International financial rescues and debtor-country moral hazard*
Preliminary draft

Prasanna Gai†
and Ashley Taylor‡

May 10, 2004

Abstract

This paper examines whether recent international policy initiatives to facilitate financial rescues in emerging market countries have influenced debtors' incentives to access official sector resources. The paper highlights a country's systemic importance as a key characteristic that drives access to official sector finance. It estimates the effect of these financial rescue initiatives on IMF programme participation using a pooled probit model. The safety net permitting exceptional access is shown to have a greater marginal impact on official sector resource usage, the more systemically important the debtor country. The results can be interpreted as offering some support for the presence of debtor-country moral hazard.

JEL Classification: F33, F34.

Keywords: Moral Hazard, International Lending, Financial Crises.

1 Introduction

The recent debate on the 'international financial architecture' has highlighted the potential moral hazard implications of large official sector financial rescues of emerging market economies. Concern that the increased scale of IMF-led bailouts may distort debtor and creditor incentives, generating excessive borrowing and

*We thank Gordon de Brouewer, Andrew Haldane, Warwick McKibbin, Victoria Saporta, and two anonymous referees for helpful suggestions. The comments of seminar participants at the Australian National University, the Bank of England and the London School of Economics are also gratefully acknowledged.

†Australian National University and Financial Markets Group, London School of Economics. E-mail: prasanna.gai@anu.edu.au

‡Financial Markets Group, London School of Economics. E-mail: a.d.taylor@lse.ac.uk

lending, has led to calls for clearly defined limits to official support and greater private sector involvement in crisis resolution.[1] As Table A shows, the size of rescue packages has risen substantially relative to the economies involved. Financing arrangements agreed between the IMF and debtor countries were of the order of 6% of GDP during the financial crises since the mid-1990s, compared with some 1.5% of GDP during the debt problems of the early 1980s.

Table A: IMF arrangements with selected debtor countries 1983-2002

	Programme[a]	Funds available:[b]			Funds drawn:[d]
		as per cent of quota	as per cent of GDP[c]	SDR bn	SDR bn
Post-1995					
Brazil 2002	SBA with SRF	752%	6.9%	22.8	7.6
Turkey 2002	SBA	1330%	9.5%	12.8	10.4
Brazil 2001	SBA with SRF	400%	3.0%	12.1	11.4
Argentina 2000	SBA with SRF[e]	800%	7.8%	16.9	9.8
Turkey 1999	SBA with SRF[f]	1560%	10.5%	15.0	11.7
Brazil 1998	SBA with SRF	600%	2.3%	13.0	9.5
Korea 1997	SBA with SRF	1938%	4.4%	15.5	14.4
Indonesia 1997	SBA	557%	5.2%	8.3	3.7
Thailand 1997	SBA	505%	2.6%	2.9	2.5
Mexico 1995	SBA	688%	6.3%	12.1	8.8
Early 1980s					
Argentina 1984	SBA	106%	1.0%	1.2	1.2
Korea 1983	SBA	124%	0.7%	0.6	0.6
Brazil 1983	EFF	528%	3.0%	4.2	2.7
Philippines 1983	SBA	100%	1.0%	0.3	0.1
Argentina 1983	SBA	187%	1.5%	1.5	0.6
Mexico 1983	EFF	425%	2.4%	3.4	2.5

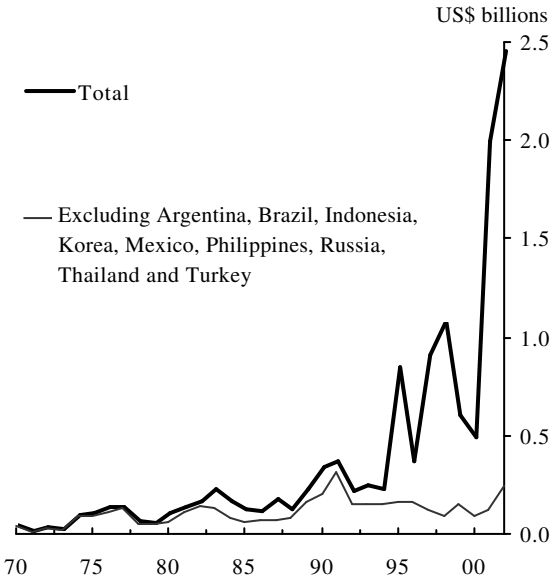
Sources: IMF and IMF *World Economic Outlook*.
(a) SBA - Stand-By Arrangements; SRF - Supplemental Reserve Facility (introduced from December 1997).
(b) Funds available include augmentations to initial amount announced.
(c) Relative to GDP in year of initial programme announcement.
(d) Funds drawn under programmes as at 30 April 2003.
(e) SRF approved Jan. 2001.
(f) SRF approved Dec. 2000.

Chart 1 illustrates the evolution of credit purchases from the IMF's General Resources Account (GRA) through programmes involving conditionality. The average annual purchase of those countries accessing such resources has risen sharply to almost $2.5 billion in 2002, from around $150 million in the early

[1] Mathieson *et al* (2000) provide a comprehensive review of this debate. See also Haldane and Kruger (2001), and Krueger (2001).

1980s.[2] But, when the prominent crisis economies of the 1990s are excluded, purchases of IMF credit display a more benign pattern. As Chart 2 shows, there has also been a general rise in the relative scale of resource usage. Purchases of IMF GRA resources, as a percentage of the total GDP of those countries accessing credit tranches, rose in the 1990s after being broadly stable during the previous 20 years. The greater use of official sector funds by a relatively small number of countries belies the view that the large size of recent rescues reflects a general rise in *real* hazard due to the greater integration of emerging market economies into international capital markets.[3]

Chart 1: Average purchases (GRA) per year (excluding reserve tranches)[(a)]

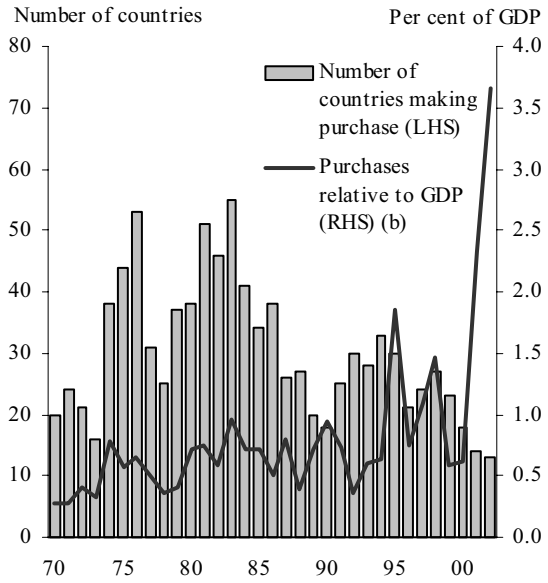


Sources: IMF IFS and authors' calculations.
(a) Average annual purchase from GRA (excluding reserve tranche purchases) of those IMF member countries making a purchase in given year. Total sample is 172 countries.

[2]In real terms, average purchases have returned to levels seen at the peak of the early 1980s debt crisis.

[3]Mussa (1999) discusses the real hazards facing such countries in their interactions with the global financial system.

Chart 2: Number of GRA purchases (excluding reserve tranches) and their scale relative to GDP[(a)]



Sources: IMF, IMF *World Economic Outlook* and authors' calculations.
(a) Purchase from GRA (excluding reserve tranche purchases). Sample is those member countries for which purchase and GDP data available.
(b) Sum of purchases of IMF member countries making a purchase in given year relative to their total GDP.

The increased scale of official sector packages has been made possible by several policy decisions that altered both the size of the IMF's total financial resources, and the amount it could lend to each member. In the wake of the Mexican crisis, concerns about capital account crises prompted industrial countries to initiate the New Arrangements to Borrow (NAB) in January 1997 to supplement existing IMF resources. Shortly afterwards, in December 1997, a Supplemental Reserve Facility (SRF) was introduced to provide emergency large scale short-term financing in the event of a capital account crisis.[4] Lane and Phillips (2000) note that if debtors and creditors perceived these measures to be regularising access to exceptional funding above normal limits, then an increase in moral hazard (and resource usage) might be expected.[5] But there has been little formal work to examine whether the 'international financial safety net' established by these policy changes has influenced debtors' reliance on official sector

[4]A brief description of the main IMF facilities is offered in the appendix.

[5]Consistent with this view, some commentators (Jeanne and Zettelmeyer (2001); Mussa (2002) suggest that large-scale official financing can generate moral hazard 'indirectly' by encouraging inappropriate domestic policies in emerging market economies.

resources.[6]

Empirical tests for the presence of moral hazard have been the subject of much attention in the literature on health and labour economics.[7] The basic insight of these studies is that incentive effects of contracts (ie moral hazard) are, in general, easiest to detect when there are exogenous changes in the incentive structure. As Chiappori and Salanie (2000) note, when the same population successively faces different government regulations or policies, any resulting change in behaviour can likely be attributed to the variation of incentives, at least to the extent that no other significant factor has changed in the meantime. On its own, this 'natural experiment' approach only establishes simultaneity rather than causality.[8] This problem is usually addressed by distinguishing those agents that are subject to the regulatory or policy change (the 'test' group) from agents who are not (a 'control' group). The estimated effect of policy on incentives is then inferred from the difference in the difference of the outcomes for these two groups.

In this paper, we ask how the demand for IMF resources (as realised through participation in IMF programmes) differs before and after the change in lending practices through the introduction of the SRF and NAB. But two factors prevent direct application of the natural experiment approach to the issue of a debtor's reliance on official sector finances. First, to count as a true natural experiment, the policy change should be exogenous. However, this is not the case since the creation of an international safety net was a purposeful action by the official sector in response to a set of turbulent economic and financial circumstances. So it is necessary to identify and control for factors that drive potential access to the safety net created by the SRF and NAB. Second, an explicit control group must be identified. In principle, however, all IMF members who remain current on their obligations have access to nonconcessional financing. So, the policy changes to extend the international safety net cannot be restricted *ex ante* to a specific group of countries to create a ready 'control' group.

To surmount these hurdles, we construct a variable based on the systemic importance of countries that allows us to capture a country's changed likelihood of receiving funds following the policy change and permits us to proxy test and control groups. The SRF and NAB were designed to contain the systemic impact of capital account crises. This suggests that the resultant safety net might have a greater impact on incentives, the more likely is a country to receive funding under these measures – ie the more 'systemic' the country. We therefore consider a systemic index, which reflects a country's importance in international finance and trade, and lag the measure in our regressions in order to address endogeneity problems.

[6] See Haldane and Taylor (2003), for example, for a review of the literature.

[7] See, for example, Chiappori *et al* (1998), Blundell and MaCurdy (1999), and Chiappori and Salanie (2000).

[8] So, for instance, a change in health regulation could coincide with a cold winter, the latter resulting in increased demand for medical services.

Using a pooled probit model across the period 1995–2001, we explore how observed changes in programme participation following the introduction of the SRF and the NAB vary with the systemic importance of a country (as appropriately defined) using a pooled probit model across the period 1995–2001. Our test of debtor moral hazard depends on changes in the sensitivity, to fundamentals, of the debtor's decision to access IMF resources, conditional on the likelihood of a country being affected by the policy change. In contrast to the pure natural experiment approach, the likelihood of being affected is dictated by the systemic index. In particular, debtor moral hazard can be considered as the marginal change in the sensitivity, to fundamentals, of the decision to access IMF resources beyond:

- any mean differences observed pre- and post- policy change for the entire sample;
- any mean differences in the sensitivity, conditional on the likelihood of a country being affected by the policy change, which are observed across the entire time period.

We examine the sensitivity of our test results to the 'systemic index' variable. The results are robust to use of a continuous index or the values of this index to split the sample into more or less systemic groupings (which can be viewed as proxy test and control groups).

Our probit model provides a link to the empirical literature on the economic determinants of IMF programmes. Specifically, we draw on the insights of Joyce (1992), Knight and Santaella (1997), IMF (2001b) and Barro and Lee (2002) to identify the key economic variables influencing access to IMF credit. Ideally, a structural model of demand and supply-side factors would be used in this identification process. But, problems of empirical tractability mean that a reduced-form model is the preferred approach in the literature.

In drawing on lessons from the natural experiment methodology, we introduce an innovation to the existing empirical literature and a different approach to the intrinsic identification problems faced in such studies of moral hazard induced by IMF lending. A first generic identification issue faced by empirical studies of moral hazard is how to measure changes in agents' behaviour. Existing studies, such as Dell'Ariccia *et al* (2002), Haldane and Scheibe (2004), Kamin (2002), and Zhang (1999), use asset prices as the dependent variable.[9] But, asset prices are, at best, an indirect measure of changes in agents' incentive structures. A second identification problem is disentangling empirically the effects of IMF policies on the likelihood of real hazard from their effects on moral hazard. This question is particularly pertinent to studies employing forward-looking asset prices which could respond to both effects. A third concern is whether the credit events around

[9]See also McBrady and Seasholes (2000), and Lane and Phillips (2000).

which moral hazard tests are conducted are truly exogenous.[10] To address the above concerns we first consider a directly observable action (a country's usage of IMF resources) as the dependent variable. Second, we model the dependence of this decision on lagged fundamentals to avoid the problems of forward-looking studies. Finally we employ a systemic index to identify the specific effects of the policy change on incentives, distinct from any generic structural shift in behaviour at the time of policy implementation.

The structure of the paper is as follows. Section 2 outlines our methodology and describes the data. Section 3 presents and interprets the results. A final section concludes.

2 Empirical framework

2.1 Access to official sector finance

We regard the introduction of the SRF and NAB as measures that marked a shift in the official sector response to capital account crises. The realisation that the management of such crises needed substantial resources prompted the major industrial countries to develop ways of supplementing existing IMF programmes to countries facing balance of payments difficulties. Both the SRF and NAB embody an *ex-ante* expectation that the availability of official resources would be dependent on a member's characteristics. The SRF was likely 'to be utilized in cases where the magnitude of the outflows may create a risk of contagion that could pose a potential threat to the international monetary system'.[11] And participants in the NAB agreed 'to make loans to the IMF when supplementary resources are needed to forestall or cope with an impairment of the international monetary system, or to deal with an exceptional situation that poses a threat to the stability of the system'.[12]

The focus on the need to limit contagion suggests that the likelihood of access to official resources under these facilities depends, in the main, on the systemic

[10] Dell'Ariccia *et al* (2002) and Haldane and Scheibe (2004) provide different approaches to this issue in relation to the use of major credit events as 'policy experiments' in asset price studies.

[11] Section 1(b), *Use of Fund's Resources, Supplemental Reserve Facility and Contingent Credit Lines*, IMF (2001a). The SRF has features akin to those of a domestic lender of last resort (see Appendix Table H for further details), including short-maturity terms and surcharges on the rate of interest for exceptional lending to limit moral hazard. However, whether the latter effect is sufficient is questionable. For example it could be argued that '[S]ince SRF resources are provided at a time when access to capital markets is essentially cut off, the rate of charge on SRF resources is still much lower than the (presumably extremely high) rate the markets would charge, if credit from the markets were available at all in such situations' (IMF (2000)).

[12] *IMF Press Release 97/5*, 'IMF adopts a decision on New Arrangements to Borrow', 27 January 1997.

importance of a country.[13] In other words, whether a country is granted access to the extended international safety net can be described as:

$$P_{it} = f(\lambda_{i,t-1}) \tag{1}$$

where P_{it} is a binary decision variable, and $\lambda_{i,t-1}$ is a measure of the systemic importance of country i lagged one quarter to reflect endogeneity concerns.

The advent of measures explicitly designed to facilitate financial rescues of systemically important countries can be expected to influence the incentive structures of debtors. The introduction of the NAB and SRF should have a greater effect on resource usage the more systemic the country. Moreover, both initiatives satisfy two requirements that Dell'Ariccia *et al* (2002) argue are central to the natural experiment approach. First, they were events with the potential to change expectations of the extent and nature of future crisis lending. And second, they were events unlikely to lead to a reassessment of risks other than through expectations of a future bailout.

2.2 Econometric model

We suppose that the IMF participation decision of country i at time t, I_{it}, is a binary variable which equals one if the country is in an IMF arrangement (SBA, EFF or SRF) *and* draws upon those funds at some point during the programme. I_{it} is zero otherwise. This well-defined action avoids the complexities, inherent in existing studies of IMF lending and moral hazard, posed by the use of asset prices to infer changes in agents' incentive structures. We follow other studies examining access to IMF credit in using a probit model (eg Knight and Santaella (1997), Barro and Lee (2002)). We analyse the incidence of a debtor country's claims on IMF resources by invoking a latent variable, I^*_{it}, that is governed according to the relationship:

$$\begin{aligned} I^*_{i,t} &= (\alpha + \lambda_{i,t-1}\alpha' + D_t\Delta\alpha + D_t P_{i,t}\Delta\alpha') \\ &\quad + \sum_{k=1}^{K} \left[\beta_k + \lambda_{i,t-1}\beta'_k + D_t\Delta\beta_k + D_t P_{i,t}\Delta\beta'_k\right] X_{ik,t-1} + \varepsilon_{it} \end{aligned} \tag{2}$$

Our specification can be viewed as a reduced-form model that reflects both the demand and the supply of IMF loans, a fact which must be borne in mind when interpreting the coefficients (see Section 3.2). The vector, $X_{ik,t-1}$, denotes the k country-specific economic fundamentals that influence a country's decision to seek, or the IMF's decision to offer, assistance. D_t is a temporal dummy that equals one in the period following the announcement of the SRF/NAB. Policy following the safety net is described by $P_{i,t}$. Following Knight and Santaella

[13] Factors such as a country's economic performance which also influence access to IMF resources are considered separately in our analysis.

(1997), we use lagged values of X_{ik} and λ_i to address possible simultaneity issues (for example, the fact a country is in a programme might affect its ratings). The lags also help account for gaps between programme implementation and the availability of information about the debtor.

From **(1)**, we assume a simple linear relation between the lending policy following the extension of the safety net and the systemic index. It is exogenous to the participation decision and uncorrelated with $X_{ik,t-1}$.[14] Substituting into **(2)** gives

$$\begin{aligned} I^*_{i,t} &= (\alpha + \lambda_{i,t-1}\alpha' + D_t\Delta\alpha + D_t\lambda_{i,t-1}\Delta\alpha') \\ &\quad + \sum_{k=1}^{K} \left[\beta_k + \lambda_{i,t-1}\beta'_k + D_t\Delta\beta_k + D_t\lambda_{i,t-1}\Delta\beta'_k\right] X_{ik,t-1} + \varepsilon_{it} \end{aligned} \tag{3}$$

So the decision rule that determines whether a country has entered a programme and on which it draws during the programme period is

$$I_{i,t} = \begin{cases} 1 & \textit{if} \quad I^*_{i,t} > 0 \\ 0 & \textit{if} \quad I^*_{i,t} \leq 0 \end{cases} \tag{4}$$

Equation **(3)** decomposes the constant and marginal coefficient terms into a number of components.[15] The coefficient α' reflects the probability of programme participation across the whole time period conditional on the debtor's systemic characteristics; $\Delta\alpha$ represents the general structural shift in the probability of participation following the policy event; and $\Delta\alpha'$ reflects any additional shift, post-policy, conditioning for the systemic nature of the country. The coefficients β'_k, $\Delta\beta_k$, and $\Delta\beta'_k$ analogously decompose the sensitivity of programme participation to fundamentals, $X_{ik,t-1}$. One interpretation of the general interaction terms post-policy change (ie the terms $\Delta\alpha$ and $\Delta\beta_k$) is that they represent a general shift in real hazard leading to a change in conditional programme participation.

[14]The components of the index (see Appendix Table I) may depend on lagged values of the fundamentals. However, we reject correlation between contemporaneous values of λ_i and the X_{ik} for the fundamental variables in the base model specification of Table F - a regression of the former on the latter is insignificant. Using a Rivers-Vuong test, we also reject endogeneity of the lagged systemic index when it is added to this reduced model.

[15]The discussion below is framed in terms of the coefficients as the marginal effect. This is for ease of exposition since, in the nonlinear probit model, the coefficients do not necessarily indicate the marginal effect of the fundamentals. The marginal effect in the probit model is $\frac{\partial\Phi}{\partial(x_k)} = \Phi(X\beta)\beta_k$, and our results indicate this marginal effect calculated at the means.

2.2.1 Hypothesis tests

A debtor's incentives to access IMF resources are reflected through changes in the sensitivity, to fundamentals, of the decision to enter an IMF programme.[16] Our test for moral hazard examines this change in sensitivity, conditional on the likelihood of the debtor being affected by the policy change.[17] In particular, to examine the moral hazard effect of a change in Fund policy, we focus on the change in sensitivity beyond:

- any mean differences observed pre- and post-policy change for the entire sample;
- any mean differences in the sensitivity, conditional on the likelihood of a country being affected by the policy change, observed across the entire time period.

Furthermore, this marginal change in sensitivity post-policy change should be realised in such a way that would imply greater, rather than less, risk-taking on the part of the debtor. So our null hypothesis of moral hazard has two necessary, but not sufficient, conditions:

- There is a change in incentives, following the policy measure, in proportion to the systemic importance of the economy, ie $\Delta\beta'_k \neq 0$;
- This change in incentives is such that it is in the reverse direction of any *a priori* economic relationship between fundamentals and programme participation. For example, if we abstract the impact of policy changes, we might expect *a priori* that a country with a lower reserve coverage of short-term debt would be more likely to seek IMF assistance. But under the null of moral hazard, the opposite incentives occur once we condition on the policy incidence. Within our framework this implies that conditioning the differences, in the sensitivity to fundamentals which are observed post-policy change, on the systemic nature of the economy should suggest that participation is associated with stronger fundamentals (in this example, higher reserve coverage).

Although the first condition can be tested formally, the second must be examined for each individual control variable and depends on the significance of the coefficients. The null hypothesis does not place restrictions on whether there

[16] Notice that, given the reduced form of equation **(3)**, the observed sensitivity of programme participation to fundamentals could also reflect supply-side incentives, ie the sensitivity to fundamentals of the IMF's decision to offer a programme. This is discussed further in Section 3.2.

[17] We examine the sensitivity of our test results to the use of the 'systemic index' variable as a proxy for this likelihood – the results are robust to use of a continuous index or a sample split into more or less systemic groupings (which can be viewed as proxy test and control groups).

are structural changes post-policy ($\Delta\alpha \neq 0$, $\Delta\alpha' \neq 0$), or whether there is a general change in incentives post-policy ($\Delta\beta_k \neq 0$). A more restrictive null would be to test whether any structural or incentive changes post-policy are *only* in proportion to the systemic nature of the EME, ie $\Delta\alpha = 0$, $\Delta\alpha' \neq 0$, $\Delta\beta_k = 0$, $\Delta\beta_k' \neq 0$.

2.3 Data

We use a balanced panel of quarterly observations on 19 middle-to-lower income developing countries over the period 1995 Q1-2001 Q4 (see Table B). These countries are drawn from the major emerging market asset price indices (the Morgan Stanley equity index and the JP Morgan EMBIG bond index) and so have access to private external finance. The sample is limited, owing to restrictions on data availability for the transition economies. Nonetheless, the countries are broadly similar in terms of their economic development (as indicated by income per capita and trade openness) and integration into international capital markets. They also account, on average, for more than half of all IMF credit outstanding during the period in question.

Table B: Sample countries

	N=19	
Countries	Argentina	Malaysia
	Brazil	Mexico
	Chile	Pakistan
	China	Philippines
	Colombia	South Africa
	Czech Rep.	Thailand
	Hungary	Turkey
	India	Uruguay
	Indonesia	Venezuela
	Korea	
Memo items, 1999 values:[(a)]		
Gross national income per capita, US$	3474	
	(2357)	
Average external debt, % of GDP	47.3	
	(22.1)	
Average total trade, % of GDP	67.1	
	(48.1)	

Sources: World Bank World Development Indicators 2001.

(a) Standard deviation in brackets. All countries are members of JP Morgan Chase & Co's Emerging Markets Bond Index Global.

2.3.1 Systemic importance

Empirical and theoretical studies of contagion suggest the risk of contagion is likely to be greater the more important a country is in international capital markets, the larger the international bank exposure to the country, and the greater

its importance in international trade.[18] We therefore construct a 'systemic index' comprising the relative size of a country's outstanding international debt securities, BIS reporting banks' foreign claims on the country, and total trade.[19] The average values for this index (which is bounded by zero and one) and its components are shown in Appendix Table J. The ranking obtained, which is relatively stable over time, appears consistent with other recent analyses (eg Kamin (2002)).

2.3.2 The endogenous variable

The dependent variable is a binary $(0-1)$ index that takes the value one if a country is under an IMF programme (SBA, EFF or SRF) in any quarter *and* makes drawings upon IMF resources during the arrangement. Table C provides summary statistics of the IMF programmes (SBA, EFF or SRF), focusing on changes post-SRF. The size of funds agreed relative to quota appear to increase sharply, following the introduction of the SRF. The average programme duration also appears to lengthen somewhat. For illustrative purposes we include statistics for two sub-samples, broadly defined as more or less systemic relative to the median value of the country average index over time. Both sub-samples experience similar proportional changes, post-SRF, in terms of the average and maximum programme sizes relative to quota. In absolute terms, the increases are much larger for the more systemic sub-sample however.

[18] Although the exact definition of the interlinkage varies, trade and financial channels have been widely tested in the contagion literature. For example, Kaminsky and Reinhart (2000) consider trade linkages (bilateral and via third markets) and financial linkages (via bank exposures and capital market correlations).

[19] The components and equal weightings applied in this index and its linear construction are open to debate. But the index does capture key financial and trade propagation mechanisms. We do not consider explicit geopolitical indicators (although clearly there may be a correlation between such indicators and our choice of instrument). Barro and Lee (2002) examine the impact of such indicators on IMF lending decisions.

Table C: IMF programmes (SBA, EFF, SRF) announced in sample countries, 1995 Q1 to 2001 Q4[a]

	Full sample		Countries with average systemic index above median, N=9[b]		Countries with average systemic index below median, N=10	
	Pre-SRF	**Post-SRF**	**Pre-SRF**	**Post-SRF**	**Pre-SRF**	**Post-SRF**
Number of programmes						
Total, o/w	10 (2)	14 (3)	4(0)	9 (1)	6 (2)	5 (2)
SBA	*9 (2)*	*5 (1)*	*4 (0)*	*1 (0)*	*5 (2)*	*4 (1)*
EFF	*1 (0)*	*4 (2)*	*0 (0)*	*3 (1)*	*1 (0)*	*1 (1)*
SRF with SBA or EFF	*n.a.*	*5 (0)*	*n.a.*	*5 (0)*	*n.a.*	*0 (0)*
Amount agreed relative to quota						
Mean	212%	494%	449%	709%	53%	108%
Max	688%	1938%	688%	1938%	74%	253%
Average time to expiration or cancellation (years)	1.8	2.2	1.9	2.3	1.8	1.9

Sources: IMF website www.imf.org, IMF *International Financial Statistics* and authors' calculations.
(a) SRF was introduced on 17 December 1997 (Korea's associated SBA agreed on 4 December 1997 included in post-SRF figures).
Figures in brackets indicate number of programmes which were undrawn.
(b) Countries with average quarterly systemic index (1995-2001) above the sample median are Argentina, Brazil, China, Indonesia, Korea, Malaysia, Mexico, Thailand and Turkey.

Table D provides summary statistics on country participation in IMF programmes. In the seven-year period there were 176 quarterly programme participations. The average number of participations per country per quarter shows a somewhat different pattern across our two illustrative sub-samples. The frequency of programme participation rises, on average, following the SRF for the more systemic countries. The same does not appear to be the case for the rest of the sample.

Table D: Endogenous variable: sample summary[(a)]

		Number of quarterly programme participations[(b)]	Programme participations per quarter (sample average)[(c)]
Full sample	Pre-SRF	55	0.263 (0.441)
	Post-SRF	121	0.375 (0.485)
Countries with average systemic index above median	Pre-SRF	26	0.263 (0.442)
	Post-SRF	79	0.516 (0.501)
Countries with average systemic index equal or below median	Pre-SRF	29	0.264 (0.443)
	Post-SRF	42	0.247 (0.433)

Sources: IMF and authors' calculations.
(a) Pre-SRF period is 1995 Q1 to 1997 Q3; post-SRF period is 1997 Q4 to 2001 Q4.
(b) Defined as a quarter in which a country is in a SBA or EFF programme (with or without SRF) and makes a drawing under that programme at some point before the end of the programme.
(c) Standard deviation in brackets.

2.3.3 Exogenous variables

The incidence of claims on IMF resources depends, to a large extent, on domestic economic conditions and external vulnerabilities. We follow the literature on the determinants of sovereign spreads and IMF arrangements (eg Joyce (1992); Knight and Santaella (1997)) and choose variables that influence the demand and supply of IMF loans (see Table E). A country's demand for IMF resources is likely to depend on variables such as real GDP growth, inflation, the extent of real effective exchange rate (REER) misalignment (with a positive value indicating appreciation relative to trend), the level of indebtedness and the cost of alternative financing.[20] On the supply side, the approval of an arrangement is likely to depend, in part, on credit growth and the fiscal stance. The incidence of credit disbursal also relates to exchange rate policy – a devaluation is either a prior action of a programme, or a reason for IMF support. Given that absolute ratings are likely to be correlated with the above variables, following Dell'Ariccia *et al* (2002), we also include the residual of a regression of credit ratings against other country fundamentals. This summary variable potentially

[20]Changes in the cost of alternative financing could reflect changes in incentives through creditor moral hazard raising the possibility of endogeneity. However, as discussed below, this variable is insignificant in our specification and does not test positive for endogeneity if included in the base model.

incorporates information relevant to a country's capacity, and ability, to repay that is not captured by other control variables.

Table E: Exogenous variables[(a)]

Variable	Definition	Units
Macroeconomic position:		
INFLATION	Consumer price index inflation	Proportional change yoy of rolling-average index
GROWTH	Real GDP growth	Proportional change yoy of four-quarter rolling sum
Domestic vulnerabilities:		
CREDIT	Real domestic credit growth	Proportional change yoy of four-quarter rolling average
FISCAL	Government fiscal balance relative to GDP	Four-quarter rolling fiscal balance as proportion of four-quarter rolling nominal GDP
External vulnerabilities:		
EXPORT	Growth rate of merchandise exports	Proportional change yoy of four-quarter rolling sum
RESERVE COVER	International reserves (excluding gold) to short-term (less than one-year) outstanding BIS external debt	Ratio
DEPRECIATION	Dummy equal to 1 if nominal depreciation exceeding 5% over previous quarter, 0 otherwise	Binary variable
REER	Real effective exchange rate deviation from trend (1990-2001 where data available)	Proportional deviation relative to trend
External liquidity:		
LIQUIDITY	Spread of yield to maturity of Merrill Lynch High Yield Master Index over 10-year US Treasury yield	Percentage points
Ratings:		
RATING (RESIDUAL)	Residual of OLS regression by country of Moodys long-term foreign currency ceiling for bonds and notes on all above exogenous variables. Rating converted into numerical index (ranging from 1 for C rating to 23 for Aaa1).	

Sources: JP Morgan Chase & Co, International Monetary Fund *International Financial Statistics* and *World Economic Outlook* database, Thomson Financial Datastream, Moodys, national authorities.
(a) When underlying quarterly data not available linear interpolation from annual values used.

3 Estimation

3.1 Results

Pooled probit approaches have been commonly used in previous empirical studies of IMF programme participation decisions (eg Knight and Santaella (1997)) and in the currency crisis and early warning system literatures (eg Eichengreen *et al* (1996)). But a simple pooled approach ignores the panel nature of the data and

the potential serial correlation / heteroscedasticity in errors that could arise.[21] A random effects panel approach would take into account such unobserved country-specific effects.[22] The estimated coefficients of Equation (3) are not stable to the quadrature specification of the numerical integration technique, however.[23]

As highlighted by Duflo *et al* (2002), serial correlation is problematic in difference-in-difference approaches. One option is to employ a robust covariance structure over time within clusters (in our cases defined as countries).[24] We therefore adopt a pooled approach with robust standard errors clustered by country.[25] These adjusted errors allow for correlation within-cluster (ie country) observations due, for example, to omitted country-specific characteristics. It does however retain the assumption of independence across observations on different countries.[26] Clustering by individuals is widely used in labour economics, and clustering by country has been employed in some studies of currency crises (see Esquivel and Larraín (1998)) and of IMF programme participation (see Barro and Lee (2002))).

In order to identify the exogenous variables to be included in the specification of equation **(3)**, we first estimate a basic pooled probit model that excludes the variables relating to the policy measures and systemic importance (see Table F). The full set of independent variables is jointly significant. The signs of the coefficients for reserve coverage of short-term debt, fiscal balance, GDP growth and liquidity variables are as expected – a lower reserve coverage, lower fiscal surplus, lower growth, and tighter external financing conditions all increase the likelihood of a country participating in an IMF programme. One might also expect a weaker export position, higher domestic price inflation and large nominal depreciation to increase the probability of a country entering an IMF programme.

[21] We initially tested for and could not reject heteroscedasticity of the form $\sigma_j^2 = \{\exp(z_j\gamma)^2\}$. We also used a dynamic completeness test and found serial correlation in the residuals in all the model specifications in the paper.

[22] As Greene (2000, page 837) emphasises, the probit model does not lend itself to the fixed effects panel approach.

[23] The potential for serial correlation also raises the question of whether a lagged dependent variable should be included in our estimation. However, we do not employ such an approach for reasons of empirical tractability and because it would complicate the interpretation of our test for moral hazard discussed below.

[24] Duflo *et al* (2003) suggest two other options which are not directly applicable in our context. The first involves removing the time series dimension by aggregating data into pre- and post-policy change and is problematic due to our limited cross-section dimension. The second involves using the empirical distribution of the estimated effects for a number of randomly generate placebo policy to form a significance test for the true policy change and requires defined test and control groups.

[25] See Rogers (1993), Williams (2000) and Wooldridge (2002).

[26] Greene (2000) notes that the usage of the robust estimator to estimate the asymptotic covariance matrix is dependent on the quasi maximum likelihood converging to a meaningful probability limit but that there is no guarantee of this.

But the estimated coefficients on these variables were of the opposite sign.[27]

The signs of the other remaining variables, real domestic credit growth, the ratings residual and the deviation of the real exchange rate from trend, are open to interpretation. Although a rapid expansion of credit could create banking sector stress and precipitate a crisis, it could also reflect a deepening of the domestic financial sector which may reduce reliance on external finance. Similarly, while ratings residuals could reflect some form of ratings error conditioned on fundamentals, they may also represent additional indicators of creditworthiness and we would expect a negative coefficient. The estimate obtained in Table F is consistent with this view, though the caveat must be borne in mind. If deviations of the real exchange rate from trend are driven by private capital flows, then an overvaluation may imply little need for international financial support. Likewise, if deviations are below trend and a programme is initiated following downward pressure on the exchange rate, we might expect a negative coefficient. This is supported by graphical inspection and borne out by the estimates of Table F. We, therefore, take this as our base interpretation.[28]

The coefficient estimates for real GDP growth, fiscal balance, inflation, exchange rate dummy, real domestic credit growth variables were found to be jointly insignificant at the 5% level. Sequential elimination of these variables produces the core model, the fit of which is broadly comparable with the univariate specification of Knight and Santaella. Importantly, all the supply-side variables used by Knight and Santaella are insignificant in our specification suggesting that the key fundamental variables that explain IMF participation are largely on the demand side.

[27]The sign of these coefficients could reflect some endogeneity. For instance, the presence of a programme could be associated with a restoration of export growth and reduction in inflation. However, the signs remain the same with lags of up to six quarters and if we add these variables individually back into our reduced specification of Table F we reject their endogeneity. Interestingly, Barro and Lee (2002) look explicitly at the impact of IMF lending on country growth and find that the contemporaneous relationship is insignificant but that there is a significant negative effect on growth in the next five-year period.

[28]A real exchange rate overvaluation could also indicate the potential for future exchange rate corrections and could encourage a debtor to seek IMF support. This suggests that a positive coefficient is also plausible. But our sample evidence suggests that such countries do not actually seek to draw on official resources, so we regard our base interpretation as being more in keeping with our definition of participation.

Table F: Pooled probit estimation: basic model specification

	Full model				**Base model**			
	Coeff.	Marginal effect at means	Robust s.e.[(b)]	**P** $>\|z\|$	Coeff.	Marginal effect at means	Robust s.e.[(b)]	**P** $>\|z\|$
$REER_{(t-1)}$	-3.420**	-1.090	1.531	0.026	-3.393**	-1.114	1.514	0.025
$RESERVE\ COVER_{(t-1)}$	-0.706***	-0.225	0.248	0.004	-0.616***	-0.202	0.215	0.004
$FISCAL_{(t-1)}$	-3.810	-1.214	5.482	0.487				
$GROWTH_{(t-1)}$	-3.203	-1.021	2.497	0.200				
$EXPORT_{(t-1)}$	1.911*	0.609	1.110	0.085				
$INFLATION_{(t-1)}$	-0.093	-0.030	0.182	0.608				
$DEPRECIATION^{(a)}_{(t-1)}$	-0.162	-0.050	0.192	0.398				
$CREDIT_{(t-1)}$	-1.054	-0.336	1.105	0.340				
$LIQUIDITY_{(t-1)}$	0.056	0.018	0.067	0.402				
$RATING\ (RESIDUAL)_{(t-1)}$	-0.272***	-0.087	0.081	0.001	-0.270***	-0.089	0.087	0.002
CONSTANT	0.266		0.486	0.585	0.486		0.390	0.213
Observations	532				532			
Wald χ^2	47.890				14.330			
Degrees of freedom	10				3			
Prob>χ^2	0.000				0.000			
Log Likelihood	-263.9				-276.0			
Pseudo $R^{2\ (c)}$	0.219				0.183			
Adjusted Pseudo $R^{2\ (c)}$	0.186				0.171			
Accuracy ratio[(d)]	74.8%				73.7%			

Notes: (a) Marginal effect is for discrete change of dummy from 0 to 1. (b) Robust standard errors clustered on EME.

(c) McFadden's Pseudo R^2=1-(lnL-lnL_0) where lnL_0 is the log-likelihood when only a constant is in the regression. Adjusted Pseudo R^2=1-((lnL-K*)/lnL_0) where K*=k+1.

(d) The proportion of participation decisions correctly predicted.

*** indicates significance at 1% confidence level. ** indicates significance at 5% confidence level. * indicates significance at 10% confidence level.

Having identified the fundamental variables in the core model we now consider whether there were generic structural changes in the programme participation decision post-policy change.[29] This is an intermediate step before the full specification of equation (3).[30] The results are informative (see Table G). The dummy variable for the post-SRF period is significant at the 5% level and indicates a rise in programme participation. As in the core model, the fundamental variables of the real exchange rate deviation, reserve coverage of short-term debt, and the ratings residual term are significant with negative signs. Interestingly, the interaction terms ($\Delta\beta_k$) are jointly insignificant suggesting that, on the whole, the sensitivity to fundamentals does not vary post-policy change with only the interaction term for reserve coverage significant (at the 10% level).

[29]This involves testing the following specification (with D_t a temporal dummy that equals one in the periods following the announcement of the SRF).

$$I^*_{i,t} = \alpha + D_t\Delta\alpha + \sum_{k=1}^{K} \left[\beta_k + D_t\Delta\beta_k\right] X_{ik,t-1} + \varepsilon_{it} \tag{5}$$

with decision rule:

$$I_{i,t} = \begin{cases} 1 & if \quad I^*_{i,t} > 0 \\ 0 & if \quad I^*_{i,t} \leq 0 \end{cases} \tag{6}$$

[30]We thank an anonymous referee for this suggestion.

Table G: Pooled probit estimation with policy change interaction terms

	Coeff.	Marginal effect at means	Robust s.e.[(b)]	P > |z|
Structural effects [(a)]				
α	0.067		0.442	0.879
Marginal change post-SRF				
$\mathbf{D}_t \triangle\alpha$	0.925**	0.264	0.454	0.041
Sensitivity to fundamentals				
β_k:				
$\text{REER}_{(t-1)}$	-5.510*	-1.714	3.224	0.087
$\text{RESERVE COVER}_{(t-1)}$	-0.424*	-0.132	0.231	0.067
$\text{RATING (RESIDUAL)}_{(t-1)}$	-0.721*	-0.224	0.371	0.052
Marginal change post-SRF				
$\triangle\beta_k$:				
$\mathbf{D}_t$*$\text{REER}_{(t-1)}$	4.395	1.367	3.314	0.185
$\mathbf{D}_t$*$\text{RESERVE COVER}_{(t-1)}$	-0.452*	-0.141	0.273	0.098
$\mathbf{D}_t$*$\text{RATING (RESIDUAL)}_{(t-1)}$	0.601	0.187	0.432	0.164
Observations	532			
Wald $\chi^2(k=7)$	18.05			
Prob> χ^2	0.012			
Log Likelihood	-261.2			
Pseudo $R^{2(c)}$	0.227			
Adjusted Pseudo $R^{2(c)}$	0.203			
Accuracy ratio[(d)]	76.7%			

Notes:

(a) Marginal effect is for discrete change of dummy from 0 to 1.

(b) Robust standard errors clustered on EME.

(c) McFadden's Pseudo $R^2 = 1 - (\ln L / \ln L_0$ where $\ln L_0$ is the log-likelihood when only a constant is included in the regression. Adjusted Pseudo $R^2 = 1 - ((\ln L - K^*)/\ln L_0)$ where $K^* = k + 1$.

(d) The proportion of participation decisions correctly predicted.

*** indicates significance at 1% confidence level.

** indicates significance at 5% confidence level. * indicates significance at 10% confidence level.

We insert the fundamental variables identified by the core model into the specification of equation **(3)** to examine the effects of the SRF (see Table G). The fit of the model is improved relative to the core model and the coefficients are jointly significant.[31] The significance of $\Delta\alpha$ suggests a general upward shift in the probability of programme participation for all countries, following the introduction of the SRF. There does not appear to be a significant change in the probability of programme participation solely due to the systemic nature of a country (with α' and $\Delta\alpha'$ insignificant). But, across the whole period, the interaction coefficients of fundamentals with the systemic index (β'_k) are jointly

[31] The accuracy ratio under the moral hazard specification is 77.3% and the adjusted pseudo R^2 is 0.257 compared to 73.7% and 0.171 respectively under our core model.

significant, suggesting a difference in incentives related to the systemic nature of economies.

In contrast to the results of Table G, Table H indicates a general change in fundamental sensitivities post-SRF (ie $\Delta\beta_k$ are jointly significant primarily due to the strongly significant negative interaction term on reserve coverage). Furthermore, the results in Table H suggest that the first element in our moral hazard test is satisfied – the coefficients $\Delta\beta'_k$ are jointly significant – there has been a marginal change in incentives post-policy proportional to the systemic nature of the country.[32] There is also support for the second element of the hypothesis. For both reserve coverage and the real effective exchange rate coefficient, the marginal change in incentives following the SRF, conditioning on the systemic nature of the country, is the reverse of the *a priori* relationship between fundamentals and participation decision. Post-SRF, the marginal change for more systemic countries is consistent with more reserve coverage positively related to IMF programme participation, ie the opposite of our *a priori* relationship.[33] The marginal coefficient, post-SRF, for the REER coefficient interacted with the systemic index is also opposite to our *a priori* assumption that smaller misalignments of the real exchange rate make participation in IMF programmes by systemic countries more likely. The coefficients on the ratings residuals have a more ambiguous interpretation and do not indicate a significant change in incentives in the post-SRF period. Our estimates suggest that, for reserve coverage in particular, the marginal change in resource usage post-SRF by more systemic countries is in the opposite direction to the general trend.[34]

We repeat the above analysis using the announcement of the NAB in 1997 Q1 as the key policy event. The effects on resource usage were expected to be similar to those arising from the introduction of the SRF. The test results, both in terms of the significance of $\Delta\beta'_k$ and the direction of the fundamental variables of reserve coverage and real effective exchange rate deviation, are the same as in the SRF case.

Another candidate for a policy event is the Russian crisis (1998 Q3). Dell'Ariccia *et al* (2002) suggest that the IMF's decision not to intervene reduced expectations of future bailouts, casting doubts over the 'international financial safety net'. Our

[32]In relation to the discussion in Section 3.1, it is worth noting that the robust clustered standard errors are on average 40% larger than the unadjusted errors.

[33]This might reflect the rise in reserve coverage in Asia post-crisis which was concurrent with the presence of a number of more systemic Asian countries being in an IMF programme. But estimating the model excluding the Asian crisis economies (Indonesia, Korea, Malaysia, Philippines and Thailand) produced the same results.

[34]Furthermore this effect appears to be of significant relative magnitude (as calculated by the marginal effect at the means). Post-SRF, for a given reserve cover, the marginal effect at the mean suggests that a country with a systemic index of 0.25 would be 30% more likely to be in a programme than a country with a systemic index of zero. This effect compares to a general fall in the probability of programme participation post-SRF, for given reserve cover, of around 40%.

results are again unchanged when we estimate our model using this event. There is a general upward shift in the probability of entering a programme in the period from 1998 Q3, and systemically important countries appear to have acted as if a financial safety net was present. In other words, the Russian non-bailout did not lower the propensity for systemic countries to use official sector resources. But the lack of sensitivity of our results to changes in events could reflect the similar time periods involved (each event roughly divides the sample into periods before and after late 1997-98). It could also reflect limitations in our policy equation, which depends only on the degree of systemic importance. Clearly other factors were also relevant – a fuller analysis would require a richer set of indicators to explain the reasons for the non-intervention of the official sector during the Russian crisis.

We also examine the sensitivity of our results to the structural specification, for example the choice of probability model, lags and systemic index definition.[35] The results are robust to the use of an alternative logit probability model. Using the same variables as in Table G, if the lag is varied from zero to four quarters the core results remain: $\Delta\alpha$, $\Delta\beta_k$ and $\Delta\beta'_k$ are significant (at least at the 10% level) and the reserve cover coefficient is positive in $\Delta\beta'_k$ and negative in $\Delta\beta_k$. However, for lags of more than two quarters the sign of the real effective exchange rate coefficient differs to the base results.[36] The core results also hold if we use a dichotomous systemic index (defined as one for a country if its average systemic index was above the sample median and zero otherwise). Similarly for systemic indices based solely on shares of foreign claims or international debt securities.[37] The results do not hold if we use an index based solely on the trade shares. This is perhaps unsurprising as this variable appears a less valid instrument for the policy decision given the lower risk of contagion of international capital markets through trade flows alone.

[35]We also test the robustness of the results to different samples. The overall results in terms of the significance of $\Delta\beta'_k$ and their signs for reserve coverage and real effective exchange rate deviation were generally robust to the exclusion of individual countries or time periods (although in some cases there was a reduction in the significance of individual coefficients).

[36]However, the significance levels of these individual coefficients falls. In part this is likely to reflect the fact that these variables were chosen from a base specification using a single lag. If we identify the appropriate fundamental variables for different lags again our core results of joint significance of the groups of coefficients and signing of the reserve cover coefficient remain.

[37]Following Barro and Lee (2002), we also consider a country's political proximity to the US as an alternative proxy for a country's likelihood of being affected by the Fund policy changes. This variable was constructed from UN General Assembly voting patterns over the sample period. Although not reported here, the coefficients $\Delta\beta'_k$ were jointly significant indicating a change in incentives (although the sign component of our test was not satisfied).

Table H: Pooled probit estimation: moral hazard test specification

	Coeff.	Marginal effect at means	Robust s.e.[(b)]	$P>\|z\|$
Structural effects [(a)]				
α	-0.080		0.724	0.912
$\lambda_{i,t-1}\alpha'$	1.004	0.282	1.834	0.584
Marginal change post-SRF				
$\mathbf{D}_t\triangle\alpha$	1.279**	0.316	0.640	0.046
$\mathbf{D}_t\lambda_{i,t-1}\triangle\alpha'$	-1.633	-0.459	2.374	0.491
Sensitivity to fundamentals				
β_k:				
$\text{REER}_{(t-1)}$	0.475	0.133	6.141	0.938
$\text{RESERVE COVER}_{(t-1)}$	0.094	0.026	0.435	0.829
$\text{RATING (RESIDUAL)}_{(t-1)}$	-0.837	-0.235	0.525	0.111
β'_k:				
$\lambda_{i,t-1}*\text{REER}_{(t-1)}$	-22.419**	-6.300	10.752	0.037
$\lambda_{i,t-1}*\text{RESERVE COVER}_{(t-1)}$	-3.026	-0.850	2.341	0.196
$\lambda_{i,t-1}*\text{RATING (RESIDUAL)}_{(t-1)}$	0.248	0.700	1.245	0.842
Marginal change post-SRF				
$\triangle\beta_k$:				
$\mathbf{D}_t*\text{REER}_{(t-1)}$	-0.991	-0.278	6.056	0.870
$\mathbf{D}_t*\text{RESERVE COVER}_{(t-1)}$	-1.461**	-0.410	0.570	0.010
$\mathbf{D}_t*\text{RATING (RESIDUAL)}_{(t-1)}$	0.950	0.267	0.633	0.133
$\triangle\beta'_k$:				
$\mathbf{D}_t*\lambda_{i,t-1}*\text{REER}_{(t-1)}$	18.871*	5.303	10.497	0.072
$\mathbf{D}_t*\lambda_{i,t-1}*\text{RESERVE COVER}_{(t-1)}$	4.528*	1.273	2.710	0.095
$\mathbf{D}_t*\lambda_{i,t-1}*\text{RATING (RESIDUAL)}_{(t-1)}$	-1.014	-0.285	1.370	0.459

Observations	532
Wald $\chi^2(k=15)$	164.8
Prob> χ^2	0.000
Log Likelihood	-234.9
Pseudo $R^{2(c)}$	0.304
Adjusted Pseudo $R^{2(c)}$	0.257
Accuracy ratio[(d)]	77.3%

Notes:
(a) Marginal effect is for discrete change of dummy from 0 to 1.
(b) Robust standard errors clustered on EME.
(c) McFadden's Pseudo $R^2 = 1 - (\ln L / \ln L_0)$ where $\ln L_0$ is the log-likelihood when only a constant is included in the regression. Adjusted Pseudo $R^2 = 1 - ((\ln L - K^*)/\ln L_0)$ where $K^* = k+1$.
(d) The proportion of participation decisions correctly predicted.
*** indicates significance at 1% confidence level.
** indicates significance at 5% confidence level. * indicates significance at 10% confidence level.

3.2 Interpretation

Careful interpretation of our reduced form model results is required – changes in programme participation could reflect changes in the supply-side incentives for

the IMF to lend, changes in the demand-side incentives of potential borrowers or a combination of the two. Only changes in demand-side incentives could be related to potential debtor moral hazard. Given this identification problem, one would ideally estimate a structural model of both the demand and supply side of IMF programme participation. If one is to follow this approach, which variables should be incorporated in the supply side of such a model?

Some guidance may be provided by an IMF study of the empirical importance of different existing access criteria (IMF (2001b)). These criteria included a perceived need for Fund resources (the demand-side) and various supply-side variables, for example the borrower's capacity to repay, its track record in previous programmes and its stock of outstanding Fund credit relative to its quota. A number of financial and 'strength of programme' variables were used as indicators of the capacity to repay. The significant supply-side variables were the level of outstanding Fund credit at the beginning of the arrangement relative to exports (viewed as a financial indicator of the capacity to repay), the projected current account adjustment (a 'strength of programme' indicator of the capacity to repay) and the presence of a poor track record in previous programmes. Incorporating these variables into our study is problematic. There are issues of data availability, all of these variables are defined only at the start of a programme and, hence, not amenable to the time series dimension in our data set. So the use of a structural model presents a trade-off between analytical rigour and empirical tractability. In light of this trade-off our choice remains the reduced-form model, which is the preferred model of the related literature on the economic determinants of IMF programmes.

The fundamental variables in our final reduced-form model – reserve coverage, real exchange rate appreciation and a residual indicator of creditworthiness (the ratings residual variable) – are all indicators of a debtor's potential need for Fund resources. Furthermore, they are consistent with those variables identified in previous studies (Knight and Santaella (1997) and IMF (2001b)) as indicators of the demand for Fund resources. This suggests that our results are indeed picking up changes in demand-side incentives that are required to validate our moral hazard hypothesis tests.[38] However, there may be alternative explanations. For example, the marginal change in debtor incentives may be because the available programmes post-policy change are viewed by systemic countries in particular as more effective in dealing with real hazard. Such differential effects would not be picked up in our binary approach and would be difficult to disentangle given the concurrent usage of regular SBA and SRF programmes for a single country (as highlighted in Table A).

[38]Indeed the IMF study (IMF (2001b)) concluded that the relatively small explanatory power of indicators of existing access criteria and the importance of the constant term 'suggests the existence of an implicit norm for access' (page 25). This could be viewed as adding weight to the interpretation of our reduced-form model as picking up primarily changes in demand-side incentives.

4 Concluding remarks

This paper has specified and estimated a probit model in an attempt to identify whether recent policy measures to facilitate international financial rescues have influenced debtors' reliance on official sector resources. To the extent that these measures may lead certain debtors to view exceptional funding as 'part of the furniture', an increase in moral hazard might be expected. Our analysis highlights the systemic importance of debtors as a key characteristic driving access to exceptional funds. Using an index of systemic importance as an indicator of the likelihood of a country being able to gain access to such funds, we estimate the incidence of IMF programme participation. In adapting the natural experiment methodology, our approach aims to avoid potential problems of endogeneity and the lack of well-defined control groups. Combined with the use of directly observable actions to gauge the degree of moral hazard, this methodology provides an innovation to the previous, asset price-based, literature and an alternative attempt to address some of the inherent identification problems of such empirical studies of moral hazard.

The initial empirical results obtained from our simple set-up are suggestive. We find that the introduction of the NAB and SRF has a greater marginal impact on incentives for official sector resource usage, the more systemically important the debtor, ie the more likely an economy is to benefit from the safety net created by these measures. The results appear particularly robust in relation to reserve coverage (which conceptually seems to be a primary driver of a debtor's incentives to access official sector resources). A potential problem, however, is the difficulty of distinguishing between supply and demand-side influence on observed behaviour. While this could suggest that the findings might also be consistent with a change in IMF supply-side incentives as well as moral hazard, our estimates, and the related literature, point to the importance of demand-side factors in explaining the participation decision. The findings could thus be interpreted as offering some support for an increase in the degree of moral hazard on the debtor side during the late 1990s. But this should not be taken as definitive evidence of IMF-induced moral hazard. As Rogoff (2002) notes, empirical studies of moral hazard in international lending are extremely mixed and best viewed with caution. A fuller analysis must directly analyse the behaviour of both borrowers and lenders, as international capital flows reflect the interaction of both types of agent.

Some other limitations of our study must also be kept in mind before drawing any policy implications. First, our results confirm a *necessary*, but not *sufficient*, condition for debtor-side moral hazard. Second, our inability to identify a control group necessitates the use of a proxy variable, the choice of which is open to debate. Third, in contrast to other natural experiment analyses of moral hazard in the insurance or labour economics literature, our data set is relatively small limiting the econometric methodology which can be employed. Finally, the common

finding across different policy events may reflect some broader structural change to debtor incentives that occurred during the late 1990s.

Our findings should not be taken to mean that measures such as the SRF have no place in crisis management policy. The desirability and extent of an 'international financial safety net' involve trading off the *ex-ante* problems of moral hazard against the *ex-post* costs of crisis. But our results provide some support to those who argue that official finance can distort the incentives of debtors and, potentially, substitute for private capital flows. As in many other instances, policies towards crisis management must aim to strike a balance – between official finance, debtor adjustment, and private sector involvement.

A Appendix: IMF facilities and construction of a systemic index

A.1 IMF facilities

The main IMF facilities are described in Table I below.

Table I: Main IMF facilities[(a)]

	Stand-By Arrangements (SBA)	**Extended Fund Facility (EFF), introduced 1974**	**Supplemental Reserve Facility (SRF), introduced 1997**
Objective	Address short-term balance of payments difficulties	Address longer-term balance of payments difficulties	Meet very short-term large scale financing needs
Typical length	12 to 18 months	3 years	Funds will be committed for up to one year
Access limits	Normally 100% of quota annually and 300% cumulatively although greater access may be allowed in certain circumstances	As for SBA	In excess of normal access limits
Repayment period	Normally expected within 2¼ to 4 years unless extended	Normally expected within 4½ to 7 years unless extended	Normally expected within 1 to 1½ years but may be extended up to 1 year
Charges	Surcharges of 100bp above basic rate of charge for credit over 200% quota and 200bp for credit over 300% of quota	As for SBA	Surcharge of 300bp above basic rate of charge in first year from date of drawing. Surcharge increases thereafter by 50bp every six months up to 500bp.

Source: IMF website (www.imf.org).

(a) Other IMF facilities are:

- Poverty Reduction and Growth Facility (PRGF) to assist low-income countries;
- Contingent Credit Lines (CCL) which aim to provide financing to prevent crises (it has yet to be used);
- Compensatory Financing Facility (CFF) to help countries experiencing shortfalls in export earnings and services receipts that are temporary and arise from events beyond the members' control;
- Emergency assistance for countries experiencing natural disasters or recovering from conflict.

A.2 Systemic index

Our quarterly 'systemic index' consists of three sub-indices representing:

- The country's international debt securities for all types of issuer relative to the total for all developing countries (BIS data);
- BIS reporting banks' foreign claims on the country relative to total such claims on all developing countries (BIS data);
- The country's merchandise trade (exports plus imports) relative to total world merchandise trade on a rolling four-quarter basis (IMF Direction of Trade Statistics data). We use total world trade, rather than developing country trade, to capture spillovers via competition in third markets.[39]

Each sub-index was calculated by scaling a country's value relative to the maximum value in our sample in that year (so the sub-indices are bounded by zero and one). The three sub-indices were combined with equal weighting to form the overall index. Table J provides the sample period averages for the components of the sub-indices and for the overall index. For the purposes of the sensitivity test we also divided the sample into those with high systemic index (above the median) and those with lower systemic index.

[39]The BIS foreign claims data is only available on a semi-annual basis prior to 1999 Q4 so linear interpolation was used to produce the quarterly values. Quarterly trade data was also not available for South Africa prior to 1998 Q4 so linear interpolation from annual data was used.

Appendix Table J: Systemic index components[(a)]

	Average systemic index	Merchandise trade as % of world total	Foreign claims on EME as % of total foreign claims on developing countries	International debt securities outstanding as % of developing country total
Mexico[b]	0.81	2.21	8.47	15.05
Korea[b]	0.80	2.46	7.99	13.42
Brazil[b]	0.65	0.99	10.10	10.89
China[b]	0.61	3.09	5.63	5.04
Argentina[b]	0.52	0.44	6.20	13.26
Thailand[b]	0.37	1.07	5.43	3.78
Malaysia[b]	0.31	1.37	2.91	3.39
Indonesia[b]	0.30	0.79	4.54	3.38
Turkey[b]	0.26	0.61	2.83	5.00
India	0.19	0.69	2.70	1.53
Hungary	0.18	0.39	1.55	4.30
Philippines	0.17	0.61	1.59	2.80
South Africa	0.15	0.49	1.93	1.56
Chile	0.15	0.30	3.09	0.89
Venezuela	0.13	0.34	1.53	2.34
Czech Republic	0.11	0.48	1.50	0.51
Colombia	0.11	0.22	1.55	1.57
Pakistan	0.05	0.17	0.72	0.19
Uruguay	0.03	0.05	0.52	0.37
Memo item:				
Median	0.19	0.61	2.83	3.38

Sources: BIS, IMF Direction of Trade Statistics and authors' calculations.
(a) Average quarterly values 1995 Q1-2001 Q4.
(b) Countries whose sample average systemic index is above the median such value across countries.

References

[1] **Barro, R and Lee, J (2002)**, 'IMF programs: who is chosen and what are the effects?', *NBER Working Paper no. 8951.*

[2] **Blundell, R and MaCurdy, T (1999)**, 'Labour supply: a review of alternative approaches', in Ashenfelter, O C and Card, D (eds), *Handbook of Labour Economics Volume 3A*, North-Holland.

[3] **Chiappori, P, Durand, F and Geoffard, P (1998)**, 'Moral hazard and the demand for physician services: first lessons from a French natural experiment', *European Economic Review*, Vol. 42, pages 499-511.

[4] **Chiappori, P and Salanie, B (2000)**, 'Testing contract theory: a survey of recent work', *Invited Lecture*, World Congress of the Econometric Society, Seattle.

[5] **Dell'Ariccia, G, Schnabel, I and Zettelmeyer, J (2002)**, 'Moral hazard and international crisis lending: a test', *IMF Working Paper no. 02/181.*

[6] **Duflo, E, Bertrand, M and Mullainathan S (2002)**, 'How Much Should We Trust Differences-in-Differences Estimates?', *NBER Working Paper no. 8841.*

[7] **Eichengreen, B, Rose, A and Wyplosz, C (1996)**, 'Contagious currency crisis', *NBER Working Paper no. 5681.*

[8] **Esquivel, G and Larraín, F B (1998)**, 'Explaining currency crises', *Harvard Institute for International Development, Development Discussion Paper no.666.*

[9] **Greene, W H (2000)**, *Econometric analysis*, fourth edition, Prentice Hall International.

[10] **Haldane, A G and Kruger, M (2001)**, 'The resolution of international financial crises – private finance and public funds', *Bank of England Financial Stability Review*, December.

[11] **Haldane, A G and Scheibe, J (2004)**, 'IMF lending and creditor moral hazard', *Bank of England Working Paper no. 216.*

[12] **Haldane, A G and Taylor, A (2003)**, 'Moral hazard: how does IMF lending affect debtor and creditor incentives?', *Bank of England Financial Stability Review*, June.

[13] **IMF (2000)**, 'Review of Fund facilities – preliminary considerations', IMF, Washington DC.

[14] **IMF (2001a)**, 'Selected decisions and selected documents of the IMF, Twenty-sixth issue', IMF, Washington DC.

[15] **IMF (2001b)**, 'Review of access policy in the credit tranches and under the Extended Fund Facility – background paper', IMF, Washington DC.

[16] **Jeanne, O and Zettelmeyer, J (2001)**, 'International bailouts, financial transparency and moral hazard', *paper prepared for the 33rd Economic Policy Panel Meeting*, Stockholm, 6-7 April 2001.

[17] **Joyce, J (1992)**, 'The economic characteristics of IMF program countries', *Economics Letters*, Vol. 8, pages 237-42.

[18] **Kamin, S B (2002)**, 'Identifying the role of moral hazard in international financial markets', *Federal Reserve Board International Finance Discussion Paper no. 2002-736*.

[19] **Kaminsky, G and Reinhart, C (2000)**, 'On crises, contagion and confusion', *Journal of International Economics*, Vol. 51, pages 145-68.

[20] **Knight, M and Santaella, J (1997)**, 'Economic determinants of IMF financial arrangements', *Journal of Development Economics*, Vol. 54, pages 405-36.

[21] **Krueger, A (2001)**, 'International financial architecture for 2002: a new approach to sovereign debt restructuring', *address given at the National Economists' Club Annual Members' Dinner, American Enterprise Institute*, Washington DC.

[22] **Lane, P and Phillips, S (2000)**, 'Does IMF financing result in moral hazard?', *IMF Working Paper no. 00/168*.

[23] **Mathieson, D, Schinasi, G J and IMF staff (2000)**, 'International capital markets – developments, prospects and key policy issues', IMF, Washington DC.

[24] **McBrady, M R and Seasholes, M S (2000)**, 'Bailing-in', University of California Berkeley Haas School of Business, *mimeo*.

[25] **Mussa, M (1999)**, 'Reforming the international financial architecture: limiting moral hazard and containing real hazard', paper presented at the *Reserve Bank of Australia Conference on Capital Flows and the International Financial System*, 9-10 August 1999.

[26] **Mussa, M (2002)**, 'Reflections on moral hazard and private sector involvement in the resolution of emerging market financial crises', paper presented at the *Bank of England Conference on The Role of the Official and Private Sectors in Resolving International Financial Crises*, 23-24 July 2002.

[27] **Rogers, W H (1993)**, 'Regression standard errors in clustered samples', *STATA Technical Bulletin*, Vol. 53, pages 32-35. Reprinted in *STATA Technical Bulletin Reprints*, Vol. 9, pages 275-77.

[28] **Rogoff, K (2002)**, 'Moral hazard in IMF loans: how big a concern?', *Finance and Development*, Vol. 39(3).

[29] **Williams, R L (2000)**, 'A Note on Robust Variance Estimation for Cluster-Correlated Data', *Biometrics*, Vol. 56, pages 645-646.

[30] **Wooldridge, J M (2002)**, *Econometric Analysis of Cross Section and Panel Data*, Cambridge, MA: MIT Press, 2002.

[31] **Zhang, X A (1999)**, 'Testing for "moral hazard" in emerging markets lending', *Institute of International Finance Research Paper no. 99-1.*