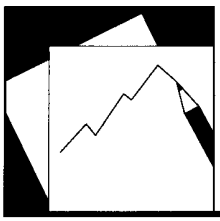
WP/07/258



IMF Working Paper

The Duration of Capital Account Crises—An Empirical Analysis

Mauro Mecagni, Ruben Atoyan,
David Hofman, and Dimitri Tzanninis

INTERNATIONAL MONETARY FUND

 WP/07/258

IMF Working Paper

Policy Development and Review Department

The Duration of Capital Account Crises—An Empirical Analysis

Prepared by Mauro Mecagni, Ruben Atoyan, David Hofman, and Dimitri Tzanninis [1]

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November 2007

Abstract

This paper examines the duration of capital account crises. We develop a new index to identify both the start and the end of these crises. Applying the index to a sample of 18 crisis episodes, we derive stylized facts on crisis duration and review the economic and financial circumstances that prevailed at the dusk of crises, a relatively unexplored area. We use the econometric technique of duration analysis to gauge the relative importance of various factors affecting the probability of exiting a crisis. We find that initial and external conditions are key determinants. But fiscal and monetary policies can also help shorten crisis duration.

JEL Classification Numbers: F32, F34, C41, C43

Keywords: Capital account crises, duration, crises identification
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[1] In the process of preparing this paper, we greatly benefited from stimulating discussions with Jorge Marquez-Ruarte, Alan MacArthur, Thanos Arvanitis, Bhaswar Mukhopadhyay, and our colleagues in the Crisis Resolution Issues Division in PDR. We also thank Mark Allen, Matthew Fisher, G. Russell Kincaid, Michael Hadjimichael, Adnan Mazarei, and Atish Ghosh for their many helpful comments and suggestions. Ivetta Hakobyan and Cecilia S. Lon provided excellent research assistance and technical support. All remaining errors are our own.

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"In a crisis, you are hostage of your past"
Guillermo Calvo

I. INTRODUCTION

Capital account crises—episodes of financial distress characterized by abrupt capital outflows—tend to be highly disruptive and to have deep macroeconomic and social consequences. Their disruptive effects have posed major challenges to policymakers, making it important to gain a thorough understanding of these crises and their impact.

Most of the literature on capital account crises has focused on the causes of financial distress and "crisis triggers," stressing the role of domestic and external factors. Several studies have highlighted global financial conditions—such as liquidity and investor perceptions of emerging market risk—and the self-fulfilling potential of investors' expectations. These studies tend to argue that prudent domestic policies are a necessary but not sufficient condition for protection from financial shocks.[2] Another strand of literature emphasizes weaknesses in domestic balance sheets as a key cause of crises, and, sometimes, limited openness to trade, since trade can work as an adjustor of financial imbalances.[3] Countries' solvency and liquidity conditions are also identified as critical determinants of vulnerability to crises.[4]

Other studies have focused on the macroeconomic impact of capital account crises and on the policy response. These studies typically find a large negative effect on output growth.[5] As to the implications for the design of Fund-supported programs, an early IMF staff study concluded that while there is a prevention role in addressing balance sheet vulnerabilities, the experience underscores the severe difficulties of program design in circumstances where stock imbalances trigger sudden massive outflows of capital.[6]

To our knowledge, however, the duration of, and exit from capital account crises has received relatively little attention.[7] The issue of crisis duration is virtually unexplored, possibly reflecting the difficulty in defining the conditions that mark the end of a capital account crisis. Consequently, little is known about the evolution of key macroeconomic and

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[2] See, for example Calvo (1998) and Calvo (2005).

[3] Ghosh (2006); Calvo, Izquierdo, and Mejia (2004) highlight the importance of balance sheet vulnerabilities; and Frankel and Cavallo (2004) focus on the link between trade openness and the probability of a crisis.

[4] Ramakrishnan and Zalduendo (2006); and Eichengreen, Gupta, and Mody (2006).

[5] This effect appears to be short lived, even in the absence of recoveries of domestic or foreign credit and investment; see Hutchison and Noy (2004); and Calvo, Izquierdo, and Talvi (2006).

[6] Ghosh *et al* (2002).

[7] Ramakrishnan and Zalduendo (2006) are an exception. Their work includes estimates of duration for episodes of "market pressures." See Section II for a discussion of how our approach is different.

financial indicators at the dusk of these crises, including balance sheet characteristics and persistent vulnerabilities. There is also little systematic evidence on the factors that influence the duration of crises. A better understanding of these aspects could inform the design of crisis resolution policies and financing options.

Against this background, this paper seeks to provide a systematic account of how recent capital account crises came to an end. Using a data set covering crisis episodes starting with Turkey and Mexico in 1994, and ending with Uruguay's crisis in 2002, the paper attempts to answer the following questions:

- How can the duration of a capital account crisis be measured, and what marks the beginning and the end of a crisis?
- What has been the duration of capital account crises?
- Is there a relationship between the complexity of a crisis and its duration?
- How do macroeconomic variables—in both flow and balance sheet dimensions—evolve during capital account crises, and where do they settle at the dusk of crises?
- What factors affect the speed of crisis resolution? To what extent do these reflect initial conditions, exogenous factors ("good luck"), or adjustment policies? And what is the impact of IMF financial support?

The paper is organized as follows. Section II introduces a new methodology for measuring the duration of capital account crises and discusses key findings for the episodes in our sample. Section III distils stylized facts on economic and financial conditions at the end of crises, relating them to the beginning and peak of crisis episodes. Section IV provides an econometric analysis of the probability of exiting a crisis, using a duration analysis methodology. Section V concludes.

II. Measuring the Duration of Capital Account Crises

A. Conceptual Challenge of Defining the End of Crises

While there are established methods to identify the start of capital account crises, timing the end of a crisis is more complicated.[8] At the beginning of a crisis, key indicators (such as spreads on sovereign bonds, international reserves, and the exchange rate) tend to move sharply and in a highly correlated fashion (Box 1). In contrast, at the tail end of a crisis, these indicators often do not move together and may even give conflicting signals.

[8] The literature on crisis identification has typically focused on the beginning of crises, with little systematic attention to their end. The methods used in this literature can be broadly divided in two groups: those relying solely on capital flow patterns (in particular sudden stops), and those relying on a broader range of indicators.

Box 1. Methods for Identifying the Beginning of Crises

Many studies have relied on the evolution of capital flows to identify capital account crises.

- Following Calvo (1998), one class of crisis measures aims to capture *sudden stops* by applying numerical rules to the *first and second moments of the capital flow time series*. Calvo (2005); Frankel and Cavallo (2004); and Eichengreen, Gupta, and Mody (2006), among others, assume that a country has experienced a sudden stop when the financial account balance in percent of GDP falls below its mean by a certain amount, typically one or two standard deviations. Calvo, Izquierdo, and Mejia (2004) look at the first and second moments of *changes in capital flows* and therefore rely on the volatility of these flows to identify crises.

- Chamon, Manasse, and Prati (2006) also employ measures that rely on capital flows, but validate and revise their crisis identification based on the subjective inputs of the IMF's country desks. They consider validation important because numerical rules occasionally identify capital flow reversals that have noncrisis explanations.

These methods are not without shortcomings. Exclusive reliance on the behavior of capital flows may result in a "delayed" identification of the beginning of a crisis in countries with significant capital account restrictions. Indeed, large capital outflows sometimes lag behind developments in other relevant indicators. Malaysia is a case in point. Following the gradual easing of capital controls in the aftermath of the Asian crisis, sizeable private capital outflows took place in an environment of low sovereign bond spreads, mildly appreciating nominal effective exchange rate, and (relatively) stable international reserves. With these shortcomings in mind, some of the studies mentioned above have used different thresholds to signal the beginning and end of a crisis, or focused on output behavior as a complementary crisis indicator.

Arguing that no single indicator can capture the complexity of capital account crises, other studies have used "market pressure" indices to identify crises. As financial crises are often preceded by overvalued exchange rates, low international reserves, high external debt, and rapid credit growth, these indicators are routinely used for assessing countries' vulnerabilities to crises.

- Hawkins and Klaus (2000) provide a survey of various indices developed for measuring financial market pressures and vulnerabilities in emerging market economies. They argue that vulnerability indicators—such as the current account deficit, external debt, and international reserves—are satisfactory predictors of crises, but cannot explain by themselves the severity of crises.

- Ramakrishnan and Zalduendo (2006) draw on the literature on "market pressure" and apply an index—combining the real effective exchange rate, international reserves, and spreads on sovereign bonds—to identify episodes of intense pressures that underpin a capital account crisis. Their index is the unweighted sum of percentage changes of these variables and thus summarizes developments in the first derivative of each variable. By design, the index will resume "normal" values as its constituent variables pass their inflection points, even though the levels of the variables may still be in disequilibirum. Using this index, the authors identify as capital account crises those episodes of intense market pressures that are accompanied by large net private capital outflows.

A market pressure index is likely to perform better at signaling the outbreak of a capital account crisis than individual indicators: its components may capture the build up of pressures reflecting heightened vulnerabilities and a weakening balance of payments. For instance, exchange rate pressures may appear before capital outflows become large, thus providing an early warning of the beginning of a crisis. Similarly, concerns about the sustainability of public finances may cause spreads on sovereign bonds to widen in advance of a capital flow reversal.

What constitutes the endpoint of a crisis needs therefore further examination. The following aspects may be considered:[9]

- *Stabilization of pressure indicators*. Given that sudden strong pressure on the exchange rate, reserves, and spreads marks the beginning of financial distress, the end of a crisis could be called when such pressure subsides and these variables stabilize. However, this may be an inaccurate call, because the new levels of these variables may not be sustainable. Indeed, stabilization may merely mean that the crisis is no longer deepening, rather than that it is over—e.g., large scale capital outflows may continue.

- *Resumption of capital inflows*. Since a sudden stop or an abrupt outflow of capital is the defining characteristic of a capital account crisis, it may be attractive to use the resumption of capital inflows to pinpoint the end of the crisis. In practice, there are two problems with this approach. First, changes in the economy triggered by the crisis may induce different patterns of capital flows, so that inflows need not resume (as in the Asian crisis, or in the case of "carry trade"). Second, where capital inflows do resume, they need not be accompanied by a simultaneous reduction of spreads to sustainable levels, for instance, in cases of equity inflows.

- *Return of spreads to "normal" levels*. A measure of investor sentiment generally available on a continuous basis is the secondary market spread on sovereign bonds. Since a sharp increase in spreads is closely associated with financial distress, a return to "normal" values could signal that the crisis is over. However, spreads often remain at high levels—compared to the pre-crisis period—for quite some time after a crisis. This may be due to two reasons. First, amid the uncertainty prevailing in the aftermath of a crisis, investors may demand higher premia until there is a credible policy response and corrective measures take hold. Second, when a crisis is the result of contagion, spreads may be affected by a general change in sentiment vis-à-vis emerging markets. In all, while a reduction in spreads indicates subsiding pressures, identifying a specific level that would signal the end of a crisis is rather arbitrary.

- *Resumption of market access*. The time of market reaccess could be another convenient point to mark the end of a crisis. Restoration of market access, however, is a rather fluid concept since reaccess could take place at prohibitively expensive terms. More importantly, market access cannot be observed on a continuous basis, but only when a country decides (or attempts) to issue new debt. Therefore, market reaccess might lag the actual end of the crisis. For example, the Indonesian Government did not tap international capital markets during the six years it received IMF financing following the onset of the Asian crisis.

[9] Since capital account crises are fundamentally an external financial phenomenon, we focus on external and financial variables to determine their duration. While capital account crises often have various real and structural spillovers (such as output losses, or the need to restructure the domestic banking system), these may be considered consequences of the crisis, which may persist beyond the crisis episode itself.

- *End of reliance on exceptional financing*. While capital account crises have often involved multilateral (and bilateral) emergency financing—indeed, the majority of crisis episodes studied in this paper had Fund-supported programs following the outbreak of the crisis—the duration of such financing is generally not a good measure for the length of a crisis. The duration of Fund financing is determined by the maturities of the facilities used, and by political and cost considerations affecting the timing of repayment.

In sum, while informative, none of the above indicators seems to provide a satisfactory unique measure to determine the end of a crisis. A hybrid approach that combines the information of several indicators may therefore need to be explored. A composite measure, such as a "market pressure index," could perform better than a single indicator in identifying the end of crises. Such a measure could also be used to time the start of the crisis and therefore its duration.

B. An Index to Measure Crisis Duration

Our starting point for measuring crisis duration is the "market pressure index" constructed by Ramakrishnan and Zalduendo (2006). Their methodology is modified in two important respects. First, given the focus on capital account crises—not just episodes of market pressures—capital flows are added as a component of the index. Second, in order to identify the end of crises, we rely primarily on the *levels* of the components, where Ramakrishnan and Zalduendo focused on *changes.*[10]

The resulting Index of Capital Account Crises (IKAC) is constructed on the basis of quarterly data on foreign exchange reserves (FX), the nominal effective exchange rate (NEER), secondary market spreads on sovereign bonds (S), and net private capital flows scaled as a ratio to GDP (K):[11]

$$IKAC_{i,t} = -(FX_{i,t} - FX_{i,t}^{trend}) - \ln(NEER_{i,t} / NEER_{i,t-1}) + S_{i,t} - K_{i,t} \qquad (1)$$

Each of the four terms included in the index is standardized—that is, its mean is set equal to zero and its standard deviation equal to one. The variables enter the index so that positive values denote financial pressure.

The index is designed to account for deviations from "normal levels" of the various components. Specifically, the index associates the end of a crisis episode with spreads and capital flows (both in levels) returning to the country-specific sample mean, and with foreign exchange reserves (in millions of U.S.$) approaching their long-run trend. The nominal

[10] While changes in financial variables are informative of a crisis, using them to identify its end would risk a premature call when variables stabilize (temporarily) at levels that do not reflect a sustainable equilibrium.

[11] Foreign exchange reserves are net of IMF disbursements. Following Ramakrishnan and Zalduendo (2006), net private capital flows are computed based on the WEO definition of private capital flows applied to quarterly IFS data, excluding FDI but including errors and omissions.

effective exchange rate enters the index in percentage changes, thereby relating the stabilization of the exchange rate to the end of the crisis. This reflects the observation that the exchange rate often tends to stabilize at a new (more depreciated) level, typically after overshooting the new equilibrium.

Our measure of crisis duration is based on the IKAC index. The start of a crisis is identified as the first of two consecutive quarters in which the value of the index is positive.[12] The zero threshold yields starting dates that broadly agree with the assessments in Fund staff documents (Tables 1 and 2). Symmetrically, the end of a crisis is identified as the first of two consecutive quarters in which the value of the index is negative. In most instances, this criterion is sufficient to distinguish episodes of persistent departures from normal levels from large but short-lived, noncrisis-related movements. In a few cases, however, the two-quarter criterion was discretely overridden.[13]

In order to focus on known episodes of capital account crises, the sample considered was limited to 12 emerging market economies commonly cited in the literature on recent capital account crises: Argentina, Brazil, Ecuador, Indonesia, Korea, Malaysia, Mexico, Philippines, Russia, Thailand, Turkey, and Uruguay. Box 2 illustrates the application of the index in greater detail.

Our method is not without drawbacks. The key limitation is that, because of the relatively small quarterly sample size for each country, the four components of the index are standardized over the entire sample of available observations. As a result, the benchmark for "normality" includes crisis observations, which may introduce some bias.[14] This problem is partially mitigated by calibrating the threshold that signals the start and end of crises at the zero value—by choosing this value so as to yield plausible dates (based on a comparison with IMF staff reports), we effectively correct for the bias in the sample mean.

[12] The mean of the index is zero by construction, since each component of the index has zero mean.

[13] The two-quarter exit criterion was discretely overridden in Brazil's 1998 and Philippines' 2002 crises, where small but persistent positive index values followed a clear one-quarter drop into the negative territory.

[14] A solution to this problem might have been the use of pre-crisis observations only; lack of sufficiently long pre-crisis series for some countries prevented this correction. In addition, changes in the economy induced by a crisis could cast doubts on the plausibility of an exit criterion relying only on pre-crisis observations.

Table 1: Timeline of Recent Capital Account Crises

Country	Crisis beginning 1/	Crisis end 2/								
		Index 3/	Capital outflow 4/	Spreads 5/	Reserves 6/	Exchange rate 7/	Market access 8/	Exceptional financing (excluding IMF) 9/	IMF financing 10/	IMF staff assessment 11/
Argentina	Q1, 1995	Q4, 1995	Q3, 1995	Q1, 1996	Q4, 1995	Q3, 1995	Q3, 1995	Q2, 1996	Q4, 1997	Q4, 1995 - Q1, 1996
Argentina	Q3, 2001	Q4, 2004	Q2, 2004	not returned	not returned	Q4, 2002	Q1, 2005/Q2, 2005	ongoing	Q2, 2004	Q4, 2003 - Q1, 2004
Brazil	Q3, 1998	Q1, 2000	Q2, 1999	Q1, 1999	not returned	Q1, 2000	Q2, 1999	Q3, 1999	Q1, 2000	Q2, 1999 - Q3, 1999
Brazil	Q2, 2002	Q2, 2003	Q1, 2004	Q4, 2003	Q1, 2003	Q1, 2003	Q2, 2003	no exc. fin.	Q4, 2003	Q3, 2003 - Q4, 2003
Ecuador	Q1, 1999	Q4, 2001	Q4, 2000	Q4, 2003	not returned	Q2, 2000	Q3, 2000/Q4, 2005	ongoing	Q4, 2003	Q4, 2000 - Q1, 2001
Indonesia	Q4, 1997	Q2, 1999	Q4, 1998	Q4, 1998	Q4, 1998	Q2, 1999	Q1, 2004	no exc. fin.	Q1, 2004	Q4, 1998 - Q2, 1999
Korea	Q4, 1997	Q1, 2000	Q1, 1999	Q1, 1998	Q2, 1998	Q2, 1998	Q2, 2003	no exc. fin.	Q3, 1999	Q4, 1998 - Q1, 1999
Malaysia	Q3, 1997	Q1, 2000	Q2, 1998	Q3, 1998	Q1, 1999	Q4, 1998	Q2, 1999	no exc. fin.	no program	Q2, 1999 - Q4, 1999
Mexico	Q4, 1994	Q1, 1997	Q3, 1996	Q1, 1997	Q3, 1997	Q1, 1997	Q3, 1995/Q3, 1995	Q1, 1998	Q1, 1996	Q4, 1995 - Q2, 1996
Philippines	Q3, 1997	Q1, 1999	Q2, 1999	Q2, 1998	Q1, 1999	Q4, 1998	Q2, 1998	ongoing	Q4, 1999	Q1, 1999 - Q2, 1999
Philippines	Q2, 2000	Q4, 2001	Q2, 2001	not returned	Q4, 2001	Q4, 2001	Q2, 2001	ongoing	Q4, 2000	Q1, 2001 - Q2, 2001
Philippines	Q3, 2002	Q2, 2003	Q2, 2003	not returned	not returned	Q2, 2004	no access loss	ongoing	no program	Q1, 2003 - Q2, 2003
Russia	Q3, 1998	Q2, 2001	Q2, 1999	Q2, 2001	Q2, 2000	Q2, 1999	Q1, 2000/Q3, 2000	Q1, 2003	Q4, 1999	Q2, 1999 - Q3, 1999
Thailand	Q3, 1997	Q4, 2001	Q1, 2001	Q1, 1998	Q3, 2002	Q2, 1998	Q4, 2001	Q3, 2002	Q3, 1999	Q1, 2001 - Q2, 2001
Turkey	Q1, 1994	Q1, 1995	Q3, 1994	...	Q3, 1994	...	Q2, 1995	no exc. fin.	Q4, 1995	Q1, 1995 - Q2, 1995
Turkey	Q3, 1998	Q1, 1999	Q1, 1999	Q3, 1998	Q3, 1999	Q4, 1999	no access loss	no exc. fin.	no program	Q4, 1998
Turkey	Q4, 2000	Q2, 2003	Q4, 2002	Q4, 2003	Q3, 2002	Q2, 2003	no access loss	Q1, 2001	ongoing	Q2, 2003 - Q3, 2003
Uruguay	Q2, 2002	Q3, 2003	Q4, 2002	not returned	not returned	Q2, 2004	Q2, 2003/Q4, 2003	ongoing	Q3, 2006	Q3, 2003 - Q4, 2003

Source: IMF staff calculations and assessments.

1/ First crisis quarter as determined by the index.

2/ Exit quarter from the crisis.

3/ Based on a combined index (IKAC) of capital flows, spreads, reserves, and nominal effective exchange rate.

4/ Corresponds to the first quarter in which standardized capital outflows are nonnegative.

5/ Corresponds to the first quarter in which the risk premium over EMBIG returns to within 50 bps of the four-quarter average before the crisis. For Argentina (1995) and Mexico (1994), this criterion is applied to the country spreads rather than risk premium due to data availability.

6/ Corresponds to the first quarter in which reserves (net of IMF) return to the four-quarter average before the crisis.

7/ Corresponds to the first quarter of the period with two consecutive quarters recording nonnegative percentage changes in NEER.

8/ Corresponds to the quarter of the first primary issuance of international government bonds after the beginning of the crisis. In cases with two dates, the first date corresponds to issuance associated with debt restructuring.

9/ Corresponds to the first quarter of a period of four consecutive quarters in which gross exceptional financing (sum of debt rescheduling and arrears) falls below 0.25 percent of GDP. The term "ongoing" reflects reliance on exceptional financing at the end of the sample considered (Q4, 2004).

10/ Corresponds to the first quarter of the period with four consecutive quarters without IMF disbursements.

11/ The dates of the end of a crisis are inferred from the analysis of Fund staff documents.

Table 2: Duration of Recent Capital Account Crises

Country	Crisis beginning 1/	Crisis end 2/								
		Index 3/	Capital outflow 4/	Spreads 5/	Reserves 6/	Exchange rate 7/	Market access 8/	Exceptional financing (excluding IMF) 9/	IMF financing 10/	Staff assessment 11/
Argentina	Q1, 1995	4	3	5	4	3	3	6	12	4-5
Argentina	Q3, 2001	14	12	not returned	not returned	6	16	ongoing	12	10-11
Brazil	Q3, 1998	7	4	3	not returned	7	4	5	7	4-5
Brazil	Q2, 2002	5	8	7	4	4	5	no exc. fin.	7	6-7
Ecuador	Q1, 1999	12	8	20	not returned	6	28	ongoing	20	8-9
Indonesia	Q4, 1997	7	5	5	5	7	26	no exc. fin.	26	5-7
Korea	Q4, 1997	10	6	2	3	3	23	no exc. fin.	8	5-6
Malaysia	Q3, 1997	11	4	5	7	6	8	no exc. fin.	no program	8-10
Mexico	Q4, 1994	10	8	10	12	10	4	14	6	5-7
Philippines	Q4, 1997	7	8	4	7	6	4	ongoing	10	7-8
Philippines	Q2, 2000	7	5	not returned	7	7	5	ongoing	3	4-5
Philippines	Q3, 2002	4	4	not returned	not returned	8	no access loss	ongoing	no program	3-4
Russia	Q3, 1998	12	4	12	8	4	9	19	6	4-5
Thailand	Q3, 1997	18	11	3	21	4	18	21	9	15-16
Turkey	Q1, 1994	5	3	...	3	...	6	no exc. fin.	8	5-6
Turkey	Q3, 1998	3	3	0	5	6	no access loss	no exc. fin.	no program	2
Turkey	Q4, 2000	11	9	13	8	11	no access loss	2	ongoing	11-12
Uruguay	Q2, 2002	6	3	not returned	not returned	9	7	ongoing	18	6-7
Mean:		**8.5**	**6.0**	**6.8**	**7.2**	**6.3**	**11.1**	**11.2**	**10.9**	**6.2-7.3**
Median:		**7.0**	**5.0**	**5.0**	**7.0**	**6.0**	**7.0**	**10.0**	**8.5**	**5.0-7.0**

Source: IMF staff calculations and assessments.

1/ First crisis quarter as determined by the index.

2/ Includes exit quarter from the crisis. Means and medians are computed exclusively over the samples of crises with well-defined durations.

3/ Based on a combined index (IKAC) of capital flows, spreads, reserves, and nominal effective exchange rate.

4/ Corresponds to the first quarter in which standardized capital outflows are nonnegative.

5/ Corresponds to the first quarter in which the risk premium over EMBIG returns to within 50 bps of the four-quarter average before the crisis. For Argentina (1995) and Mexico (1994), this criterion is applied to the country spreads rather than risk premium due to data availability.

6/ Corresponds to the first quarter in which reserves (net of IMF) return to the four-quarter average before the crisis.

7/ Corresponds to the first quarter of the period with two consecutive quarters recording nonnegative percentage changes in NEER.

8/ Corresponds to the quarter of the first primary issuance of international government bonds after the beginning of the crisis, excluding issues associated with debt rescheduling.

9/ Corresponds to the first quarter of a period of four consecutive quarters in which gross exceptional financing (sum of debt rescheduling and arrears) falls below 0.25 percent of GDP. The term "ongoing" indicates reliance on exceptional financing at the end of the sample considered (Q4, 2004).

10/ Corresponds to the first quarter of the period with four consecutive quarters without IMF disbursements.

11/ Refers to the dates of the end of a crisis that are inferred from the analysis of Fund staff documents.

Box 2. Application of the Index: One Example and Two Special Cases

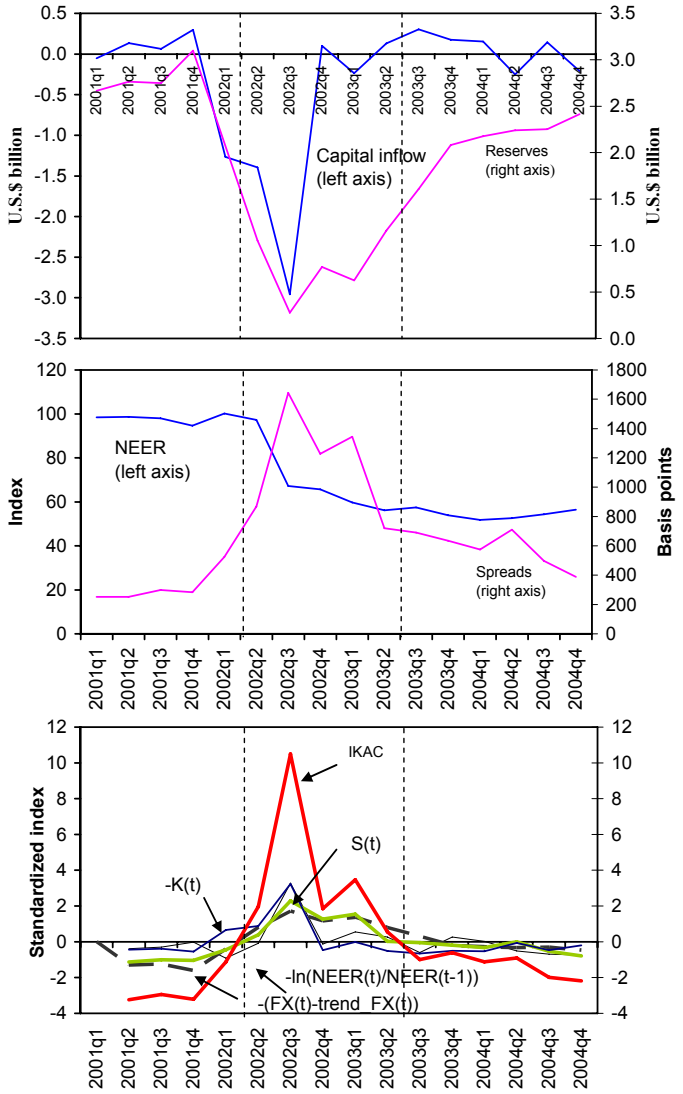
To illustrate how the IKAC index identifies the beginning and end of crises, let us first consider the case of **Uruguay** as an example of a "typical" capital account crisis.

At the start of the crisis, capital outflows picked up sharply, inducing large reserve losses and increases in spreads. Pressure on external reserves led to a change in the exchange rate regime, followed by a sharp depreciation. Together, these developments caused the index to rise significantly above its sample mean.

In subsequent quarters, most variables recovered, albeit at a different speed. The exception was the exchange rate, which stabilized at a lower level, without mean-reversion. Capital flows recovered relatively quickly, returning to their mean by the third quarter of the crisis. But spreads and reserves recovered more slowly, keeping the index above its mean for two more quarters. In all, weighing the information from all four variables, the index calls the end of the crisis in the sixth quarter.

Let us now consider two outlier cases. While the index methodology tends to yield crisis durations that are close to staff assessments, in some cases, the outcomes may surprise. This is most apparent in the crisis durations for Thailand and Korea, both somewhat longer than usually assumed.

Box Figure 1. Application of the IKAC to Uruguay's Crisis, Q2/02-Q3/03



Source: IMF staff calculations.

In the case of **Thailand**, the longer duration reflects the fact that it took five years to stem capital outflows, and even longer before reserves were rebuilt. Thus, even though spreads had broadly normalized after some 2½ years, the index calls the end of the crisis after 18 quarters, instead of the 15–16 quarters implied by staff assessments.

As for **Korea**, the crisis duration of 10 quarters resulting from the index (compared with a 5–6 quarter assessment by staff at the time) is in some ways arbitrary, but follows from a consistent application of the index methodology. In this case, the IKAC index comes very close to the zero threshold, signaling the end of the crisis, after six quarters, but it then bounces back on account of volatile spreads and small but persistent capital outflows. Eventually, it crosses the mean only in the 10th quarter after the start of the crisis.

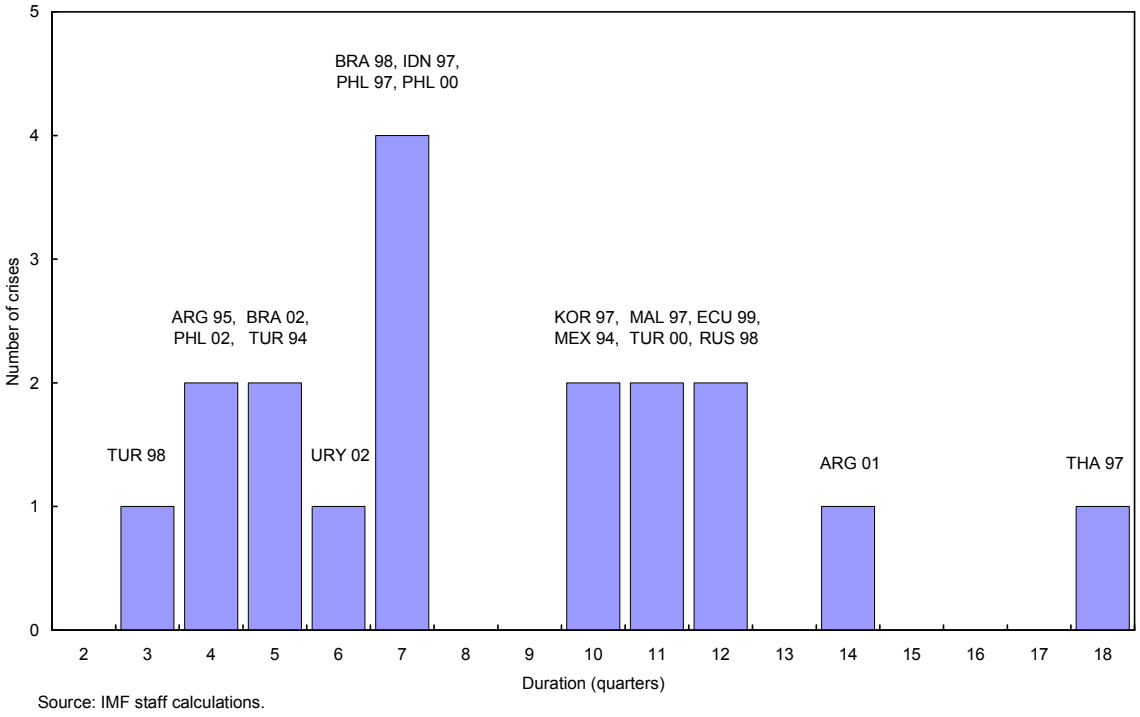
C. Stylized Facts

The application of the index methodology to data for the 12 emerging market economies recognized as having experienced capital account crises yields 18 crisis episodes, and highlights the following points.

- *Crisis duration varies quite widely across crisis episodes*. This likely reflects differences in underlying vulnerabilities, external environment, and policy response. The estimated crisis duration ranges from three quarters in the 1998 Turkey crisis episode to 18 quarters in the 1997 Thailand crisis (Figure 1).[15]

- *The average and median duration of a capital account crisis are about 8½ quarters and seven quarters, respectively*, with 16 out of 18 crises in the sample lasting less than 12 quarters (Tables 1 and 2).

Figure 1. Frequency Distribution of the Crisis Duration



Source: IMF staff calculations.

[15] On the long end, the duration of Thailand's 1997 crisis was exceptional. Prolonged political uncertainties, mismanagement of the exchange rate, and long and difficult restructuring processes in the corporate and banking sectors resulted in protracted capital outflows and slow rebuilding of reserves. The duration of Argentina's most recent crisis (14 quarters) also stands out. In this case, key factors were the interplay of deep problems in the external, banking, and government sectors, and the largest, and arguably most complicated, sovereign default in history. On the short end, Turkey's 1998 bout of sharp capital outflows, which was triggered by the crisis in Russia, was remarkably short lived, owing to the fact that major distress in the balance

(continued…)

- *Not surprisingly, duration tends to increase as the nature of crises becomes more complex*. Such complexity arises mainly because balance sheet interlinkages can quickly transmit problems originating in one sector of the economy to others. Simultaneous or subsequent distress in several sectors is commonly referred to as either "twin" crises (typically, balance of payments-cum-banking crises) or "triple" crises (where a country faces currency, banking, and sovereign debt distress).

- *Quite telling by itself, 15 out of 18 crises in our sample, involved twin or triple crises* (Table 3). Virtually all triple and half of the twin crises in our sample had longer-than-median duration. All three "single" crises were shorter than the median duration.

Table 3. Duration and Nature of Crises 1/

Duration	Type of Crisis		
	Single	Twin	Triple
		(*number of cases*)	
≥ Median	0	3	8
< Median	3	3	1
	Turkey 1998 (..) 2/ Philippines 2000 (B) Philippines 2002 (B)	Turkey 1994 (C, B) Argentina 1995 (D, B) Malaysia 1997 (C, B) Philippines 1997 (C, B) Thailand 1997 (C, B) Brazil 2002 (C, D)	Mexico 1994 (C, D, B) Indonesia 1997 (C, D, B) Korea 1997 (C, D, B) Brazil 1998 (C, D, B) Russia 1998 (C, D, B) Ecuador 1999 (C, D, B) Turkey 2001 (C, D, B) Argentina 2001 (C, D, B) Uruguay 2002 (C, D, B)

Source: Staff calculations and assessments.

1/ C: currency crisis; D: debt crisis; and B: banking crisis. Classifications are based on listings by Kaminsky and Reinhart (1999) for twin crises; Kaminsky (2003) for currency crises; Demirguc-Kunt and Detragiache (2005) and Caprio and Klingebiel (2003) for banking crises; and Manasse and others (2003) for sovereign debt crises, complemented with staff assessments for the most recent crisis episodes.

2/ In 1998, Turkey experienced large capital outflows, triggered by the Russian crisis. These outflows were not accompanied by currency, banking, or debt distress in Turkey at that time.

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of payments, the banking sector, or the government's debt profile could be avoided during this contagion episode. Such deeper problems, however, emerged prominently in Turkey's subsequent crisis in 2000.

The crisis duration estimates based on the IKAC index are broadly consistent with IMF country teams' assessments.[16] While staff reports often cautiously abstain from declaring the end of a crisis episode, staff assessments and the analysis of economic and financial developments are used to construct a narrow range of dates that would be consistent with the country team's views on the exit from the crisis. Both the upper range of the staff assessment and our index result in seven quarters as the median duration of the capital account crisis episodes in our sample. The correlation between the two measures exceeds 0.8.

D. Sensitivity Analysis

To test the robustness of the crisis duration estimates, we consider alternative measures for the end of a capital account crisis (Tables 1 and 2). These measures rely on transformations of the components of our index, as well as on indicators of broader balance of payments viability, including countries' reaccess to international capital markets, the duration of exceptional financing, and timing of IMF disbursements.[17] The exercises provide further insights:

- *While exit patterns differ significantly across crises, some indicators tend to recover before others*. Large capital outflows tend to subside first, followed by a reduction in risk premia on sovereign bonds, and a recovery of foreign exchange reserves to pre-crisis levels (Figure 2).[18] However, in several instances both spreads and foreign exchange reserves did not recover to pre-crisis levels within the sample period, likely reflecting shifts in the exchange rate regime and persistent changes in investors' assessment of country risk.

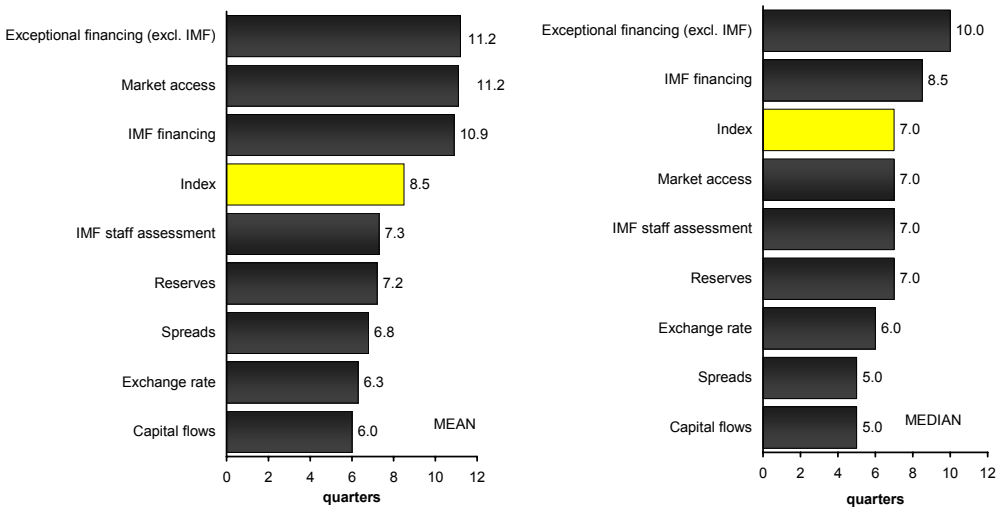
- *Broader balance of payments viability is restored only with a substantial lag*, with graduation from IMF financing generally associated with reaccess to international capital markets. Balance of payments dependence on exceptional financing—defined to include debt rescheduling and the incurrence of sizeable external arrears—tends to be more prolonged.

[16] A notable exception is the 1998 Russian crisis, where the IKAC-based duration estimate exceeds the assessment made by IMF staff by 7–8 quarters.

[17] See the footnotes to Tables 1 and 2 for the definitions of the alternative measures.

[18] The mean and median durations defined by the alternative measures should be interpreted with caution because statistics are computed on a different number of observations owing to "open ended" cases, where the end point of the indicator is not defined within the sample (for example, when spreads and reserves failed to recover to their pre-crisis levels or when there was no obvious loss of market access). The mean (or median) crisis durations derived from the individual components of the IKAC index do not conform to the mean (or median) of the index because the latter is based on standardized values.

Figure 2. Alternative Measures of Crisis Duration



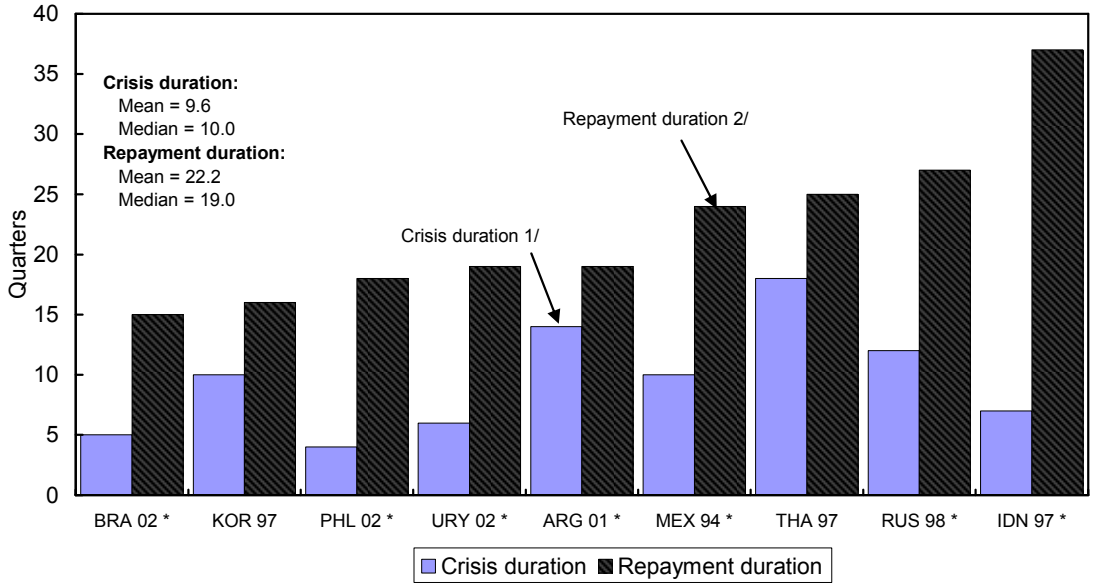
Source: IMF Staff calculations.

- *There is a weak link between exit from capital account crises and repayment of outstanding IMF credit*. Repayment depends on modalities of IMF financing and sometimes on "prepayment" decisions based on political considerations and global liquidity conditions. Nine out of the 12 countries in the sample have fully repaid IMF credit (Figure 3).

- For those countries that have repaid IMF credit, *the average repayment period was about 22 quarters after the beginning of the crisis (or 13 quarters after the end of the crisis)*. Individual country experiences vary widely, with Argentina fully repaying its outstanding credit to the Fund five quarters after exiting from the 2001 crisis, and Indonesia fully repaying 30 quarters after the end of its crisis. This pattern illustrates the limitations of using repayment as an indicator of crisis duration.

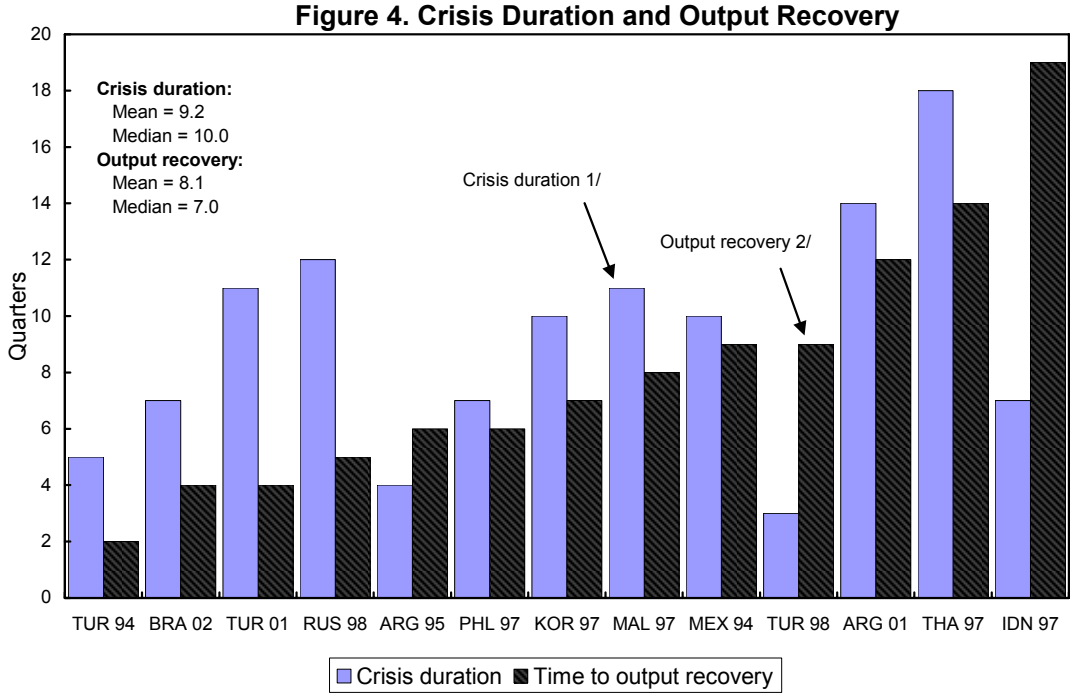
- *Following capital account crises, the real economy typically recovered faster than the financial indicators included in the duration index*. In 10 out of 13 crisis episodes for which data are available, output recovered to pre-crisis levels before financial conditions had normalized (Figure 4). The relatively faster output recovery (relative to financial indicators) may be attributed in part to the sharp turnaround in current account positions. But it could also be consistent with the so-called "phoenix miracles" (Calvo and others, 2006), which are associated with the tendency for firms to finance working capital with retained earnings and by postponing investment while spare capacity and constraints to credit persist.

Figure 3. Crisis Duration and the IMF Credit Repayment Period



Note: "*" next to the crisis identifier indicates episodes of the repayment of Fund resources ahead of schedule.
1/ Crisis duration as measured by the IKAC index.
2/ Repayment duration is identified as the number of quarters from the beginning of the crisis until the full repayment of the outstanding Fund credit.

Figure 4. Crisis Duration and Output Recovery



Source: IMF staff calculations.

1/ Crisis duration as measured by the IKAC index.
2/ Number of quarters before real GDP reaches the average level of the four quarters preceding the crisis.

- *Nonetheless, output took longer, on average, to recover as the nature of crises became more complex*.[19] [20] To illustrate, output recovery took 8.7 quarters on average for twin crises, and 10.7 quarters for triple crises. This is not surprising in light of the greater uncertainty about the policy response and crisis resolution in more complex cases.

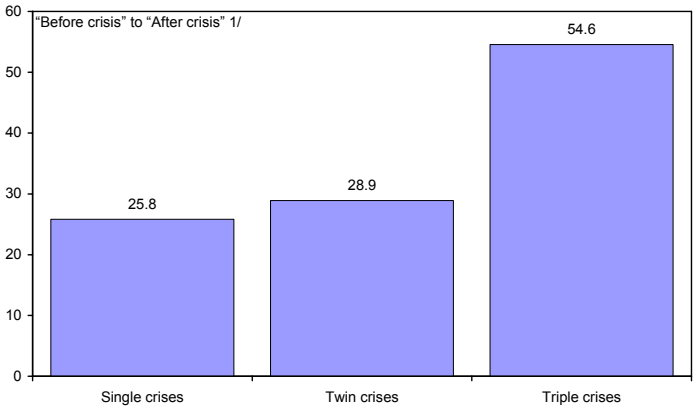
III. The Dusk and Legacy of a Capital Account Crisis

Having identified the end points of the crisis episodes in our sample, we can now examine the circumstances prevailing toward the end of these crises, an aspect that has been relatively unexplored so far. A key stylized fact is the relationship between the nature and complexity of crises and the intensity of movement of key variables. This said, the experience also underscores the diversity of capital account crises.

A. Exchange Rates and Spreads—the Nexus with the Complexity of Crises

Almost all crises were characterized by significant depreciations of the exchange rate. In many cases, strong pressures on the exchange rate and reserves forced the authorities to abandon, or loosen, existing currency peg arrangements. Without exception, currencies stabilized at considerably lower levels than those prevailing before the crisis.

Figure 5. Average NEER Depreciation
(in percent of index value "before crisis")



Source: IMF staff calculations.

1/ "Before crisis" and "After crisis" refer to an average of four quarters immediately.preceding or succeeding the crisis (if available).

Exchange rate overshooting is a typical crisis phenomenon, but the extent of currency depreciation closely correlates with crisis complexity (Figure 5). Sharp devaluations often wreak havoc in public and banking sector balance sheets, particularly in cases where liability-dollarization is significant. In such cases, a currency crisis tends to spread rapidly to the domestic banking sector, to sovereign debt, or both. At the same time, public and/or banking sector weaknesses have often been factors that triggered—or reinforced—the loss of

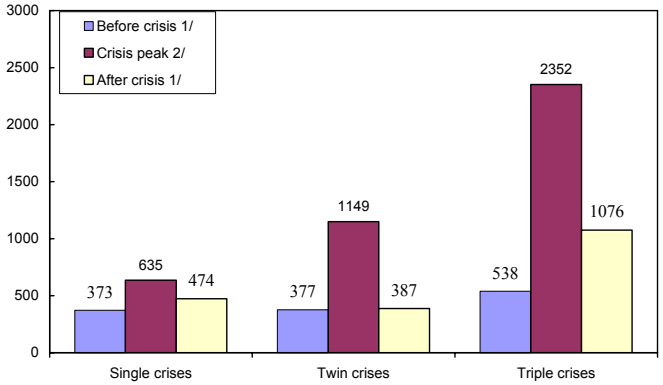
[19] There are some exceptions to this general pattern, Indonesia (1997) being the most prominent one. In Indonesia, output failed to recover until long after the financial crisis had ended, mostly owing to the protracted impact of the crisis and of political uncertainty on domestic consumer and investor confidence. This effect may have been compounded by the absence of a broad-based recovery of non-oil exports.

[20] The data show no clear relationship between the depth of output loss and the duration of crises.

confidence, forcing the exchange rate to adjust. Balance sheet problems and exchange rate developments, therefore, were intertwined and mutually reinforcing.

Secondary market spreads shot up sharply at the outset of each crisis and normally subsided gradually toward the end (Figure 6). Nonetheless, spreads often remained at elevated levels for some time after the crisis, in particular in cases involving sovereign default.[21] The size of the increase in spreads is strongly related to the complexity of crises, reflecting the market's recognition of the more difficult and damaging nature of twin and triple crises.

Figure 6. Average Secondary Market Spreads on Sovereign Bonds
(in basis points)



Source: IMF staff calculations.

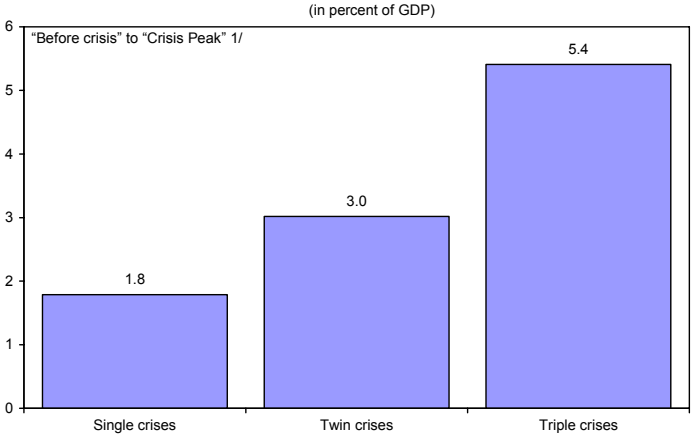
1/ Refers to an average of four quarters immediately preceding or succeeding the crisis (if available).
2/ Refers to the quarter with the highest IKAC value.

B. Flow Variables

The link between the nature of crises and their intensity is also evident in capital flows and current account and fiscal balances. This is not to say that the end game always looks the same. Indeed, there are some striking differences in cross-country experience.

Capital outflows were significantly higher during twin and triple crises (Figure 7). At the peak of crises, quarterly outflows normally ranged from around 2 percent to about 10 percent of annual GDP.[22] The pattern at the

Figure 7. Average Change in Private Net Capital Outflows
(in percent of GDP)



Source: IMF staff calculations.

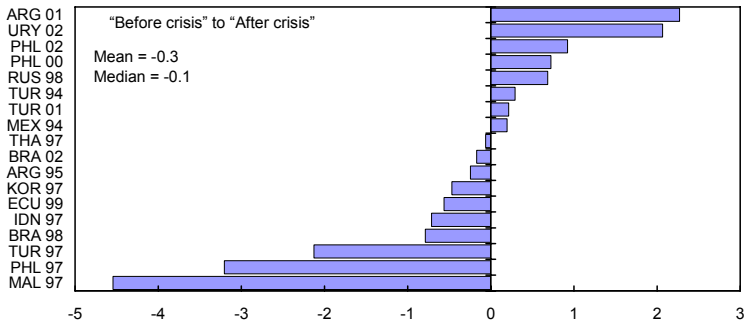
1/ "Before crisis" refers to an average of four quarters immediately preceding the crisis (if available). "Crisis peak" refers to the quarter with the highest IKAC value.

[21] This was most striking in Argentina in 2001, where spreads remained at dramatically higher levels. Brazil (2002), on the other hand, is a notable exception: here, spreads were substantially *lower* at the end of the crisis, likely reflecting the credibility of the government program.

[22] Uruguay, where capital outflows peaked at 20 percent of GDP, is an outlier in terms of intensity of outflows. The outflows were related to withdrawals of bank deposits by Argentinean residents following the crisis in Argentina.

end of crises, however, differed markedly (Figure 8). On the one hand, in most Asian countries affected by the 1997 crisis, capital flows stabilized at substantially lower levels.[23, 24] On the other hand, the countries affected by capital account crises since 2000 tended to end the crisis with higher inflows than before. This may reflect the impact of more benign global liquidity conditions in recent years.

Figure 8. Change in Private Net Capital Flows 1/
(in percent of GDP)

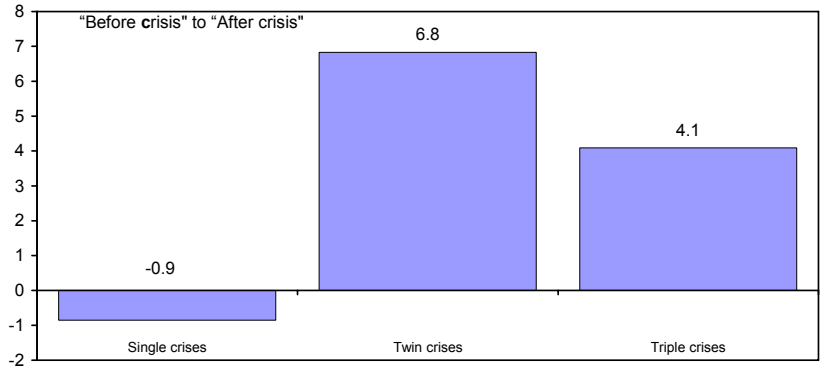


Source: IMF staff calculations.

1/ "Before crisis" and "After crisis" refer to an average of four quarters immediately preceding or succeeding the crisis (if available).

Reflecting sharp exchange rate depreciations and the intensification of financing constraints, current account balances adjusted sharply in more complex crises (Figure 9). The extent of adjustment is striking, with a median improvement of 5 percentage points of GDP.[25] The correlation between the magnitude of capital outflows and the extent of current account adjustment suggests that official financing and private sector involvement could not prevent these wrenching adjustments, often achieved by a heavy compression of imports.

Figure 9. Average Change in Current Account 1/
(in percent of GDP)



Source: IMF staff calculations.

1/ "Before crisis" and "After crisis" refer to an average of four quarters immediately preceding or succeeding the crisis (if available).

[23] In fact, consistent with sustained improvements of current account positions, capital inflows to those countries never returned to pre-crisis levels.

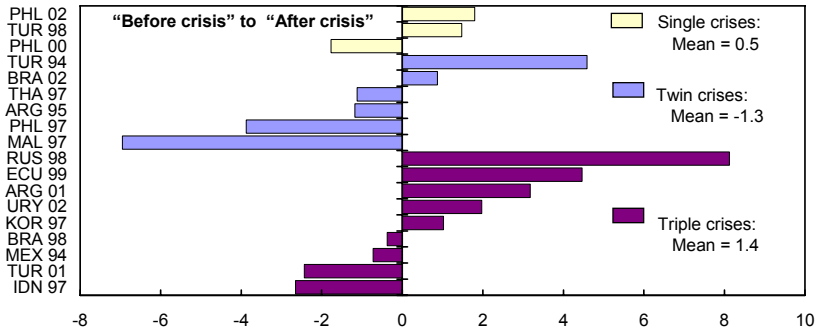
[24] In Malaysia, capital outflows even temporarily increased after the crisis, as the funds frozen at the imposition of capital controls were gradually freed.

[25] In only three cases did the external position deteriorate over the course of the crisis, two of which (Philippines 2000 and 2002) were single crisis cases.

The extent of fiscal adjustment was also positively correlated with the nature of crises. While, on average, fiscal balances improved slightly during the episodes of financial distress, this masks large differences across individual cases (Figure 10). Three groups of cases can be distinguished.

- *In the first group, the fiscal deficit deteriorated considerably during crises*. This is particularly apparent for most of the crises in Asia in 1997–98. In these crises, problems originated in the private sector, and public finances were initially relatively strong. In a setting characterized by sharp output contractions, authorities were reluctant to tighten fiscal policies, and the resolution of banking sector problems involved large fiscal costs.

Figure 10. Change in Fiscal Balance 1/
(in percent of GDP)



Source: IMF staff calculations.

1/ "Before crisis" and "After crisis" refer to an average of four quarters immediately preceding or succeeding the crisis (if available).

- *In the second group, a strong improvement in the fiscal position was achieved*. Examples are the latest crises in Argentina, Brazil, and Russia (1998) and Turkey's crises of 1994 and 1998. In these cases, concerns about fiscal sustainability were at the heart of the crisis (indeed, all involved a full-fledged sovereign liquidity or solvency crisis). Fiscal consolidation reflected efforts to address these concerns.

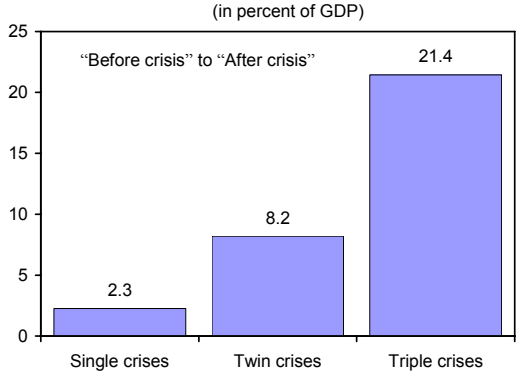
- *Yet other crises followed less intuitive patterns, reflecting country-specific factors*. These include Malaysia (1997) and Mexico (1994), where fiscal balances first improved sharply around the peak of the crisis, and then deteriorated to below pre-crisis levels.[26]

[26] The turnaround in Malaysia's fiscal position (from a sizeable surplus to deficits) was largely the result of policy measures designed to stem the decline in output by aiming for expansionary fiscal policies.

C. Stock Variables

Developments in stock variables were largely driven by the effects of exchange rate depreciation on balance sheets and by the authorities' policy response. For instance, gross external debt ratios increased considerably in almost all twin and triple crisis cases (Figure 11). These increases reflected the effect of the exchange rate depreciation on the domestic-currency value of foreign-currency denominated debt and, in some cases, the deterioration of the fiscal position and the realization of contingent liabilities in the banking system. External debt levels rose sharply, in particular, in Argentina (2001), Indonesia (1997), and Uruguay (2002), countries that also saw some of the sharpest currency depreciations. Overall, countries emerged from more complex crises with greater debt-related vulnerabilities.

Figure 11. Average Change in External Debt 1/
(in percent of GDP)

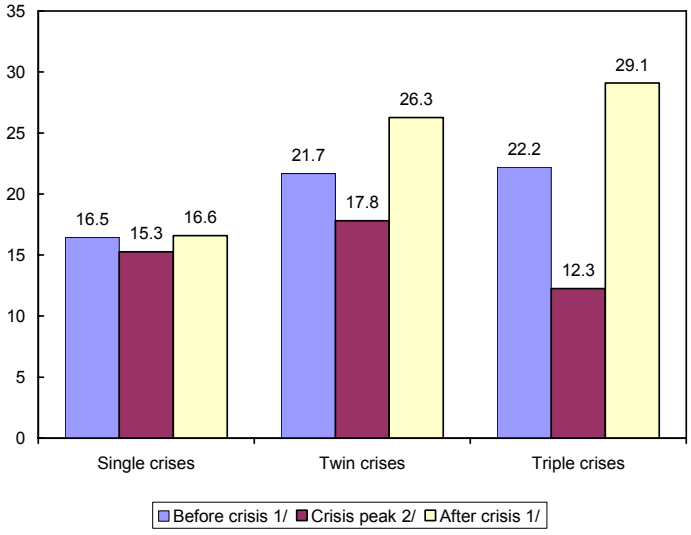


Source: IMF staff calculations.

1/ "Before crisis" and "After crisis" refer to an average of four quarters immediately preceding or succeeding the crisis (if available).

In most cases, substantial amounts of reserves were lost at the height of the crisis, typically reflecting the authorities' exchange rate defense. In the event, however, reserves were usually rebuilt quickly after the exchange rate was allowed to depreciate (Figure 12).[27] The rebuilding of reserves was stronger in more complex crises, in line with the sharp turnaround in the current account.[28]

Figure 12. Average Foreign Exchange Reserves 1/ 2/
(in U.S.$ billion)



Source: IMF staff calculations.

1/ "Before crisis" and "After crisis" refer to an average of four quarters immediately preceding or succeeding the crisis (where data are available).
2/ "Crisis peak" refers to the quarter with the highest IKAC value.

Capital account crises can also be expected to negatively affect banks' balance sheets in cases where currency mismatches are present. Indeed, in 16 out of the 18 cases in our sample, the crisis involved

[27] A notable exception is the Brazil crisis in 1998, where a sizeable current account deficit persisted throughout the crisis and reserves did not recover.

[28] To illustrate, Korea and Russia (two triple crises), where reserve accumulations were strongest, ran current account surpluses at the height of their crises of around 10 percent and 20 percent of GDP, respectively

banking sector distress. However, data limitations do not allow a systematic test of the impact of a crisis on the banking system (some partial results are presented in Appendix I).

IV. What Determines The Duration Of Capital Account Crises? A Modeling Approach

The evidence from the previous section suggests a link between complexity of crises, their duration, and the intensity of movement of key macroeconomic variables. Yet large differences in duration, even between crises of similar typology, beg the question of whether it is possible to identify more systematically the specific factors that influence crisis duration. Against this background, this section estimates a model linking the probability of exiting from crisis, once one has erupted, to a number of explanatory variables, with a view to evaluating their relative importance in explaining the persistence of crisis conditions.

A. Potential Factors Influencing the Duration of a Crisis

Conceptually, the factors expected to influence the duration of a capital account crisis can be divided into four categories.[29]

- **Initial conditions:** A country's policy record and conditions going into the crisis are likely to have a bearing on the nature, the duration, and the depth of a crisis. For instance, large external imbalances, pre-existing solvency or liquidity risks, and balance sheet vulnerabilities are likely to affect policy options and market reactions, thereby affecting the speed of crisis resolution.

- **External conditions:** The pace of restoration of market confidence and the speed of economic recovery—and thus the length of a crisis—are likely to be influenced by external factors. Prominent among these are investors' appetite for emerging market risk, global liquidity conditions, the dynamics of terms of trade, and changes in export markets.

- **Policy response:** The authorities' policy response can be expected to have a considerable impact on crisis duration, even if the interplay between certain policies and the evolution of a crisis is not always straightforward. For instance, fiscal adjustment will be essential to re-establish credibility in crises that are triggered by unsustainable fiscal positions. But it can also have adverse contractionary effects. Similarly, hikes in short-term interest rates may be critical to stem capital outflows, but can also have adverse effects on the real economy and domestic banks. And a move toward more exchange rate flexibility, unavoidable as it may be when foreign exchange reserves are running out, may have complex adverse effects on government,

[29] These categories are similar to those that may be used to examine the likelihood of entering into a crisis (see Ramakrisnan and Zalduendo (2006)). However, the considerations relevant to the probability of remaining or exiting a crisis (once the latter occurs) are quite different. See the discussion below.

corporate, and financial sector balance sheets, particularly in cases of widespread currency substitution and currency mismatches.[30]

- **IMF financial support.** The availability, extent, and timing of official financing, particularly from the Fund, may also be key to the recovery from crises driven by a sudden stop or exit of private capital. The presence of an IMF-supported program may signal the formulation of a comprehensive policy adjustment package—which could serve as a catalyst for private capital flows—and the provision of financial resources supporting the implementation of corrective measures.[31]

B. Econometric Methodology

The impact of the above explanatory factors is estimated within the framework of a *grouped duration model*—a class of duration models typically used for panel-like data.[32] Our dataset covers the 18 crisis episodes with a binary indicator that denotes the exit from crisis. The model assumes that the probability of exiting a crisis in each period (the dependent variable) is a function of two components: the time already spent in crisis (a time-dependent baseline probability, λ_0, common to all crisis episodes) and a set of time-varying and country-specific explanatory variables, X:[33] [34]

$$p[t, X(t) \mid \beta, u] = 1 - \exp[-\exp(\lambda_0(t) + X\beta + u)] \quad (2)$$

Because empirical results can be sensitive to the specific functional form of the time dependent component, three alternative specifications are used to test the robustness of results. In line with specifications commonly used in the literature, we consider both logistic and linear time-dependent functional forms, as well as a simpler specification with no time variable, implying a time-invariant baseline probability of exiting the crisis:

---

[30] Structural policies are also likely to be important in determining the duration of a capital account crisis. However, the difficulty of quantifying these policies in a consistent format limits the scope of their inclusion in our econometric analysis.

[31] IMF-supported programs were in place in 15 out of the 18 crises in the sample. There were no programs (at the time) in Malaysia (1997), Philippines (2002), and Turkey (1998).

[32] Appendix II discusses in further detail the application of duration analysis in this study.

[33] While the estimates are potentially subject to endogeneity bias (because exiting from crisis and certain policy options may be jointly determined), there is no selection bias since the sample includes only crisis observations, starting from the first quarter in crisis and ending with the exit quarter.

[34] The hazard function determining the baseline probability is assumed to depend on the number of quarters spent in crisis. By construction, the exit probability increases with time if the estimated coefficient on the time variable is positive (i.e., a capital account crisis is treated as a finite event) and decreases if it is negative.

$$\lambda_0 = \begin{cases} \alpha_0 + \alpha_1 \ln(t), \\ \alpha_0 + \alpha_1 t, \\ \alpha_0 . \end{cases} \quad (3)$$

The modeling exercise involves a general-to-specific specification search. The initial, general specification covers a range of variables capturing the complexity and lags in the effects of policy channels.

- With respect to initial conditions, the model controls for the pre-crisis levels of external debt (in percent of GDP) and short-term debt (in percent of reserves), along with their one-period lagged values, and for the pre-crisis primary fiscal balance and public debt-to-GDP ratio.[35]

- External conditions are proxied by the ratio to GDP of net private capital flows into emerging markets (as a measure of investor's appetite for emerging market countries' assets), the three-month LIBOR rate (as indicator of global liquidity conditions), and changes in the terms of trade and trade-weighted partner-countries' demand.

- In terms of policy response channels, the model includes changes in the primary fiscal balance (in percent of GDP) over a four-quarter period (contemporaneous and up to two lags), the policy interest rate differentials (vis-à-vis LIBOR) adjusted for the inflation differential with the United States (contemporaneous and up to six lags), and the exchange rate regime (based on the Fund's AREAER classification). [36]

- IMF financial support is represented by a measure of cumulative disbursements (in percent of GDP), interacting with an IMF program dummy. [37], [38]

Starting from the general model, a specification search is conducted with a view to strike a balance between parsimony and performance of the model. The reduced form specifications were obtained by a sequential elimination of the least significant variables (or equivalently

[35] Data availability prevents the inclusion of household, corporate, and banking sector balance sheet indicators.

[36] The AREAER classification ranks the various types of exchange rate regimes in eight categories, with higher values indicating a more flexible regime.

[37] Similar results are obtained when cumulative IMF financing is normalized by the level of countries' short-term external debt.

[38] The inclusion of the (contemporaneous) IMF variable in the model is likely subject to an endogeneity problem, since the extent of the Fund's financial involvement is likely to be correlated with the perceived severity of a crisis. To mitigate this problem, this variable is instrumented by the country's IMF quota, lagged debt-to-GDP ratio, lagged short-term debt-to-reserves ratio, lagged current account balance in percent of GDP, real GDP growth, and a variable capturing the time spent in crisis (log of time in crisis). Because the severity of a crisis is likely to influence the size of the IMF financial package, the value of the IKAC index (lagged two quarters) is also included as an instrument. While the estimation results are robust to the choice of lag, the second lag yields the highest likelihood value.

those with the highest p-value), which were identified on the basis of the Bayesian and Akaike information criteria.

C. Estimation Results and Robustness Tests

The estimation results for each of the model specifications are shown in Table 4. For both the logistic and linear time dependency specifications, the general-to-specific approach yields specifications (regressions 2b and 3b, respectively) that include as explanatory variables external debt (with a one-quarter lag); the pre-crisis current account balance; capital flows to emerging market countries; the three-month LIBOR rate; the change in trade-weighted partner country demand; the change in the primary balance (with a one-quarter lag); and the real interest rate differential (with two and three-quarter lags). The exchange rate variable falls just short of being significant here and is therefore not included.[39]

Some of our results are sensitive to the specification of the functional form for the time dependency component. Exclusion of the time variable from the model results in a similar specification, but with the exchange rate regime and IMF financial support variables turning highly significant (regression 4). This result likely reflects the reduction of collinearity problems associated with the inclusion of the time variable.[40] Because there are reasons to believe that changes in the exchange rate regime and IMF financing may indeed be important determinants of crisis duration, and to provide a further check for the robustness of our results, we present the models with time dependency that include these variables (regressions 2a and 3a).

With the exceptions highlighted above, the empirical findings are generally robust to alternative model specifications, yielding very similar parameter estimates and significance levels. The explanatory power of all models is reasonably good and diagnostic results for the logistic and linear time-dependency specifications provide additional comfort with respect to

[39] In the specifications with time dependency, the exchange rate regime has p-values of 0.13 and 0.17 in regressions 2a and 3a, respectively.

[40] By construction, the cumulative IMF financing variable increases with time. Similarly, a shift toward greater exchange rate flexibility (higher indices denote more flexible exchange rate regimes) is also likely to display some correlation with the time variable. These features are likely to introduce multicollinearity in specifications that include the time variable component of the hazard function.

Table 4. Estimation Results for the Capital Account Crises Duration Model

Dependent variable:	Regression 1/					
Crisis Exit = 1-crisis ended, 0-still in crisis	General specification	More parsimonious specifications				
Regression	(1)	(2a)	(2b)	(3a)	(3b)	(4)
Time dependence in baseline hazard	$\lambda_0 = \alpha_0 + \alpha_1 \ln(t)$	$\lambda_0 = \alpha_0 + \alpha_1 \ln(t)$		$\lambda_0 = \alpha_0 + \alpha_1 t$		$\lambda_0 = \alpha_0$
Baseline hazard						
Quarters in crisis (log)	2.719**	2.680***	2.501***	...	...	...
Quarters in crisis	...	...	...	0.353***	0.342***	...
Constant	-5.100	-0.171	-2.671*	1.430	-1.059	4.491**
Initial conditions						
External debt (pre-crisis) 2/	0.044	...	...	...	...	...
External debt (lag 1) 2/	-0.058	-0.051*	-0.039**	-0.049*	-0.036**	-0.042***
Short-term debt (pre-crisis) 3/	0.008*	...	...	...	...	...
Short-term debt (lag 1) 3/	-0.007	...	...	...	...	-0.012**
Current account balance (pre-crisis) 2/	0.214***	0.280***	0.239***	0.311***	0.261***	0.162**
Primary balance (pre-crisis) 2/	-0.001	...	...	...	...	...
Public debt (pre-crisis) 2/	0.025	...	...	...	...	
External conditions						
Capital flows to EM countries 4/	0.856*	0.481	0.542	0.440	0.575	...
World interest rate 5/	-0.373*	-0.636**	-0.577***	-0.594**	-0.543***	-0.510***
Terms of trade (change)	0.036	...	...	...	...	...
Trade-weighted partner country demand (change)	1.318*	0.985**	1.165***	1.282***	1.354***	1.159***
Policy response						
Change in primary balance 2/ 6/	0.035	...	...	...	...	...
Change in primary balance (lag 1) 2/ 6/	0.174**	0.092**	0.083**	0.087*	0.082*	0.096***
Change in primary balance (lag 2) 2/ 6/	-0.029	...	...	...	...	...
Real interest rate differential 7/	0.027	...	...	...	...	...
Real interest rate differential (lag 1) 7/	-0.012	...	...	...	...	...
Real interest rate differential (lag 2) 7/	-0.050	-0.035**	-0.031	-0.036**	-0.032	-0.040**
Real interest rate differential (lag 3) 7/	0.029	0.038***	0.032**	0.039***	0.035**	0.044**
Real interest rate differential (lag 4) 7/	0.035	...	...	...	...	...
Real interest rate differential (lag 5) 7/	-0.023	...	...	...	...	...
Real interest rate differential (lag 6) 7/	0.016	...	...	...	...	...
Exchange rate regime 8/	-0.370	-0.298	...	-0.277	...	-0.386**
IMF financial support						
IMF financing*program dummy 9/	0.080	0.052	...	0.075	...	0.272**
Number of observations	153	153	153	153	153	153
Log likelihood	-30.822	-34.467	-35.858	-35.693	-36.955	-40.026
Akaike Information Criterion	111.564	92.934	91.715	95.386	93.909	102.051
Bayesian Information Criterion	187.405	129.299	122.020	131.751	124.214	135.386

Source: IMF staff calculations.

Note: ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent levels of significance based on robust standard errors.

1/ Complementary log-log model with homogenous parameters across crisis episodes. Allowing for heterogeneity across crises produces almost identical parameter estimates and LR test strongly rejecting the presence of heterogeneity, assuming Gamma or normally distributions.

2/ In percent of GDP.

3/ In percent of foreign exchange reserves.

4/ Total net private capital flows to the emerging market countries expressed as a ratio to GDP in those countries.

5/ Three-month LIBOR rate.

6/ Refers to four-quarter (t/t-4) change in primary balance.

7/ Policy rate differential with the three-month LIBOR rate, adjusted for the difference between the country's inflation and U.S. inflation.

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

9/ Fitted cumulative sum of disbursed IMF financing (in percent of GDP) starting with four quarters preceding the crisis, interacting with an IMF program dummy. Fitted values were generated by a Tobit model with the following regressors: time in crisis (log), IMF country quota, lagged of IKAC values (two quarters), real GDP growth, lagged levels of debt/GDP, ST debt/FX reserves, and CAB/GDP.

the model fit (Box 3).[41] Overall, the logistic time specification provides the tightest fit to our data, as witnessed by the highest likelihood value.[42]

As for the findings of the estimated equations, *initial* and *external conditions* are found to be important in determining the duration of a crisis.[43]

- In all regressions, the relative size of the pre-crisis current account deficit—thus the extent of the initial external disequilibrium—is shown to be an important determinant. Larger deficits are associated with longer crises, possibly reflecting spillover effects of wrenching current account adjustment. Similarly, higher levels of external debt and, in the model without time dependency, short-term external debt, are strongly correlated with longer crises.

- Benign global liquidity conditions as measured by the world interest rate—the three-month LIBOR rate—and favorable developments in partner countries' demand for domestic exports are found to shorten significantly the duration of a crisis. However, investors' attitude toward risk in emerging markets—as measured by overall net capital flows to these markets—is only weakly associated with the probability of exiting from a crisis. In fact, the variable drops out of the specification without time dependency, indicating limited robustness.

The econometric results also suggest that the authorities' *policy response* has considerable bearing on the probability of exiting a crisis.

- *Fiscal policy* tightening (with a one-quarter lag) is found to shorten crisis duration in all model specifications, likely reflecting signaling and confidence effects. This finding seems to suggest that the confidence building effects of fiscal consolidation dominate any contractionary impact.

- For *monetary policy*, we find some evidence that stemming capital outflows by raising real interest rates (relative to rates elsewhere in the world) shortens crisis duration, but with a lag of three quarters. This said, the negative (albeit insignificant in some model specifications) coefficient on the real interest rate differential with a two-quarter lag implies that the overall estimated effect of monetary tightening may not be clear cut.

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[41] While it is technically difficult to use similar diagnostic tools for the model with no time variable without making arbitrary assumptions on the disbursement profile of IMF financing, the comparable likelihood value for this model also indicates significant explanatory power.

[42] This specification has the lowest Bayesian and Akaike information criteria, suggesting that it strikes the best balance between parsimony and performance among the three alternative specifications.

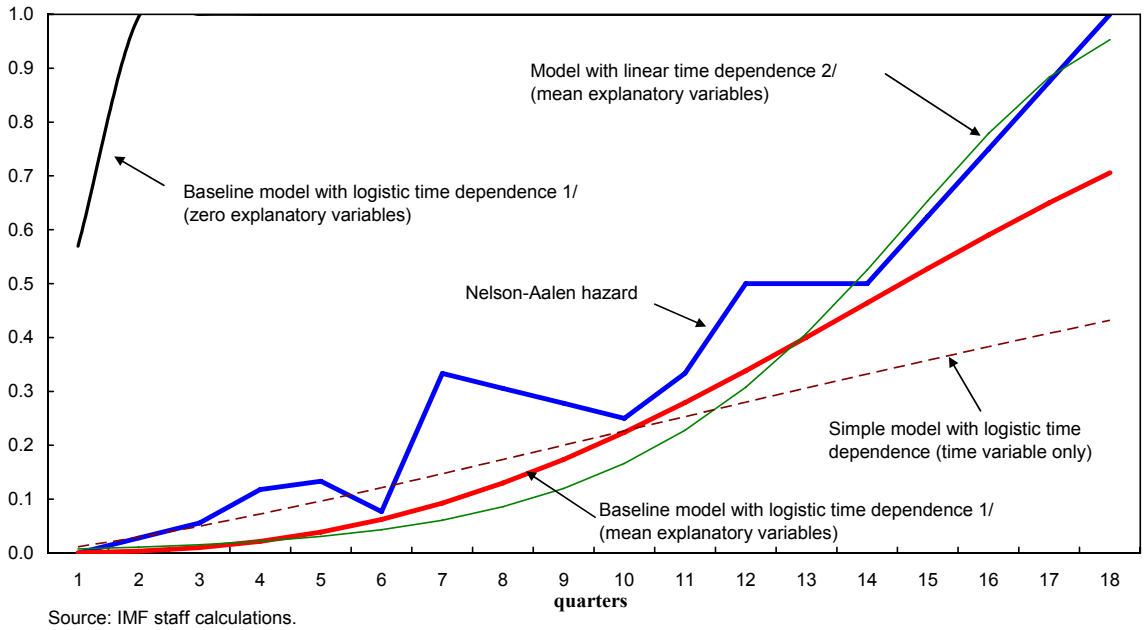
[43] Given that the dependent variable in the model is a binary indicator of the end of a crisis, a positive coefficient in the estimated regressions associates higher values of an explanatory variable with a greater probability of exiting from crisis.

Box 3. Some Further Diagnostic Results

To obtain better insight into the estimated models and evaluate the different specifications, we perform a series of diagnostic experiments (Box Figure 1).

- *The explanatory power of the model is reasonably good.* This is revealed by comparing the probability of exiting from a crisis (known in the literature as the hazard rate) predicted by our baseline model with that derived from the Nelson-Aalen estimator of cumulative hazard, an estimator that is based exclusively on the distribution of the 18 observed durations of crises (see Figure 1 in the main text). The fact that the two probability curves are quite similar provides comfort with respect to the model specification and its explanatory power.
- *The time-varying explanatory variables specified in the model are critical in determining the probability of exiting from a crisis.* This is made clear by setting the explanatory variables (e.g., initial and external conditions, policy response variables, and IMF financial support) to zero in the baseline model. This experiment results in a dramatic shift in the probability curve to the upper left, far away from the Nelson-Aalen hazard. Along the same lines, a simple duration model—estimated under the assumption that the probability of exit is influenced exclusively by the time spent in crisis—produces a virtually flat probability curve (broken line), which is inconsistent with evidence from the data.
- *The logistic specification for the time dependence component provides the best fit.* While the specification of time dependence (logistic versus linear) in the baseline hazard makes little difference for the estimated parameter values, there seems to be some difference in terms of the model's predictive power. The specification based on the logistic formulation appears to be somewhat better in predicting the probability of exiting from crises for durations less than 12 quarters. Thus, it would be the preferred specification for 16 out of 18 crises in our sample. The linear specification provides a better fit for longer crises.

Box Figure 1. Predicted Probabilities of Exit from the Crisis (Hazard Rate) for Different Models



Source: IMF staff calculations.

1/ Refers to regression (2a) reported in Table 4.
2/ Refers to regression (3a) reported in Table 4.

- The *exchange rate regime* variable enters the regressions with a negative sign, implying that a shift toward a more flexible exchange rate in the midst of a crisis tends to prolong the crisis. While floating the exchange rate helps to reduce external imbalances, a deterioration in public and private sector balance sheets appears to outweigh this positive effect.[44] Although the depletion of foreign reserves amid intense market pressures often leave policymakers little choice, floating the exchange rate in the midst of a crisis may indeed result in sharp overshooting, and wreak havoc in sectoral balance sheets, thereby deepening the crisis.

- In all specifications, the positive sign of the coefficient of *IMF financial support* implies that the probability of exiting from a crisis increases with larger (cumulative) financing packages. However, this result is not robust across different specifications, being statistically significant only in the time-invariant specification for the baseline hazard.

D. Counterfactual Experiments

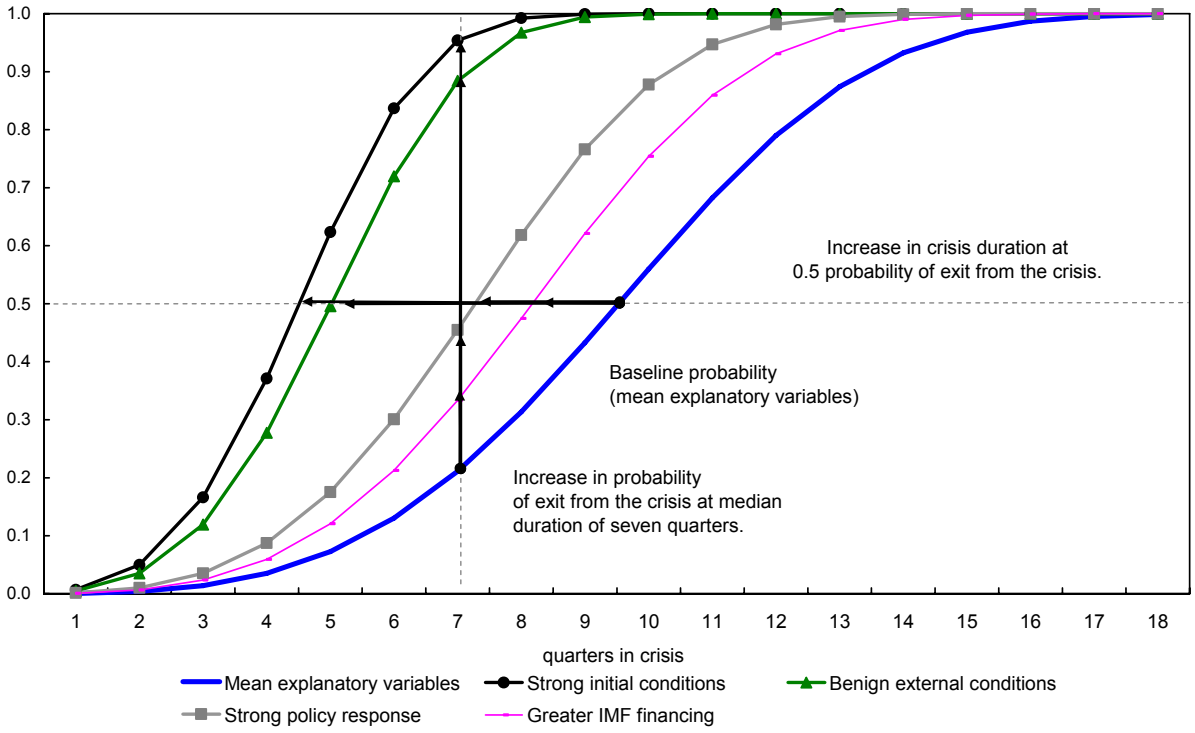
To gain further insights into the relative importance of the factors influencing crisis duration, some counterfactual experiments are performed. The experiments are based on the augmented model with the logistic time specification (regression (2a) in Table 4), which exhibits the best overall fit.

- First, the estimated parameters and the mean values of the model variables are used to construct the *baseline predicted probability* of exiting from crisis (Figure 13).

- Second, the impact of changes in individual variables on the predicted probability of exiting from crisis and its estimated duration is computed. Specifically, the mean value of individual explanatory variables is changed by one standard deviation (Table 5). The resulting difference between the baseline probability and the probability arising from the counterfactual experiment can be used to assess the relative importance of different factors. In Figure 13, for illustration, this difference is evaluated (vertically) at the median crisis duration of seven quarters. Alternatively, the potential impact on expected crisis duration can be gauged (horizontally) by comparing the number of quarters in crisis passed before the predicted probability of exiting from crisis reaches a certain value (one-half in the figure).

[44] This result seems to confirm the findings of other studies (see Eichengreen et al (1998)) according to which the chances of a smooth transition to greater exchange rate flexibility are generally not good in a crisis. Indeed, our findings show that the level of a country's external debt—which is highly sensitive to exchange rate dynamics—is a critical factor influencing the probability of exiting from a crisis.

Figure 13. Predicted Probabilities of Exit from the Crisis under Different Scenarios



Source: IMF staff calculations.

Table 5. Descriptive Statistics for the Model's Explanatory Variables

	N	Mean	Standard deviation
Exchange rate regime 1/	153	6.67	2.02
Real interest rate differential (lag 2) 2/	153	6.27	43.41
Real interest rate differential (lag 3) 2/	153	6.12	40.34
Change in primary balance (lag 1) 3/ 4/	153	0.48	4.76
Capital flows to EM countries 5/	153	1.41	0.89
Three-month Libor rate	153	4.54	1.84
Trade-weighted domestic demand (change)	153	0.58	0.62
External debt (lag 1) 3/	153	70.04	28.92
Current account balance (pre-crisis) 3/	18	-2.45	3.89
Cumulative IMF financing 6/	15	12.96	13.75

Source: IMF staff calculations.

1/ As in IMF's "Annual Report on Exchange Rate Arrangements and Exchange Restrictions."

2/ Policy rate differential with the three-month Libor rate, adjusted for the difference between the country's inflation and U.S. inflation.

3/ In percent of GDP.

4/ Refers to four-quarter (t/t-4) change in primary balance.

5/ Total net private capital flows to emerging market countries (ratio to GDP).

6/ Cumulative sum of disbursed IMF financing (in percent of quarterly GDP), starting with four quarters preceding the crisis.

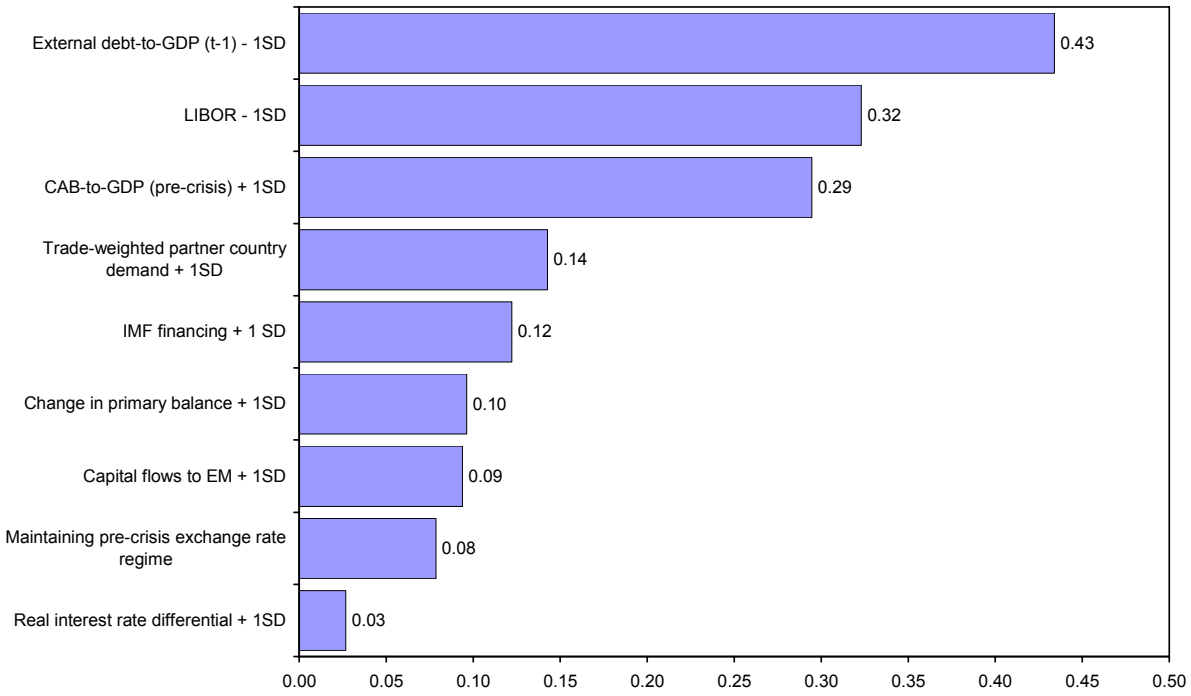
An important point to note, is that the factors that seem to have the strongest influence on crisis duration—initial and external conditions—are those outside the control of the policymakers by the time a crisis erupts. The largest gain in shortening the expected duration of capital account crises—by roughly 2–3 quarters, or about 30–40 percent of the median duration—is associated with either stronger initial conditions (lower pre-crisis current account deficits and relatively moderate external debt burden) or with a more benign external environment (more favorable international liquidity conditions and buoyant trade partners' demand).

Stronger initial conditions result from consistent implementation of sustainable macroeconomic policies. Therefore, these empirical findings highlight the critical importance of sustained prudent policies and crisis prevention efforts aimed at strengthening a country's fundamentals in normal times (the "good policies" factor). But the results also highlight the importance of the "good luck" factor, in terms of favorable external conditions.

Further counterfactual experiments were performed to assess the importance of each explanatory variable (Figures 14 and 15). The results also confirm that a strong policy response—such as undertaking fiscal adjustment, avoiding large exchange rate devaluations in the midst of the crisis, and (to a lesser extent) raising interest rates—increases the probability of exiting from a crisis. Indeed, a stronger improvement in the primary fiscal balance (by one standard deviation) or the possibility to maintain the pre-crisis exchange rate regime is found to increase the probability of exiting from a crisis by about 10 percent or, equivalently, shorten crisis duration by about one quarter. A one standard deviation higher real interest rate differential is predicted to raise the probability of exiting from crisis marginally by 3 percent, and to shorten duration by about 0.4 quarters.

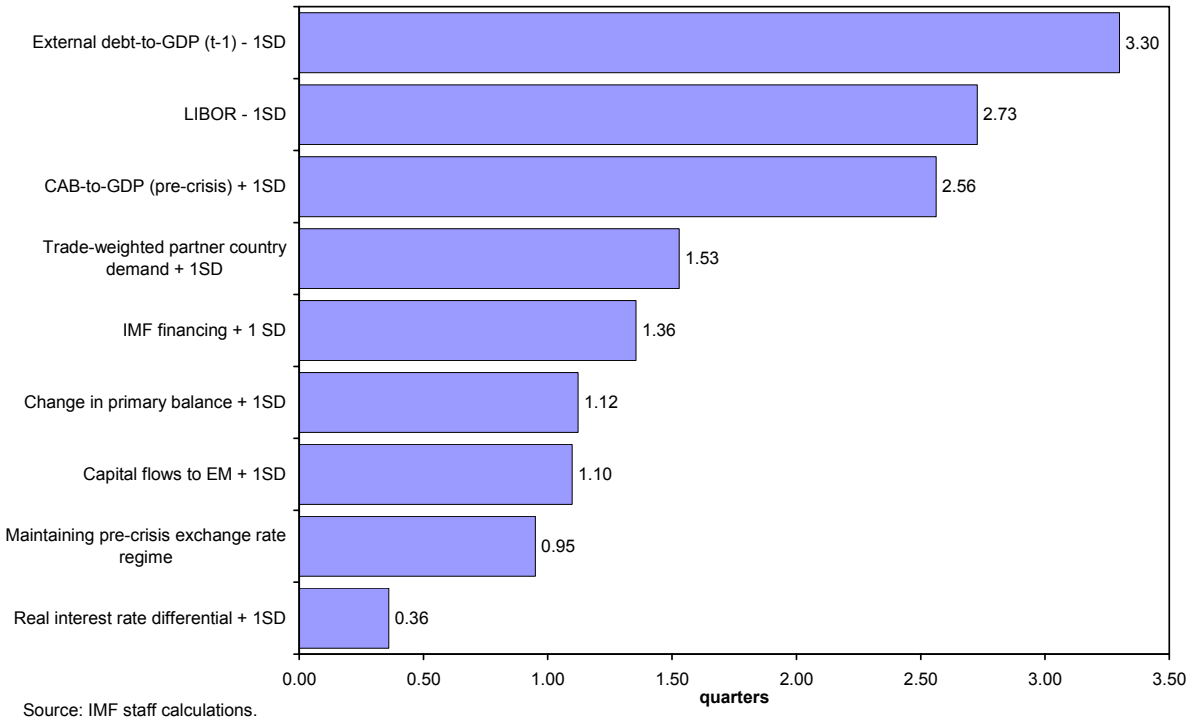
The marginal impact of one standard deviation higher IMF financing would seem to increase the probability of exiting from a crisis by about 12 percent. However, this result needs to be interpreted with caution because the regression coefficient is not statistically significant. A more meaningful assessment of the impact of IMF support could be based on the model with no time dependence (regression (4) in Table 4), where the corresponding parameter was estimated more accurately. This exercise is performed in Box 4. The findings still need to be interpreted with caution because, specification issues aside, it is difficult to separate the impact of Fund financing from the effects of a Fund-supported program on a country's policy response variables. It also needs to be born in mind that duration is only one dimension of crisis resolution and that the effects of Fund financing on other aspects, such as the depth of a crisis, are not evaluated. With these caveats, the results suggest that the marginal benefit of IMF financing, and of frontloading of disbursements, depends critically on a country's fundamentals, being more effective in cases with relatively stronger initial conditions.

Figure 14. Increase in Predicted Probability of Exit from Crisis under Various Scenarios 1/



Source: IMF staff calculations.
1/ Evaluated at median crisis duration of seven quarters. Unless noted otherwise, the mean value of individual explanatory variables is changed by one standard deviation (SD).

Figure 15. Reduction in Predicted Crisis Duration under Various Scenarios 1/



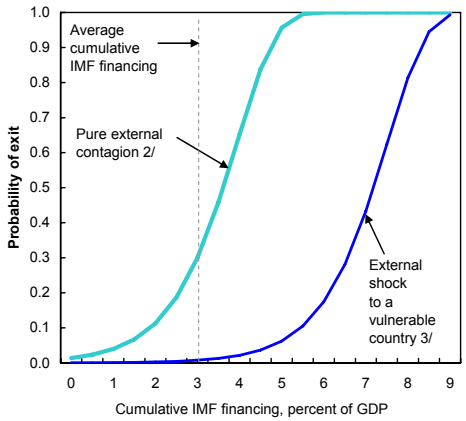
Source: IMF staff calculations.
1/ Evaluated at 0.5 probability of staying in crisis. Unless noted otherwise, the mean value of individual explanatory variables is changed by one standard deviation (SD).

Box 4. IMF Financial Support and Crisis Duration

Our empirical results can also be used, for illustrative purposes, to give some indication of the effect of the size of IMF financial packages on the speed of crisis resolution. Such an evaluation, however, is subject to a number of important caveats. First, IMF financial support and countries' policy responses are likely to be jointly determined. Second, duration is only one dimension of crisis resolution, and effects on, for instance, the depth of the crisis are not taken into account. Finally, the significance of the IMF parameter in the model is very sensitive to the model specification, pointing to a relatively large margin of error.

With these qualifiers, we trace the marginal impact of changes in the size of cumulative IMF financing on the probability of exiting from crisis in two possible scenarios: (i) *pure external contagion*; i.e., the case where a bad external environment triggers a crisis in a country with good initial conditions; and (ii) an *external shock to a vulnerable country*, where a bad external environment triggers a crisis in a country with poor initial conditions (Box Figure 1). In both scenarios, we assume that countries follow strong corrective policies under a Fund-supported program. The estimated marginal impact of IMF financing in the two scenarios differs significantly: in the case of pure contagion, substantially lower financing is needed to resolve a crisis, highlighting the importance of strong fundamentals and sustained prudent policies. In the case of a shock hitting a vulnerable country, however, the average IMF package (3.25 percent of annual GDP) appears too small to have a substantial impact on the pace of crisis resolution. These findings echo Ramakrishnan and Zalduendo's conclusions on the role of IMF financing in the context of crisis prevention.

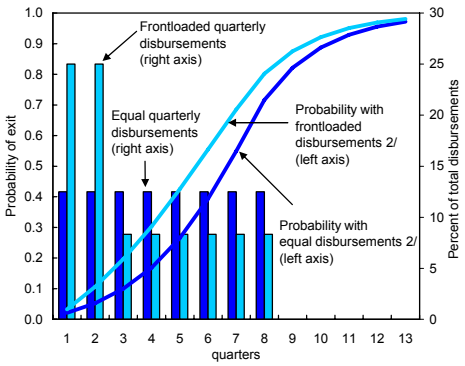
Box Figure 1. Marginal Impact of the Size of IMF Financing 1/



Source: IMF staff calculations.
1/ Based on regression (4) reported in Table 4.
2/ Good initial conditions (75th percentile); bad external environment (25th percentile); strong corrective policies (75th percentile).
3/ Bad initial conditions (25th percentile); bad external environment (25th percentile); strong corrective policies (75th percentile).

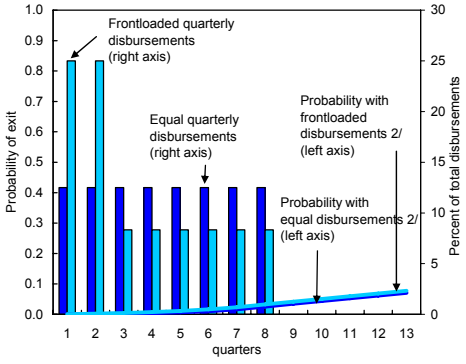
The analysis also allows to evaluate the effect of frontloading IMF disbursements. For illustration, we consider the same crisis scenarios in the context of a hypothetical two-year IMF program, with total access of 3.25 percent of GDP under two alternative disbursement patterns. A scenario where half of the committed funds are disbursed in the first two quarters of the crisis is compared with a scenario with equal quarterly disbursements over eight quarters (Box Figures 2 and 3). The results suggest that frontloading helps raise the probability of exiting a pure contagion crisis, but the marginal impact is quite small. In the vulnerable country case, given the insufficient size of the average financing package, frontloading makes little difference.

Box Figure 2. Marginal Impact of Frontloading IMF Financing: Pure External Contagion 1/



Source: IMF staff calculations.
1/ Based on regression (4) in Table 4.
2/ Pure external contagion: good initial conditions (75th percentile); bad external environment (25th percentile); and strong corrective policies (75th percentile).The total amount of financing to be disbursed over eight quarters is equal to the average financing (3.25 percent of GDP) in both scenarios.

Box Figure 3. Marginal Impact of Frontloading IMF Financing: External Shock to a Vulnerable Country 1/



Source: IMF staff calculations.
1/ Based on regression (4) in Table 4.
2/ External shock to a vulnerable country: bad initial conditions (25th percentile); bad external environment (25th percentile); and strong corrective policies (75th percentile).The total amount of financing to be disbursed over eight quarters is equal to the average financing (3.25 percent of GDP) in both scenarios.

V. CONCLUSIONS

Our paper aims to contribute to the literature on capital account crises in three ways. First, by measuring the duration of crises. Second, by deriving, on the basis of 18 recent crises episodes, stylized facts on the duration and the "end-game" of these crises. And third, by estimating a model examining the determinants of the probability of exit from the crises.

The analysis underscores the complexity and variety of experience with capital account crises. The median duration is found to be seven quarters, but the length of a crisis varies widely across different cases. Although recovery patterns differ markedly, a general feature emerging from the data is that capital outflows tend to subside first, followed by exchange rate stabilization, reductions in the risk premium on sovereign bonds, and a gradual recovery of foreign exchange reserves. Interestingly, real output tends to recover ahead of the financial indicators considered in the paper.

The analysis shows a clear relationship between the degree of crisis complexity and the intensity of movement of key variables, thereby highlighting the interdependency of balance sheet problems, exchange rate shifts, and investor confidence effects. We find that more complex ("twin" and "triple") crises are associated with more severe capital outflows, sharper currency depreciations, larger (and more persistent) increases in spreads, and more wrenching current account adjustments.

As to the picture prevailing toward the end of crises, there is a remarkably wide range of experiences with fiscal positions and capital flow patterns. In part, these reflect differences in the authorities' policy response. One common element, however, is the substantial rise in external debt levels, particularly in cases characterized by significant exchange rate depreciations. The evidence further suggests that countries emerging from more complex crises tend to have greater post-crisis debt-related vulnerabilities. Sometimes such vulnerabilities are mitigated by stronger fiscal balances which contribute to a gradual debt reduction, and by official reserves, which tend to be higher at the end of crises than before.

Regarding the factors influencing crisis duration, our econometric analysis suggests that initial conditions and the external environment are key explanatory variables. This result highlights the importance of consistently prudent macroeconomic policies, which determine initial conditions at a time of financial distress. By the same token, it highlights the role of factors—initial and external conditions—largely outside the control of the authorities once a crisis occurs.

The policy response to a crisis is also found to influence its duration. This is particularly evident for appropriate fiscal adjustment, which can shorten duration significantly. While the evidence for monetary policy is more mixed, our results suggest that an increase in (real) interest rates may also help to shorten a crisis. Changes in the exchange rate regime during a crisis, often resulting in sharp currency depreciations, tend to be associated with longer crises, likely reflecting adverse balance sheet effects. This said, we need to recognize that the strong market pressures during crises severely limit actual policy options.

With respect to the role of IMF financing, there is some partial evidence that larger financing packages may help shorten crisis duration. But the effectiveness of Fund financing is found to be more pronounced in cases with relatively strong fundamentals. This finding needs to be interpreted with particular caution, however, inter alia because it is based on econometric results sensitive to the choice of functional form for the model.

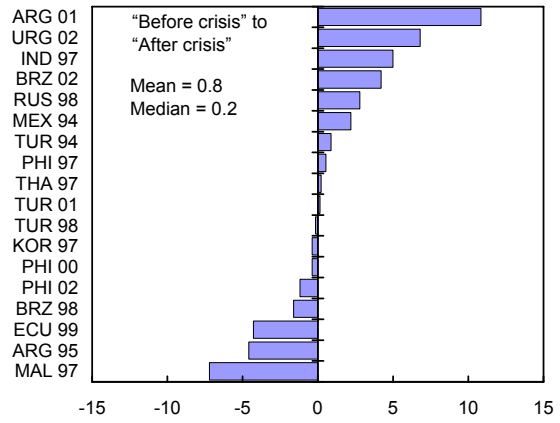
In all, the results confirm the link between the complexity of a capital account crisis and its duration. They also suggest that good policies matter, but in a hard way for policy making, since it is too late to correct initial conditions once a crisis has erupted. At that difficult stage, countries are hostage of their past. This fact underscores the fundamental importance of crisis prevention efforts. The time to repair the roof is when the sun is shining.

APPENDIX I: Banking Sector Vulnerabilities—Some Partial Evidence

Data limitations (in particular sample size), prevent a systematic analysis of the impact of capital account crises on the banking sector. This appendix presents some partial findings on the basis of available data.

The pattern of evolution of banks' liquid assets during crises appears to have differed considerably across crises. (Appendix Figure 1). However, the data suffer from two drawbacks. First, data are annual and therefore cannot capture acute, but short-lived, pressures on bank liquidity that may have taken place at the height of the crisis. Second, if banks faced acute pressures on their liquidity (the first line of defense in the banking system), central banks may have acted as lender of last resort (the second line of defense) by injecting liquidity in the banking system. As a result, bank data on liquidity may not capture the actual liquidity pressures faced by commercial banks.

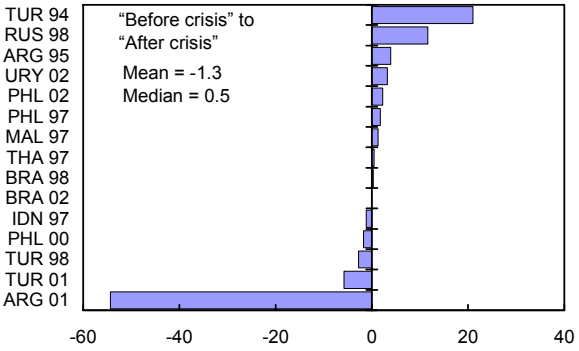
Appendix, I Figure 1. Change in Bank Liquid Reserves 1/ (in percent of total assets)



Source: IMF staff calculations.
1/ "Before crisis" and "After crisis" refer to an average of four quarters immediately preceding or succeeding the crisis (where data are available).

Deposits in foreign currency (i.e., bank liabilities dollarization) have tended to increase somewhat during most recent crises, likely reflecting the role of valuation effects of exchange rate depreciation and currency substitution (Appendix Figure 2). By the end of the crises, these deposits generally remained at the level reached around the crisis peak. In a few cases, however, deposits in foreign currency were lower at the end of the crisis, suggesting that in those cases deposit withdrawals more than offset the above-mentioned effects (the large drop in Argentina is likely associated with the 2002 pesoization).

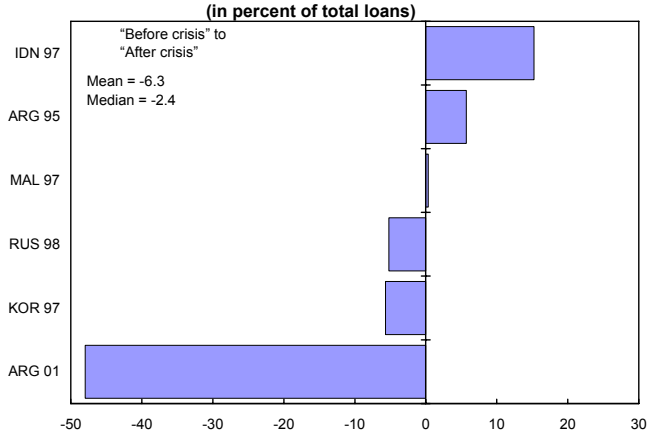
Appendix I, Figure 2. Change in Bank FX Deposits 1/ (in percent of total deposits)



Source: IMF staff calculations.
1/ "Before crisis" and "After crisis" refer to an average of four quarters immediately preceding or succeeding the crisis (where data are available).

Foreign currency loans rose, also largely reflecting valuation effects (Appendix Figure 3). These effects were, to some extent, offset by the refinancing (in domestic currency) of these loans as the crisis progressed (again, the large drop in Argentina is likely associated with the 2002 pesoization). Banks' (net) claims on the government generally also rose again, most likely, on account of valuation effects. Bank claims rose particularly sharply in Argentina in 2001 as a result of the steep depreciation of the exchange rate and the swap of sovereign bonds into loans.

Appendix I, Figure 3. Change in Bank FX Loans 1/ (in percent of total loans)

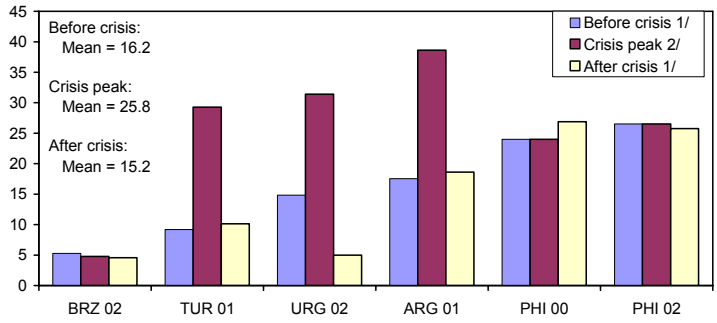


Source: IMF staff calculations.

1/"Before crisis" and "After crisis" refer to an average of four quarters immediately preceding or succeeding the crisis (where data are available).

Nonperforming loans were not systematically higher at the end of crises, but this often reflected substantial restructuring operations affecting low quality bank assets (Appendix Figure 4). As expected, nonperforming loans rose substantially during the crisis in several cases, reflecting both the negative effects on private sector balance sheets of exchange rate depreciation and rising interest rates, and the decline in borrowers' income as output contracted. Toward the end of the crises, however, all countries show strong improvements in NPL ratios. This is because as banks were restructured, NPLs were written off or passed on to special recovery vehicles, and debtors, more broadly, were recovering from the crisis.

Appendix I, Figure 4. Nonperforming Loans (in percent of total loans)



Source: IMF staff calculations.

1/ Refers to an average of four quarters immediately preceding or succeeding the crisis (if available).
2/ Refers to the quarter with the highest IKAC value.

APPENDIX II: A Model for the Duration of Capital Account Crises

The paper applies survival analysis to identify factors influencing the duration of capital account crises. More specifically, it investigates how various covariates—including initial conditions of the economy, the external environment, policy responses, and the extent of IMF financial involvement—affect the "survival" time of a country in a capital account crisis.

Let $T \geq 0$ denote the time at which an economy exits from a capital account crisis, and t denote a particular value of T. The survivor function—the probability of a country "surviving" (i.e., remaining) in crisis mode after time t—is defined as

$$S(t) \equiv 1 - F(t) = P(T > t), \tag{AII.1}$$

where $F(t) = P(T \leq t)$ is the cumulative distribution function of T.

Taking into consideration discreteness in observed crisis durations, the conditional hazard function at time t is defined as the probability of a country leaving the crisis mode in the interval $[t, t+h]$, given being in crisis up until time t and conditional on values of time-variant explanatory variables summarized by vector X:

$$\lambda\left[t; X(t)\right] = \lim_{h \downarrow 0} \frac{P\left[t \leq T < t + h \mid T \geq t, X(t+h)\right]}{h} \tag{AII.2}$$

Following the survival analysis literature, the model assumes a proportional hazard with time-varying covariates of the following form:

$$\lambda\left[t; X(t)\right] = \kappa\left[X(t)\right] \lambda_0(t), \tag{AII.3}$$

where $\kappa(.)$ is a nonnegative function of X and $\lambda_0(t)$ is the baseline hazard. The baseline hazard is common to all countries in crisis while the individual hazard functions differ proportionately based on a function $\kappa(.)$ of observed covariates.

The complementary log-log model used in this paper assumes that the discrete hazard rate has the following specification:

$$p\left[t, X(t) \mid \beta, u\right] = 1 - \exp\left[-\exp(\lambda_0(t) + X\beta + u)\right], \tag{AII.4}$$

where the baseline hazard function is assumed to be, for example, of the form $\lambda_0(t) = \log(t)$ and $X\beta$ includes an intercept term. The "error" term u is a random variable, summarizing the impact of omitted variables on the hazard rate.[45] Since it is possible that conditioning on observed covariates may be insufficient to capture all heterogeneity in various crisis episodes, it is important to test for unobserved heterogeneity in the sample of capital account

[45] An alternative interpretation of this term is that it captures measurement errors in recorded regressors or recorded survival times.

crisis episodes. To this end, the error term in the hazard function (AII.4) for different crises can be assumed to be drawn from a distribution with parameters that can be estimated (i.e., Normal, Gamma, or Inverse Gaussian distributions). The key assumption used in models with unobserved heterogeneity is that the heterogeneity is independent of the observed covariates. The probabilities defined in (AII.4) are used to construct a likelihood function, and the parameters of the model are estimated by maximizing the log-likelihood.

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