at a time. The outliers in the data sample are then dropped and the regressions re-estimated. The role of IMF resources in crisis prevention is robust to dropping data outliers identified through such technique. Another outlier control is to assess the effects of individual episodes; namely, does any one episode drive the results? As was the case for outliers in individual observations, the IMF’s crisis prevention role does not change when any one single episode is dropped from the econometric estimation.

## V. IMF SUPPORT AND CRISIS PREVENTION

The findings above suggest that IMF financing has a significant effect on the likelihood of a crisis. Before concluding that increasing the provision of IMF financing could help prevent crises, however, one important caveat is needed. Specifically, the crisis probability depends on the amount of IMF financing that can be provided and the country’s own “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, and economic policies). Therefore, while it is possible to infer the effect on the probability of a crisis by parametrically varying the amount of IMF financing in the logit specification (holding constant the contribution of the other covariates) or by varying the policy adjustment (holding financing constant), such counterfactual exercises

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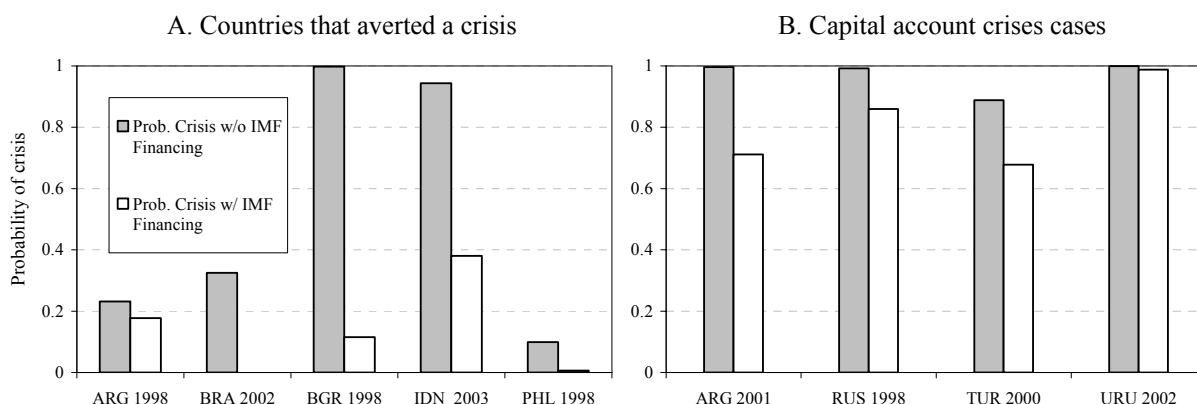
<sup>33</sup> The sample is small and, at times, dropping outliers precludes the maximum likelihood from converging. Two approaches were followed in such cases: dropping some regressors (e.g., one or both regional dummies) and setting different cutoff levels for the *dfbeta* technique. In both cases, once convergence is restored, the results on the role of IMF financing remain unchanged.

need to be interpreted with extreme caution because the country's policy response (as well as other fundamentals) and IMF financing may be simultaneously determined.

### A. The Role of IMF Financing in Crisis Prevention

With the above caveat in mind, Figure 6 provides a snapshot (in period  $t-1$ ) of the probability of crisis with and without IMF financing for countries that were receiving IMF financial support before market pressures erupted. The crisis probability is determined by the contribution of IMF financing and assuming other covariates remain constant. Within the group of countries that ultimately avoided a crisis (Figure 6, left panel), in a number of cases the model predicts that an episode of high market pressure had over a 50 percent chance of developing into a capital account crisis in the absence of IMF financing. However, with IMF financial support, this crisis probability was lowered substantially. In other cases, while the crisis probability was below 50 percent, IMF financing helped reduce this probability to negligible levels. Conversely, while the model suggests that IMF financing contributed to lower crisis probabilities in (some) of the countries that ultimately faced a capital account crisis (Figure 6, right panel), the model also shows that the crisis probability still remained high in these cases.

Figure 6. Probability of a Crisis with and without IMF Financing  
(KAC and CG countries receiving IMF financing at time  $t-1$ )

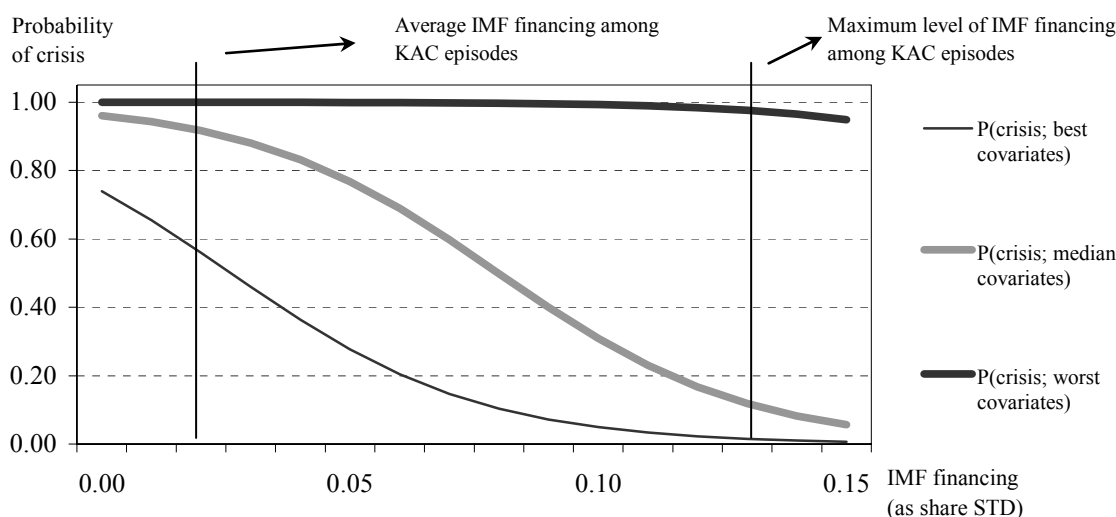


Even if the country's other covariates (including its policies) do not change as a result of changes in IMF financing, the marginal effect of that financing depends upon the average level of those covariates. By way of illustration, Figure 7 assumes constant the contribution of covariates to the crisis probability among KAC events and represents the latter for different levels of IMF financing as a ratio to short-term debt. The main conclusions are:

- When no IMF financing is available, the figure reflects the contribution of covariates to the crisis probability, in effect providing a ranking based on economic fundamentals. For example, the country with the worst initial covariates is represented by the thick black curve and the country with the least negative covariates by the thin black curve. The median covariates are represented by the gray curve. The difference in crisis probabilities without IMF financing reveals differences in economic fundamentals.

- Assuming nothing else changes, a significant drop in crisis probability can be achieved by providing IMF financing and this frequently requires fewer resources than would be necessary to fully rollover a country's short-term debt. In other cases (e.g., Indonesia), however, plausible levels of resources (the maximum financing ever provided to a KAC country) have no meaningful effect on the crisis probability. Still, in all cases, the needed resources to significantly reduce the crisis probability exceeds the average levels of IMF financing that has typically been provided to KAC cases prior to a crisis.

Figure 7. Marginal Impact of IMF Financing; Given Country Fundamentals 1/



1/ Based on regression 6 in Table 3. IMF 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 IMF financing among crises episodes.

It is also possible to ask what amounts of IMF financing would be required to lower the likelihood of a crisis to some acceptable threshold; for example, a 5 percent cut-off.<sup>34</sup> It can be shown that reducing the crisis probability to this threshold requires exceptional access (i.e., more than 100 percent of quota) in 8 out of 11 capital account crises episodes. Still, in many cases, the resources needed are less than what was ultimately provided once the crisis erupted.

As noted earlier, a key contribution of IMF-supported programs is to support stronger policies. Thus, it is useful to ask—subject to the previous caveats regarding the limitations of parametric changes—how much policy strengthening would be required in KAC cases to achieve through policies an equivalent reduction in crisis likelihood than was the case among control group

<sup>34</sup> While arbitrary, this cutoff is close to what is needed for the logit model not to have type I errors (i.e., an 8 percent cut-off). In addition, it seems sensible for the IMF to target a reduction in crisis probability that has a large margin of success.

countries as a result of the provision of IMF financing; namely, an average reduction in crisis probability of 20 percent. Parametrically varying policies in regression R6, but now keeping IMF financing constant, shows that a combined increase in fiscal adjustment and a tightening of monetary policy of close to 4½ percentage points each would be required to reduce the crisis probability by 20 percent. This highlights the difficulties of avoiding a crisis through such policies alone once the other covariates have made the country vulnerable. By contrast, a reduction in the overvaluation of the exchange rate (by 6 percent) accomplishes a similar reduction in probability, denoting the importance of exchange rate overvaluation among KAC cases. Still, these back-of-the-envelope calculations assume only a small decline in crisis probability, which in fact remains quite high among KAC episodes (the average crisis probability among KAC episodes, with and without financing, in period  $t-1$  was 87 percent).<sup>35</sup>

Although it is tempting to conclude from this discussion that a KAC could have been averted if had been enough IMF financing available, such calculations need to be interpreted with care. In particular, they do not recognize that policy responses are unlikely to be invariant to IMF resources. Also, such exercises do not take into account the deterioration in covariates that typically accompany a KAC. Indeed, political and economic developments are known to deteriorate rapidly as a crisis becomes imminent.<sup>36</sup> These caveats aside, the evidence suggests that IMF resources can have a crisis prevention role, both because of their liquidity and policy components, and that such role is most useful in countries with intermediate fundamentals.

## **B. Welfare Gains from Crisis Prevention**

To the extent that IMF support does contribute to a lower probability of a crisis, what is the associated welfare gain? Trying to evaluate this is necessarily a somewhat arbitrary exercise, requiring assumptions on growth in the absence of an intense market pressure event and on the behavior of the other covariates (specifically, that they remain constant) so that the expected decline in crisis probability can be inferred from the estimates presented above.

One possible calculation suggests that the IMF's crisis prevention role could save member countries some 5½ percent of precrisis GDP during the three years that follow a KAC (Table 5). This result is derived by assuming that the expected decline in crisis probability from IMF

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<sup>35</sup> Regressions interacting the overvaluation regressor with the exchange rate regime (not reported) show that a pegged exchange rate regime makes the country especially vulnerable. 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 balance sheet exposures that may arise if the exchange rate overshoots in the process of exiting the regime.

<sup>36</sup> Given that the focus of this paper is on crisis prevention, the logit estimation is based on developments prior to the onset of the market pressures; that is, the estimation is for period  $t-4$  through  $t-1$ . Hence, while fundamentals typically deteriorate significantly during the crisis (from period  $t$  onwards), these effects are not covered in the econometric estimation in this paper.

financing is equal to the average decline in crisis probability (due to IMF support) that is observed among control group events—as noted earlier, a decline in crisis probability of about 20 percent. 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) episodes over the first three years that follow a market pressure event provides a rough calculation of the ex-ante welfare gains from lowering the crisis probability.

Table 5. Welfare Gains 1/

	Period				3-year total	Period				3-year total
	<i>t-4:t-1</i>	<i>t+1:t+4</i>	<i>t+5:t+8</i>	<i>t+9:t+12</i>		<i>t-4:t-1</i>	<i>t+1:t+4</i>	<i>t+5:t+8</i>	<i>t+9:t+12</i>	
	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=abs(D*E); in percent of <i>t-4:t-1</i> 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.

It is important to note that this calculation can be viewed as a lower bound of the potential welfare gains from averting a capital account crisis for two reasons. First, the difference in output flows between KAC and CG events are quite high. As a result, substantially higher welfare gains are possible from avoiding altogether sharp declines in output. Second, the declines in crisis probability among capital account crises countries in the presence of IMF support might be higher than is the case for the CG episodes being used as a benchmark. Still, the calculation needs to be interpreted with care as there is no easy way to control for other differences that might characterize control group and capital account crises events.

## VI. CONCLUDING REMARKS

This paper finds empirical evidence that IMF support might play an important role in *crisis prevention*. More precisely, IMF *disbursements* (or accumulated drawing rights under precautionary arrangements) over the 12 months prior to an episode of market pressures appear

to reduce the probability a crisis will develop. This is not the case for estimations based on the existence of an IMF-supported program or on IMF resource *commitments*. In sum, private investors seem to care about how much IMF money is either actually disbursed or is available to be drawn under precautionary arrangements.

But it is not only money that matters. Because the results on the role of IMF financing hold even controlling for gross foreign exchange reserves, then this suggests that IMF money is not substitutable by other financing sources. Perhaps this reveals that IMF support also engenders better policies and sends a stronger signal to markets, but the strength of this signal depends on the institution's willingness to put its own resources on the line. The paper suggests, however, that when fundamentals are weak (i.e., the contribution of covariates to the crisis probability is high), then the IMF's involvement might be unable to achieve an orderly adjustment.

The results also suggest that there are important welfare gains to be derived through a more proactive prevention role on the part of the IMF. This would require a change in mindset: the provision of IMF resources before "the house burns down." Indeed, the resources would be available even before they are actually needed. The results also indicate that phasing of IMF disbursements may be important, with substantial front-loading of resources required in cases where the country's short-term debt coverage is low. This may also increase the risk of "policy moral hazard" as the financing would be provided before the country needs to adjust by developments in capital flows. IMF support also needs to send a positive signal to markets, thus indicating that the member would benefit from the discipline and credibility provided by IMF support, together with the immediate availability of additional liquidity should the need arise, but that it does not expect to make use of these resources. While these are all difficult issues to address, the pay-off in terms of welfare gains from avoiding a crisis are clearly quite important.

Beyond the difficulties of identifying empirical regularities from the limited number of capital account crises that have taken place, finding an effect of IMF support on crisis prevention depends also on being able to establish a counterfactual scenario—in other words, countries at risk of suffering a capital account crisis but that managed to avoid such an outcome. The paper proposes a methodic and carefully designed empirical methodology. Although there are limitations from drawing strong conclusions given the small samples involved—32 high market pressure episodes, only a handful of which turned into full blown capital account crises<sup>37</sup>—the results are, in our view, intuitive and consistent across the many robustness checks undertaken.

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<sup>37</sup> For example, the small sample precludes the assessment of nonlinearities associated with threshold effects of high debt levels or of contagion effects across market pressure events.

Appendix Table 1: Descriptive Statistics 1/

		Obs. with IMF-supported programs				Obs. without IMF-supported programs			
		Number of observations	Mean	Median	Standard deviation	Number of observations	Mean	Median	Standard deviation
KAC episodes	Fund financing	17	0.06	0.05	0.04	27	0.08	0.06	0.12
	Debt-to-GDP		61.19	54.46	18.57		86.75	96.40	40.99
	Short-term debt-to-reserves		2.46	1.76	1.47		6.40	1.47	1.05
	Political stability		0.75	0.72	0.08		0.83	0.67	0.72
	Exchange rate regime		4.76	5.00	1.79		8.00	7.00	5.00
	Exchange rate overvaluation		0.12	0.12	0.05		0.13	0.06	0.16
	Change in fiscal balance		-0.30	0.00	2.63		1.60	-7.70	-0.40
	Change in interest rates		4.37	2.74	12.66		2.90	16.72	-5.66
	Change in terms of trade		0.19	-1.10	7.74		-3.92	8.86	9.83
GDP as a share of U.S. GDP		2.31	2.13	1.73		0.14	0.17	4.86	
CG episodes	Fund financing	22	0.09	0.05	0.07	62	0.00	0.00	0.00
	Debt-to-GDP		59.95	56.56	20.37		40.95	39.68	12.13
	Short-term debt-to-reserves		1.39	1.48	0.52		1.58	1.10	1.49
	Political stability		0.77	0.83	0.19		0.70	0.67	0.19
	Exchange rate regime		5.45	7.00	2.70		6.55	6.00	1.25
	Exchange rate overvaluation		0.02	0.04	0.08		0.03	0.02	0.07
	Change in fiscal balance		2.20	0.30	8.88		-0.73	-0.35	3.25
	Change in interest rates		3.60	0.36	12.01		0.32	0.32	4.51
	Change in terms of trade		-0.32	-1.99	8.98		-1.46	-1.22	7.29
GDP as a share of U.S. GDP		2.16	2.15	1.75		1.78	1.19	1.55	

1/ Definitions presented in footnotes to Table 3.

Appendix Table 2: Simple Correlations

	FF	DGDP	STDRES	PS	ERR	OVERVAL	CHGE FB	CHGE IR	CHGE TOT	GDP SHARE
IMF financing (FF)	1.00									
Debt-to-GDP (DGDP)	0.31	1.00								
Short-term debt-to-reserves (STDRES)	0.01	-0.08	1.00							
Political stability (PS)	0.17	0.17	0.24	1.00						
Exchange rate regime (ERR)	-0.24	-0.21	0.11	-0.28	1.00					
Exchange rate overvaluation (OVERVAL)	0.15	-0.10	0.08	-0.14	-0.18	1.00				
Change in fiscal balance (CHGE FB)	0.33	0.18	0.00	0.01	-0.11	-0.06	1.00			
Change in interest rates (CHGE IR)	0.07	0.20	0.13	0.04	-0.16	0.21	0.06	1.00		
Change in terms of trade (CHGE TOT)	0.09	-0.15	0.12	-0.18	-0.01	0.11	-0.05	0.01	1.00	
GDP as a share of U.S. GDP (GDP SHARE)	0.02	-0.52	0.05	0.06	-0.09	0.31	-0.05	-0.06	0.10	1.00

## References

- Bird, Graham, and Dane Rowlands, 2002, "Do IMF Programmes Have a Catalytic Effect on Other International Capital Flows?" *Oxford Development Studies*, Vol. 30, No. 3, pp. 229–49.
- Bordo, Michael, Ashoka Mody, and Nienke Oomes, 2004, "Keeping Capital Flowing: The Role of the IMF," *International Finance*, Vol. 7, No. 3, pp. 421–50.
- 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, Massachusetts: 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 02/193 (Washington: International Monetary Fund).
- Edwards, Martin, 2000, "Reevaluating the "Catalytic" Effect of IMF Programs" (unpublished; New Brunswick, New Jersey: Rutgers University).
- 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).
- Eichengreen, Barry, Kenneth Kletzer, and Ashoka Mody, 2005, "The IMF in a World of Private Capital Markets," IMF Working Paper 05/84 (Washington: 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.
- International Monetary Fund, 2004, "Signaling by the Fund—A Historical Review." Available via the Internet <http://www.imf.org/external/np/pdr/signal/2004/071604.htm>.
- Kaminsky, Graciela, and Carmen Reinhart, 1999, "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems," *American Economic Review*, Vol. 89, No. 3, pp. 473–501.
- Kim, Jun Il, 2006, "IMF-Supported Programs and Crisis Prevention: An Analytical Framework," (unpublished; Washington: International Monetary Fund).
- Mody, Ashoka, and Diego Saravia, 2003, "Catalyzing Private Capital Flows: Do IMF Programs Work As Commitment Devices?" IMF Working Paper 03/100 (Washington: International Monetary Fund).



Morris, Stephen, and Hyun Shin, 2006, "Catalytic Finance: When Does It Work?" forthcoming in *Journal of International Economics*.

Penalver, A., 2002, "How can the IMF Catalyse Private Capital Flows? A Model" (unpublished; London: Bank of England).

Zettelmeyer, Jeronimo, 2000, "Can Official Crisis Lending be Counterproductive in the Short Run?" *Economic Notes*, Vol. 29, No. 1, pp. 13–29.