The Conditional Nature of the IMF Catalytic Effect *

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Abstract

How do international financial institutions interact with international markets? In particular, how do markets react to major multilateral lending initiatives? We analyze a formal model which demonstrates that the "catalytic effect" of the IMF, or the effect of IMF program announcements on international investment flows, is conditional. Namely, the degree to which IMF programs stimulate investment flows depends on how market actors interpret the motivations behind a lending decision of the IMF. If investors believe the decision to turn to the IMF for support is a sign of economic weakness, IMF programs should not increase foreign investment. On the other hand, if market actors believe that IMF financing and conditionality significantly reduces the risk of a financial crisis, they may respond with private investment, creating a "catalytic effect." In our model, the informal influence of major shareholders that drive IMF decisions can affect the inferences market actors draw. Our theory helps explain discrepant empirical findings with respect to the catalytic effect of IMF programs, and we test additional empirical implications by examining how sovereign credit ratings are affected by program announcements, loan size, and the scope of conditions attached to loans.

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Introduction

How do international organizations and the informal influence of powerful states within these organizations influence markets? The effect of multilteral bailouts on investment flows has long been a core concern of economists and political scientists studying economic development. However, there has been very little attention to how the politics within international organizations might condition market reactions to multilateral economic interventions. This is unfortunate because a growing body of work recognizes that the interests and biases of IO member states directly affect a range of IO outputs, including the credibility of IMF conditions (Stone 2004), loan size and conditions (Stone 2008; Copelovitch 2010), the reaction of external audiences to the decisions of security IOs (Chapman 2011). Additionally, the politics between states within international organizations, like the UN General Assembly or UN Security Council, can affect the disbursement of World Bank Loans and IMF packages (Thacker 1999; Dreher et al. 2009a, 2009b). Given the degree to which the influence of powerful states within IOs affect the decisions and effectiveness of these organizations, it is natural to expect market actors to use their knowledge about informal influence to draw inferences about IMF behavior.

We build on this insight by generating a game-theoretic model of lending between the IMF, a developing country government, and a market actor. In the game the IMF may be relatively neutral or biased in favor of the developing country, while the market actor maximizes its returns on investment. Key to our model is that the probability of economic crisis within a country, and subsequent default, is endogeous to the IMF's lending decision and market actors' investment decisions. First, the probability of crisis is a function of loan size and the types of conditions attached to IMF loans, which are determined by several parameters of the IMF's preferences. In particular, the IMF's lending decision is influenced by its political bias toward an applicant country. We conceptualize the bias as representing the interests of a pivotal state, such as the United States within the IMF, and the *degree* of the bias is determined by the strategic importance of the country to the pivotal state. For simplicity, in our model we assume that the market actor has a good grasp of the IMF's bias toward the country, and thus can anticipate its effect on the IMF's lending decision. Additionally, the market actor is able to observe loan size and conditionality. In reality, data on conditionality were not publicly released until recently; however, we argue that information about conditionality was nevertheless not too difficulty to glean from media reports or announcements made by governments involved. We assume that rational market actors are capable of acquiring such information when making important investment decisions with respect to a sovereign state.

In addition, the probability of crisis and default is also a function of the underlying state of the developing country's economy and the price of borrowing, i.e., the interest rate set by the market actor. Both the market actor and IMF lack complete information about the underlying state of the developing country's economy.[1] The interest rate is determined competitively, so market actors price their capital to offset risk. However, the price of capital itself is a component of a country risk profile. This setup allows us to examine how market actors might make inferences about the likelihood of a crisis and factor these considerations into their investment decisions, which in turn determine interest rates.

Our theoretical analysis suggests that the effect of IMF program announcements on markets is complex. There is unlikely to be a straightforward catalytic effect because the effect of IMF programs on the quality of a sovereign investment environment is conditional on a number of factors. First, the size of the program matters. Larger influxes of liquidity are, all else equal, more likely to stabilize a country. Second, the type and number of conditions matter, as the reforms mandated by agreeing to a loan package have important effects on the long-run stability of a country. However, reforms are often costly for a government politically, so it may resist an agreement that comes with strict conditionality. Intuitively, then, all else equal, stricter conditionality is more likely to be accepted by countries that are experiencing worse economic situations in exchange for a loan. This means that market actors may

[1] As Blustein documents in his 2001 book, the IMF is often as much "in the dark" as market actors when it comes to knowing detailed information about a country's underlying economic state.

learn new information about a country's economic fundamentals by observing details of IMF programs. The direction of such an update can go either way, depending on the content of the agreement. Moreover, if indeed the IMF's lending decision is conditional on its bias, then relatively lenient conditionality may not signal a healthier economy; it may simply reflect the favoritism that the IMF displays towards a country that is under severe economic stress. This is a core innovation in our model: the IMF itself has biases in favor of specific countries, owing to their strategic and financial importance to key IMF member states. Thus, when drawing inferences about investment environments, market actors consider the likely bias of the IMF, the possible underlying state of the economy, and the likely conditions attached to loans.

Our paper proceeds as follows. We first briefly discuss the literature on the catalytic effect of the IMF, and the larger theoretical implications of our argument for theories about international organizations and global economic order. We then present our theoretical model, followed by preliminary quantitative analysis.

Global Economic Governance and Market Response

How and why international organizations matter, as well as how organizations and their behaviors are influenced by member states' preferences, has long been an area of interest for international relations scholars. The IMF is a useful institution to study in order to understand these questions, since it deals in the high stakes policy realm of financial crises and its organizational structure allows both formal and informal channels of influence for powerful states (Stone 2011). The quota based voting system within the IMF and the ability of the U.S. to exert extraordinary control during special circumstances allows so-called "high politics" to enter into lending and conditionality decisions, as a number of studies demonstrate (Thacker 1999; Stone 2002, 2004, 2008; Dreher et al. 2009).

However, the key question of how IMF programs influence international markets has not been studied with sensitivity to these fundamental political factors. To be sure, the "catalytic" effect of IMF programs has received considerable attention in the economics literature (Bird and Rowlands 2002; Brune et al. 2004; Edwards 2005; Mody and Saravia 2003; Eichengreen et al. 2007).[2] The degree to which IMF interventions restore investors' confidence is a critical component of understanding whether the IMF is "good" for recipient countries. Yet empirical research on the catalytic effect displays mixed findings. For instance, correcting for selection, Edwards (2006) finds that IMF programs generate net outflows of portfolio investment. Mody and Saravia (2003) find a positive effect of IMF programs only in cases of intermediate financial risk, which the authors characterize as instances when IMF programs are viewed as joint commitments between a government and the IMF. Eichengreen and Mody (2000) find evidence that IMF lending decreases bond spreads, while Cottarelli and Giannini (2002) find little evidence that IMF interventions catalyze investment. It is clear that catalytic effects vary considerably across types of countries, but there is little consensus about the systematic sources of this variation.

In our view, the emphasis in the existing empirical research on finding positive catalytic effects may be misplaced. As we discussed above, there are several factors that influence market actors' investment decisions. An agreement with the IMF suggests that a significant financial institution is committed to helping an economy get back on its feet, which should send a positive signal to the capital market. On the other hand, the fact that a country needs a rescue package suggests that there may be problems with the country's economic fundamentals, which can make investors balk at lending to the government. These two opposing effects of IMF lending may explain the mixed findings, including the finding that there can a negative catalytic effect. Finally, the fact that IMF lending decisions are also subject to the political biases of the major IMF shareholders further complicates the inferences that market actors could draw from observing an agreement. Therefore, it is not surprising that previous studies have not reached consensus on a general pattern of catalytic effects. Our theoretical analysis provides a detailed explanation for this lack of consensus. The catalytic effect of IMF programs is highly conditional on a number of factors. Market actors may condition

[2] See Steinwand and Stone 2008 for a review.

their response on expectations of the importance of countries to key IMF shareholders, in addition to observable factors, like the size of the IMF loan stimulus and state of financial crisis within a country.

Our study also has broader implications for how political scientists think about international organizations. While some work has focused on how international institutions might be valuable as information sources or information facilitators (e.g. Keohane 1984; Haas 1990; Abbott and Snidal 1998; Dai 2002), recent work has begun to unpack the strategic sources of information transmission between IOs and relevant audiences. Our study fits in this more recent tradition. It also highlights the fact that certain design features of IOs that may be necessary for their creation and effectiveness, such as the quota-based voting system incentivizing contributions from individual IMF member states, can also have unintended and complicated consequences for the functioning of organizations (cf. Stone 2011). Below we specify a theoretical model to explore how U.S. influence in the IMF, in particular, should affect the reaction of international markets to IMF lending programs.

Model

In this section we develop a game-theoretic model to analyze the strategic interactions between a government, the IMF, and the international capital market. Let G denote a government in charge of an economy, I the IMF, and M a representative market actor. Suppose the health of the economy is a random variable, $\theta \in [-1, 0]$: if $\theta = -1$, the economy is experiencing an acute crisis; if $\theta = 0$, the economy is healthy; any value between the two extremes would mean that the economy is under some level of stress and there is a positive probability of imminent crisis.

Our model contains a bargaining phase between the government and the IMF regarding a loan agreement and a market reaction phase, in which the market sets the interest rate for investment in the country after observing the outcome of bargaining. The sequence of the game is as follows. At the beginning of the game nature draws the true state of the economy, θ; G learns the true value, but neither I nor M does. The government then enters negotiations with the IMF about a loan. We capture this phase by a simple bargaining game where the IMF makes a take-it-or-leave-it offer and the government decides whether to accept it. Specifically, the IMF proposes (s, x), where $s \in R^+$ is the size of the loan, and $x \in [0, 1]$ is the degree of reform mandated, or the conditionality. We normalize conditionality so that $x = 0$ is the status quo and $x = 1$ is IMF's ideal point. Additionally, the pivotal IMF shareholder may be biased in favor of the country due to geopolitical interests. Assume the degree of the bias is $\beta \in [0, 1]$. After I proposes, G accepts or rejects the offer. If G accepts, (s, x) will be implemented; if G rejects, there is no agreement, which means that $s = x = 0$. After observing the value of (s, x), M sets the interest rate that will offset the risk of lending to the country. Finally, nature moves again and reveals whether or not there is an economic crisis as a result of the state of the economy and the choices that the actors have made.

Assume that the probability of crisis is $p(s, x, \theta, r) \in (0, 1)$. That is, the probability is a function of the size of the loan, its conditionality, the initial state of the economy, and the interest rate on government bonds. Assume that $p'_\theta < 0$, $p'_x < 0$, and $p'_r > 0$. That is, the probability of a crisis decreases as the initial condition of the economy is less severe, and as more reforms are implemented. On the other hand, the probability increases as the interest rate rises.

The strategies of players are mappings specifying actions as functions of the history of the game. The action of the IMF is $(s, x) \in \mathbb{R}_+ \times [0, 1]$. G observes IMF's action, and then chooses to accept or reject based on it own type $\theta \in [-1, 0]$. Hence, the action of G with type θ is $I_\theta(s, x) : \mathbb{R}_+ \times [0, 1] \to \{0, 1\}$, where $I_\theta(s, x) = 0$ means it rejects and $I_\theta(s, x) = 1$ means it accepts. Lastly, after M observes s and x, it decides the market clearing interest rate in both the case where there is an agreement between IMF and G and that where there is no agreement. Hence, M's action is $r_a(s, x) : \mathbb{R}_+ \times [0, 1] \to [0, 1]$ if there is an agreement, and $r_n(s, x) : \mathbb{R}_+ \times [0, 1] \to [0, 1]$ otherwise.

We now proceed to specify the actors' payoffs. The government's utility function is as follows:

$$u_G(s,x;\theta) = -x + f(s) - p(s,x,\theta,r),$$

where $f(s) \in [0,1]$ and $f(\cdot)$ is a monotonically increasing function of s. In essence, $f(s)$ is the amount of reform that the government is willing to implement given the size of an IMF loan, so the different between x and $f(s)$, i.e., $-x + f(s)$ can be interpreted as the discrepancy between the amount of reform that the government is asked to implement, i.e., x, and what the government feels that the IMF has paid for, i.e., $f(s)$. The state of the economy and the interest rate on government bonds enter G's payoff through their effect on the probability of crisis. If there is a crisis later on, then the state of the economy is at the worst possible state, -1, thus the expected payoff in that case is $-p(s,x,\theta,r)$; if there is no crisis, then economy is back to healthy state, 0. If there is no agreement, then $s = x = 0$ and $u_G = -p(0,0,\theta,r)$. The

IMF's utility function is:

$$u_I(s,x) = -(1-\beta)g(s) - p(s,x,\theta,r)(1+\beta),$$

where $g(s) \in [0,1]$ and $g(\cdot)$ is a monotonically increasing function of s. Two things worth noting. First, the IMF loses utility when it lends to a country; we allow the relationship between the loan size and the utility for the IMF, $g(s)$, to be different from that for the government, $f(s)$. Second, the geopolitical importance of the country to the donor countries of the IMF enters IMF's utility function. As a result, the IMF has both direct and indirect incentives to make bigger loans to countries that are more "important" through the loan itself and its negative effect on the probability of crisis. If there is no agreement, then $u_I = -p(0,0,\theta,r)(1+\beta)$.

Lastly, let v be the amount of investment that the market actor is willing to make. Define M's utility function as follows:

$$\mathrm{u_M} = \begin{cases} v(1+r) & \text{if invest and no crisis,} \\ 0 & \text{if invest and crisis,} \\ v & \text{no investment.} \end{cases}$$

We focus on finding a cutpoint Subgame Perfect Equilibrium in which for all s and x, there exists a $\bar{\theta}(s,x) \in (0,1)$ such that for G, $I_\theta(s,x) = 1$ when $\theta \in [-1, \bar{\theta}(s,x))$, $I_\theta(s,x) = 0$ when $\theta \in (\bar{\theta}(s,x), 0]$, and G is indifferent between $I_\theta(s,x) = 1$ and $I_\theta(s,x) = 0$ when $\theta = \bar{\theta}(s,x)$. Due to the complexity of the model, we cannot fully solve the model analytically and computational analysis will be used as the project moves forward. Below is a partial equilibrium analysis that provides intuitions about what to look for in our empirical analysis.

We first analyze M's problem. In equilibrium we assume $EU_M(v) = 0$, because the interest rate should make M indifferent between investing and not investing. If M knows θ, then the market clearing interest rate can be derived as follows:

$$v(1+r)(1-p(s,x,\theta,r)) - 0 \cdot p(s,x,\theta,r) = v$$

This gives us the equilibrium interest rate:

$$r = \frac{p(s,x,\theta,r)}{1-p(s,x,\theta,r)} \tag{1}$$

Equation (1) has to be modified further because M only knows the *distribution* of θ, so the market clearing interest rate is going to depend on M's belief about a country's type, θ, conditional on the country's decision to accept or reject an IMF agreement. Assume that there is a cutpoint type $\bar{\theta} \in (-1, 0)$.[3] G always accepts when θ is below $\bar{\theta}$, and rejects when θ is above $\bar{\theta}$. Hence, when M observes an agreement, it knows that θ is uniformly distributed on $[-1, \bar{\theta}]$. Let $r_a(s,x,\bar{\theta})$ be the market clearing interest rate when G accepts IMF's offer. Then it is the solution to the following equation:[4]

$$r = \frac{E(p|\theta \in [-1,\bar{\theta}])}{1-E(p|\theta \in [-1,\bar{\theta}])} = \frac{\frac{\int_{-1}^{\bar{\theta}} p(s,x,\theta,r)d\theta}{1+\bar{\theta}}}{1-\frac{\int_{-1}^{\bar{\theta}} p(s,x,\theta,r)d\theta}{1+\bar{\theta}}} \tag{2}$$

Similarly, when M observes that there is no agreement, it knows that θ is uniformly distributed on $[\bar{\theta}, 0]$. Let $r_n(s,x,\bar{\theta})$ be the market clearing interest rate when M rejects

[3] In Lemma 2 we prove the existence of such a cutpoint type.

[4] We suppress the notations for the variables in $r_a(s,x,\bar{\theta})$ whenever no confusion will arise.

IMF's offer. Then it is the solution to the following equation:

$$r = \frac{E(p|\theta \in (\bar{\theta}, 0])}{1 - E(p|\theta \in (\bar{\theta}, 0])} = \frac{\frac{\int_{\bar{\theta}}^{0} p(0,0,\theta,r)d\theta}{-\bar{\theta}}}{1 - \frac{\int_{\bar{\theta}}^{0} p(0,0,\theta,r)d\theta}{-\bar{\theta}}} \quad (3)$$

Now we turn to the conditions under which $r_a(s, x, \bar{\theta})$ and $r_n(s, x, \bar{\theta})$ are uniquely determined given a set of s, x and $\bar{\theta}$.

Lemma 1. *If $p''_{rr} > 0$ and $0 < p < 1/2$, then for any s, x and $\bar{\theta}$, there exists a unique $r_a \in (0, 1)$ and $r_n \in (0, 1)$.*

The lemma shows that there is a unique solution to Equation (2) and Equation (3) under some conditions. The condition p''_{rr} implies that the probability of crisis increases at an increasing rate in r, which is a reasonable assumption.

Now we consider G's problem. G observes s and x. If G of type θ accepts, then M observes the agreement and the interest rate is $r_a(s, x, \bar{\theta})$. Consequently, G's payoff from accepting the offer is:

$$u_G(s, x; \theta) = -x + f(s) - p(s, x, \theta, r_a(s, x, \bar{\theta})) \quad (4)$$

On the other hand, if there is no agreement, then $s = x = 0$, and the interest rate is $r_n(0, 0, \bar{\theta})$. G's payoff in this case is:

$$u_G(0, 0; \theta) = -p(0, 0, \theta, r_n(0, 0, \bar{\theta})) \quad (5)$$

G will reject an agreement if (5)>(4). Recall that $\bar{\theta}(s, x)$ is defined to be the type that is indifferent between accepting and rejecting the offer. Then $u_G(s, x; \bar{\theta}(s, x)) = u_G(0, 0; \bar{\theta}(s, x))$. In other words, $\bar{\theta}(s, x)$ solves the following equation.

$$-x + f(s) - p(s, x, \theta, r_a(s, x, \theta)) = -p(0, 0, \theta, r_n(s, x, \theta)) \quad (6)$$

Our second lemma states that if there is a (unique) solution to (6), then $\bar{\theta}(s, x)$ is indeed a cutpoint type as we assumed before.[5] That is, the types below $\bar{\theta}(s, x)$ will accept (s, x), and the types above $\bar{\theta}(s, x)$ will reject (s, x).

[5] We cannot prove the existence and the uniqueness analytically, so will adopt a computational approach.

Lemma 2. *If* $p''_{s\theta} > 0$*,* $p''_{x\theta} > 0$*, and* $p''_{r\theta} < 0$ *if* $r_a(s,x,\theta) \leq r_n(s,x,\theta)$*, or* $p''_{r\theta} > 0$ *if* $r_a(s,x,\theta) \geq r_n(s,x,\theta)$*, then* $u_G(s,x;\theta) > u_G(0,0;\theta)$ *when* $\theta \in [-1,\bar{\theta}(s,x))$*, and* $u_G(s,x;\theta) < u_G(0,0;\theta)$ *when* $\theta \in (\bar{\theta}(s,x),0]$*.*

To understand the intuitions behind the lemma, consider the first two cross-partial derivatives above. Since $p'_\theta < 0$, i.e., the probability of crisis decreases if the initial economic conditions are better, $p''_{s\theta} > 0$ means that an increase in s reduces the probability of crisis more when the economy is better. Similarly, $p''_{x\theta} > 0$ means that an increase in x reduces the probability of crisis more when the economy is better. That is, the effect of additional reforms is larger for an economy that is in a better shape. These assumptions make intuitive sense. Finally, $p''_{r\theta} < 0$ means a higher interest rate is even more harmful for a more stressed economy, and in equilibrium it should be accompanied by $r_a(s,x,\theta) \leq r_n(s,x,\theta)$; on the other hand, since $p'_r > 0$, $p''_{r\theta} > 0$ suggests a higher interest rate leads to a bigger increase in the probability of crisis when the economy is in a better condition and in equilibrium if the condition holds, then we should observe that $r_a(s,x,\theta) \geq r_n(s,x,\theta)$.

Therefore, we have our first result:

Result 1. *Depending on* $p''_{r\theta}$*, i.e., the effect of the interest rate on the probability of crisis conditional on the state of the economy, in equilibrium it can be either* $r_a(s,x,\theta) \geq r_n(s,x,\theta)$ *or* $r_a(s,x,\theta) \leq r_n(s,x,\theta)$*.*

In other words, we have no way of knowing *generally* whether the market interest rate is higher or lower given an IMF agreement. Therefore, we should not expect a positive or negative catalytic effect across all cases.

Next result says that the size of loan and the degree of conditionality have a decreasing effect on the interest rate.

Result 2. $\partial r_a(s,x,\bar{\theta})/\partial s < 0$*,* $\partial r_a(s,x,\bar{\theta})/\partial x < 0$*.*

The result says that if there is a cutpoint equilibrium, then a larger loan size and a higher level of conditionality have the effect of decreasing the interest rate if there is an agreement.

To understand the effect of β on the interest rates, we need to analyze the IMF's optimization problem. However, the analysis will depend on the existence and uniqueness of $\bar{\theta}$, which we have not established analytically at this point. Our empirical analysis in the next section, however, will take a first step look at the data for the effect of β on the interest rate.

Empirical Implications

Our theory generates theoretical predictions linking the preference relationship between IMF principals and loan recepient countries, which roughly corresponds to the expected bias of the IMF in our theoretical model, with the size of the IMF's catalytic effect. Previous empirical work on the size of the catalytic effect shows quite mixed results (Steinwand and Stone 2008). Our argument generates one candidate explanation for these inconsistent findings: existing research has not properly accounted for the conditional nature of market reactions to IMF programs. We operationalize the depedent variable of our study as the short term change in sovereign bond yield spreads in the wake of IMF program decisions. The theory implies that participating in IMF programs causes a deterioration of market demand—and a corresponding increase in yield—for government bonds for a large portion of the parameter space, but that the effects are conditional on U.S. influence. Consequently, we estimate interactive models, where the effect of IMF programs on the interest rate on government bonds is a function of variables that measure U.S. incentives to interfere in program design.

Following extant studies (e.g. Thacker 1999, Stone 2004, Oakley and Yackee 2006), we operationalize U.S. interests in terms of similarity in UN General Assembly voting patterns and alliance portfolios with developing countries, and U.S. bank exposure in recipient countries (Copelovitch 2010, Stone 2011). Our quantity of interest is the effect of an IMF program, and our hypothesis is that this effect increases the interest rates that countries pay when U.S. influence is maximized. In addition, the model implies that market agents make inferences from the size of IMF loans and from the conditionality attached to them, and that these features in turn are also affected by U.S. influence. Consequently, we investigate the effects of IMF programs using instrumental variables models that allow the size and conditionality of IMF programs to be endogenous. The dependent variable is the annual interest rate on short-term government treasury bonds.

Hypothesis 1: Political importance is associated with higher interest rates.

Hypothesis 2: IMF programs are associated with higher interest rates, controlling for conditionality and amount of financing.

Hypothesis 3: IMF programs are associated with greater interest rate premia for politically influential borrowers.

Measures of U.S. Influence

Our theory does not provide guidance about what particular interests motivate the United States to interfere in IMF program design, so we take an eclectic approach and allow for a range of variables to exert effects that reflect alternative interests. We tested for effects of similarity of alliance portfolios with the U.S., voting patterns in the United Nations, U.S. bank exposure, U.S. foreign aid, and U.S. exports. We find effects of the first three variables, and only those are included in the specifications that we report below.

Instrumental Variables

The theory suggests that IMF conditionality, loan size, and market responses are endogenous to U.S. interests, so we adopt an instrumental variables approach. The validity of instrumental-variables analysis depends on the strength and exogeneity of the instruments. We use the following instrumental variables, which are each plausibly correlated with loan size and conditionality, but presumably unrelated to short-term market reactions to loan announcements:

Number of countries participating: Przeworski and Vreeland (2000, 2001) and Vreeland (2003) argue that the IMF becomes reluctant to lend when its resources are stretched thin because of the need to hold something in reserve for future crises.

Prior participation: Vreeland (2003) argues that countries that have not previously participated in IMF programs pay sovereignty costs when they agree to fulfill IMF conditions in return for financing.

Prior commitments of IMF financing: The IMF is reluctant to extend credit substantially beyond previous precedents as a multiple of the borrower's IMF quota. Such decisions lead to substantial discussion in the Executive Board.

Missing data: This is a measure derived from a principal components analysis of missingness of 19 time series reported by member countries to the IMF. To the degree that countries fail to report these data, they are likely to have low administrative capacity and low compliance with conditionality.

Extended program: This is a dummy variable that codes arrangement types that are extended over more than one year, including the EFF, ESAF and PRGF.

Low-income program: This is a dummy variable that codes arrangements with concessionary interest rates that are only available to low-income developing countries, such as SAF, ESAF, and PRGF.

Performance under previous programs, if any: This is a 12-month moving average of IMF status, which is a dummy variable coded one if a country has an IMF program that is currently suspended.

U.S. exports. Millions of U.S. dollars per month: This is expected to be associated with loans of larger scale.

Control Variables

We use a common set of controls, including our three measures of U.S. influence (alliance patterns, UN voting patterns, and U.S. bank exposure) and economic variables (foreign debt, GDP per capita, reserves as a share of GDP, and population). We use fixed effects to control for a host of country-specific features that affect sovereign risk. Consequently, our estimates can be treated as reflecting factors that affect changes in interest rates over time within countries, rather than differences across countries.

Results

The results of three models are presented in Table 1 below. The first model uses OLS with fixed-effects, and the second and third use instrumental variables (2SLS) to model the endogeneity of conditionality and the size of IMF lending facilities, respectively, also with fixed effects. The results are broadly consistent across the three models, but there are a few significant differences. In each model, the effect of IMF program initiation is substantively important but statistically insignificant. As we will see below when we interpret the conditional effects, however, IMF program initiation is statistically significant across most of the range of the U.S. influence variables. Note that this variable measures the short-term effect of initiating a new IMF program, not the steady-state effect of having an IMF program.

The results indicate that conditionality has a substantial depressing effect on bond yields. Conditionality is measured as a count of types of conditions contained in a particular program review, ranging from 0 to 19 and averaging almost 6, so conditionality is estimated to depress bond yields under IMF programs by 1.3 percentage points on average. Conditionality is endogenous, however; it is well established that conditionality responds both to economic conditions and to U.S. influence measures. When we estimate the model with instrumental variables for conditionality, we estimate a six-fold increase in its effect on bond yields: the average effect is to depress bond yields by 7.4 percentage points, and a one standard-deviation increase is sufficient to depress interest rates by another 4.6 percentage points. Since the conditionality effect is measured continuously, unlike program initiation, it exerts downward pressure throughout the life of an IMF program.

IMF credit, again, is measured only in the month in which a new program is introduced,

Table 1: Table 1: Effect of IMF Program Initiation and U.S. Influence on Bond Yields

	Fixed Effects		IV: Conditionality		IV: Size	
	Coefficient (std. error)	p-value	Coefficient (std. error)	p-value	Coefficient (std. error)	p-value
IMF Program Initiation	6.89 (4.38)	0.012	7.98 (4.97)	0.11	4.01 (5.06)	0.43
Number of Conditions	-0.21 (0.06)	0.00	-1.28 (0.10)	0.00	-0.22 (0.06)	0.00
IMF Credit	0.0004 (0.00051)	0.43	0.0008 (0.00061)	0.19	0.0083 (0.0055)	0.13
Interaction with IMF Program						
Alliance portfolio	1.08 (9.55)	0.91	2.53 (10.96)	0.82	2.29 (10.88)	0.83
UN Voting	16.36 (4.56)	0.00	13.65 (5.17)	0.01	17.98 (5.16)	0.00
U.S. Bank Exposure	52.30 (78.74)	0.51	4.48 (89.32)	0.96	-398.42 (312.12)	0.20
Direct Effects						
Alliance portfolio	30.92 (4.26)	0.00	44.21 (5.03)	0.00	43.17 (5.00)	0.00
UN Voting	3.75 (0.72)	0.07	4.57 (0.83)	0.00	4.24 (0.82)	0.00
U.S. Bank Exposure	19.51 (10.61)	0.07	40.68 (22.18)	0.07	9.75 (22.98)	0.67
Control Variables						
Population	-0.19 (0.07)	0.01	0.35 (0.09)	0.00	0.06 (0.08)	0.45
Foreign Debt	-9.1 x 10^{-12}($4.3\text{x}10^{-12}$)	0.03	3.4 x 10^{-10} ($7.6\text{x}10^{-}11$))	0.000	$1.7\text{x}10^{-10}$ ($7.4\text{x}10^{-11}$)	0.02
GDP per capita	-0.0011 (0.0001)	0.00	-0.0012 (0.0003)	0.00	-0.0011 (0.0003)	0.00
Reserves	0.028 (0.051)	0.58	-45.31 (3.23)	0.00	-46.18 (3.21)	0.00
Constant	12.24 (2.45)	0.00	-1.64 (2.96)	0.58	3.72 (2.92)	0.20
Fixed Effects						
F test of fixed effects	89.44	0.00	58.46	0.00	56.54	0.00
number of obs	10,947		8,373		8,373	
rho (variance due to fixed effects)	0.61		0.72	0.55		

so it represents a short-term effect. The effect is substantively and statistically insignificant in the first two models. In the third model, however, we correct for the fact that the size of IMF facilities is endogenous, and again, has been shown to be affected both by economic variables and by U.S. influence. When we correct for the resulting endogeneity bias using instrumental variables, the effect strengthens substantively—a one standard-deviation increase in IMF financing results in a 6.6 percent increase in bond yields—and that effect becomes marginally significant (p=.13). As we will see below, however, this modeling change has more substantially significant effects.

Across each of our models, the measures of U.S. influence have direct effects that substantially inflate bond yields. The direct effects are the ones felt by countries that are not under IMF programs, or that have IMF programs that are on-going, but were not originated in the current month. We interpret these effects as consequences of variations in IMF credibility, which affects current borrowers and non-borrowers alike, because resorting to IMF financing is always part of the game tree for developing countries and emerging markets. The effects of UN voting and U.S. bank exposure on these countries are weak on average, because the average country has a value close to zero on both variables; the effects range across models from 4 to 15 basis points. The effects are substantial for countries close to the maximum of each scale, however. Mexico accounted for 18 percent of U.S. bank lending abroad in 1995, which corresponds to an interest rate premium of 7.3 percent, and countries that vote in close alignment with the United States in the UN pay an interest rate premium of 3.75 to 4.58 percentage points. The average IMF program participant has an alliance portfolio that is moderately correlated with that of the United States, and that association is estimated to increase yields by 14 to 20 percentage points. These penalties become more substantial when a new IMF program is initiated.

The exception comes in the third model, where we instrument for the scale of IMF financing. In this case, the effect of bank exposure reverses sign when a new IMF program is initiated—the coefficient becomes negative, so increasing exposure is predicted to lead to depressed yields, rather than a risk premium—but the coefficient becomes insignificant (p=.22). A possible interpretation of this finding is that it represents a liquidity effect, which moves in the opposite direction of the credibility effect. U.S. bank exposure plays a significant role in the first stage equation that predicts the scale of IMF financing. It may be the case that U.S. bank exposure has the effect of producing a short-term reduction of interest rates when a new loan is announced to a major emerging market country, because a country that is important to the U.S. banking sector receives a larger loan, even while the long-term moral hazard problems extract a loan premium once the news cycle moves on.

Because the interpretation of interaction effects is not straightforward, Table 2 presents the conditional effects of IMF programs with U.S. influence measures fixed at their means and at one standard deviation above their means. [Table 3 about here] The effect of initiating a new IMF program in the fixed effects OLS equation is highly significant when all three U.S. influence measures are fixed at their mean, and extracts a risk premium of 6.2 percentage points (the 95% confidence interval of the effect runs from 3.6 to 8.8 percentage points). These effects become stronger when any of the U.S. influence measures is increased, and approximately double in magnitude in countries that vote in alignment with the United States in the UN to a degree that puts them one standard deviation above the mean. The effects of IMF program initiation are still stronger in the second equation, which instruments for conditionality. Recall that the effect of conditionality was strengthened in that equation, which suggests that endogeneity bias had attenuated its effects. U.S. influence measures are associated with decreased conditionality in the first-stage equation, and the instrumental variables equation estimates stronger interaction effects between those variables and program initiation. The size of the risk premium for program initiation ranges from 8 percent (5.0 to 11.0) with all U.S. influence variables at their means to 13 percentage points (8.2 to 17.9) with the S-score of association with U.S. voting in the UNGA one standard deviation above the mean.

Instrumenting for the scale of IMF financing leads to substantial differences in the estimate of new program initiation, which are again traceable to the effect of U.S. bank exposure. In this estimation, the interactive effect of bank exposure and new program initiation is very

Table 2: Table 2: Conditional Effects of IMF Programs

	Fixed Effects		IV: Conditionality		IV:Size	
	Coefficient (std. error)	p-value	Coefficient (std. error)	p-value	Coefficient (std. error)	p-value
All variables at their means	6.19 (1.33)	0.00	8.00 (1.54)	0.00	2.07 (2.71)	0.45
Alliance S-score 1 std. dev. above mean	6.40 (2.36)	0.01	8.48 (2.76)	0.00	2.51 (3.52)	0.48
UN Voting S-score 1 std. dev. above mean	12.23 (2.16)	0.00	13.04 (2.49)	0.00	8.71 (3.2)	0.01
US Bank exposure 1 std. dev. above mean	6.94	0.00	8.06	0.00	-3.60	0.60

large and negative, with a large standard error. This overwhelms the other effects of U.S. influence, so that the estimated effect of program initiation is insignificant when all of the measures are at their mean, and only becomes significantly positive when the S-score for UN voting is one standard deviation above the mean. This again lends support to the interpretation that the effect of U.S. bank exposure on interest rates has a short-term liquidity component and a medium-term credibility component. This shows up in the equation in which we instrument for the scale of IMF financing, because large loan packages are extended when the U.S. banking sector is exposed to substantial losses.

In summary, we find several pieces of evidence that support our model. We find robust direct effects of measures of U.S. influence—alliances, UN voting patterns, and U.S. bank exposure—on the yields of sovereign bonds, which are consistent with the moral hazard hypothesis that countries that enjoy privileged access to U.S. decision makers pay additional risk premia. We find that the initiation of new IMF programs is associated with an increase in the risk premium, and that the risk premium increases more sharply in the presence of U.S. influence. We find these results in the context of models with fixed effects, so we are confident that they are not artifacts of particular country-specific correlations. These results, furthermore, are strengthened when we instrument for conditionality, and they hold, although with an interesting qualification, as well when we instrument for the scale of IMF financing.

Conclusion

Our paper investigated the theoretical and empirical linkages between IMF programs, loan size, conditionality, and informal political influence and international financial market responses. We argued that the "catalytic" effect of the IMF is highly contextual, but varies in systematic ways. We found that all else equal, the catalytic effect is dampened for countries that are strategically important to U.S. interests, evidence of a credibility deficit in IMF lending for countries that may receive preferential treatment. This analysis also provides a good example of the broader tradeoff of allowing informal influence in exchange for "buy-in" from powerful countries, possibly at the expense of unintended policy outcomes. Our future research will extend the theoretical and empirical analysis in this paper.

Appendix

Lemma 1. *If $p''_{rr} > 0$ and $0 < p < 1/2$, then for any s, x and $\bar{\theta}$, there exists a unique $r_a \in (0,1)$ and $r_n \in (0,1)$.*

Proof. Let $f(r) = \frac{\int_{-1}^{\bar{\theta}} p(s,x,\theta,r_a)d\theta}{1+\theta}$ in (2), i.e., $f(r)$ is the expectation of $p(s,x,\theta,r)$ for $\theta \in [-1,\bar{\theta}]$. Furthermore, let $F(r) = \frac{f(r)}{1-f(r)}$. Then, Equation (2) becomes $r = F(r)$.[6] It is easy to see that the following are sufficient conditions for a unique solution to the equation: $F(0) > 0$, $F(1) < 1$, $F'(r) > 0$, and $F''(r) > 0$. First, $F(r) > 0$ is always true because $p(\cdot) > 0$, and thus $f(r) > 0$. Second, if $\forall r\ p(\cdot) < 1/2$, then $f(r) < 1/2$, and consequently, $F(1) < 1$. Third, $p'_r > 0$ implies $f'(r) > 0$, and thus, $F'(r) = \frac{f'(r)}{(1-f(r))^2} > 0$. Finally, if $p''_r > 0$, i.e., p'_r is increasing in r, then $f'(r)$ is increasing in r, while $(1-f(r))^2$ is decreasing in r. Thus, $F'(r) = \frac{f'(r)}{(1-f(r))^2}$ is increasing in r, i.e., $F''(r) > 0$. These conditions combined ensure that r_a is unique, and a similar analysis of (3) ensures that r_n is unique. □

Lemma 2. *If $p''_{s\theta} > 0$, $p''_{x\theta} > 0$, and $p''_{r\theta} < 0$ if $r_a(s,x,\theta) \leq r_n(s,x,\theta)$, or $p''_{r\theta} > 0$ if $r_a(s,x,\theta) \geq r_n(s,x,\theta)$, then $u_G(s,x;\theta) > u_G(0,0;\theta)$ when $\theta \in [-1,\bar{\theta}(s,x))$, and $u_G(s,x;\theta) < u_G(0,0;\theta)$ when $\theta \in (\bar{\theta}(s,x),0]$.*

Proof. We only need to prove that $u_G(s,x;\theta)$ has increasing differences in $-\theta$. By Theorem 6 of Milgrom and Shannon (1994), $u_G(s,x;\theta)$ has increasing differences in $-\theta$ if and only if $\partial^2 u_G/\partial s\partial\theta < 0$ and $\partial^2 u_G/\partial x\partial\theta < 0$, or, $p''_{s\theta} > 0$, $p''_{x\theta} > 0$. Moreover, it must be the case that $p''_{r\theta} > 0$ if $r_a(s,x,\theta) \geq r_n(s,x,\theta)$, and $p''_{r\theta} < 0$ if $r_a(s,x,\theta) \leq r_n(s,x,\theta)$. □

Result 2. $\partial r_a(s,x,\bar{\theta})/\partial s < 0$, $\partial r_a(s,x,\bar{\theta})/\partial x < 0$.

Proof. Consider Equation (2). Let $f(r)$ and $F(r)$ be as assumed in the proof of Lemma 1. As s increases, $f(r)$ decreases for all r. Consequently, $F(r)$ shifts downward, and thus intersects with r at a lower r_a. Hence, $\partial r_a(s,x,\bar{\theta})/\partial s < 0$. Similarly, $\partial r_a(s,x,\bar{\theta})/\partial x < 0$. □

[6] We suppose the subscript of r for convenience.

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