

**The Mussa Theorem**  
**(and other results on IMF induced moral hazard)**

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**Abstract**

Using a simple model of international lending, we show that as long as the IMF lends at an actuarially fair interest rate and debtor governments maximize the welfare of their taxpayers, any changes in policy effort, capital flows or borrowing costs in response to IMF crisis lending are efficient. Thus, under these assumptions, the IMF cannot cause moral hazard, as long argued by Mike Mussa. It follows that examining the effects of IMF lending on capital flows or borrowing costs is not a useful strategy to test for IMF induced moral hazard. Instead, empirical research on moral hazard should focus on the assumptions of Mussa's theorem.

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## I. INTRODUCTION

It must have been some time in January or February of 1999, when Mike Mussa, sitting in his office on the 10<sup>th</sup> floor of the IMF headquarters building, remarked to us that if IMF loans were always repaid, there was obviously no way that the IMF could be a source of moral hazard.

We nodded our heads respectfully, but did not really believe him. Clearly, it could not be as simple as that. Whether or not they were repaid, IMF loans made crises less unpleasant for countries, so they created an incentive to be less careful about avoiding them in the first place. That was moral hazard, wasn't it—like failing to install fire detectors in the presence of fire insurance? Mike's observation, furthermore, seemed to relate only to the relationship between the IMF and crisis countries. But what about international investors, that had contributed to the crises through their reckless lending behavior? They were let off the hook with the help of IMF crisis lending. There had to be "investor moral hazard", which Mike's claim seemed to ignore altogether.

But who was to contradict such an authority in international economics, who also happened to be the author of a pathbreaking early contribution to the theory of moral hazard and adverse selection, not to mention our boss? So, rather than engaging him in an argument there and then, we went down to the second floor cafeteria, and thought about it.

For once, IMF (and academic) hierarchy proved justified. By the time we were back in his office, in one of our regular meetings with Mike and Alexander Swoboda on a paper on international financial architecture that we were writing at the time, we realized not only that Mike was right, but that his "theorem" was far more comprehensive and meaningful than we had thought at first. In particular, Mike was making a much stronger point than the usual argument that IMF lending provided desirable insurance at a justifiable cost to incentives, and thus did not generate "excessive moral hazard". Larry Summers, for example, had on many occasions compared the IMF to a fire brigade, arguing that although fire brigades were undoubtedly a source of moral hazard, everyone agreed they were a good thing. In contrast, Mike was pointing out that—under some conditions, which he believed were generally met—IMF assistance quite literally created *no* moral hazard. According to Mike, in the circumstances under which the IMF lends (or should be lending), there *is* no trade-off between insurance and incentives. To the extent that governments or investors adjust their behavior in the presence of the IMF "safety net"—say by lending more, at lower interest rates, or by monitoring less—this will be efficient and desired under the conditions of Mike's theorem.

But what are these conditions? In essence, Mussa's theorem holds if IMF lending occurs at no-one's expense. In particular, it must not occur at the expense of IMF creditor countries and their taxpayers. This would be the case if the IMF were to provide transfers, rather than loans; hence Mike's insistence that IMF loans take place under adequate safeguards, and that the terms of IMF lending reflect the repayment risk faced by the IMF. But IMF lending must

also not occur at the expense of the taxpayers in the *borrowing* countries, which are ultimately the source of IMF repayment. This point had been left implicit by Mike, who had assumed that countries acted like a single agent, or were ruled by benevolent governments. Our contribution to the Mussa theorem was to persuade Mike to make this assumption explicit. In this form, the “theorem”—in words—made it into our joint paper (Mussa, Swoboda, Zettelmeyer and Jeanne, 2000). This was an extensive treatise on financial architecture, which turned out to be so long and mind-numbingly even-handed, (perhaps reflecting the fact that it was originally intended for the IMF Executive Board) that Rudi Dornbusch, our discussant at the conference when it was presented, accused it of “reading like a report by the Council on Foreign Relations”.

Thus buried, it is perhaps no wonder that Mussa’s theorem did not make much of an initial impact. Mike himself stated his point in two subsequent papers (Mussa, 1999, 2004), and we for our part tried on at least one occasion (Jeanne and Zettelmeyer, 2001). But as far as we can see, it has still failed to win many converts, and basic misunderstandings on the welfare effects of IMF lending and the conditions under which it creates moral hazard continue to plague the literature. One reason may be that Mussa’s theorem has never been stated as such, namely, as a tight, irrefutable link between assumptions and results. The objective of the paper is to fill this gap. With this out of the way, one can have a useful discussion on whether the assumptions underlying Mussa’s theorem are likely to be satisfied or not—and if not, how IMF lending policies would need to be structured to make them hold.

In the section that follows, we develop the theorem in the context of a simple model of IMF lending. We begin by showing that even in a model in which moral hazard is ruled out by construction—in the sense that outcomes are independent of any effort variables—the presence of IMF lending will lead to the symptoms that are commonly associated with moral hazard, namely an increase in capital flows and a decline in risk premia. We then introduce policy effort and show that under the assumptions of Mussa’s theorem, any reduction in effort as a result of IMF lending is efficient and hence does not constitute moral hazard in the usual sense. Finally, we discuss how moral hazard arises when the assumptions of Mussa’s theorem are violated.

In the second half of the paper we explore the implications of the theorem for the empirical literature on moral hazard and for IMF lending policy. The main contribution here is to point out that virtually all empirical “tests of moral hazard” that have been proposed in the literature miss the point, because they test for symptoms of insurance that arise—assuming that IMF lending is effective—regardless of whether moral hazard is present or not. Instead, we advocate an approach that focuses on testing the assumptions of Mussa’s theorem directly.

## II. A SIMPLE MODEL OF THE IMF

Our analysis is based on a simple model in which the IMF may or not lend to countries that are unable to roll over their external debt with private investors. We look at the impact of IMF lending not only *ex post* (at the time of the crisis) but also *ex ante*, on the equilibrium of

the credit market. The question is whether IMF bailouts distort the behavior of international investors or the domestic authorities in a way that could be characterized as moral hazard.

### A. Assumptions

Consider a large number of identical emerging market (capital scarce) countries  $i$ . For now, we focus on one country and omit the country index  $i$ . The rest of the world is populated by investors from rich countries. We denote by  $W$  the wealth of foreign investors per emerging market country.

There are three periods,  $t=0,1,2$ . The country invests  $k$  in period 0; this yields  $y = \theta k$  in period 2, where the productivity parameter  $\theta$  is stochastic with pdf  $g(\cdot)$ . The shock  $\theta$  could be correlated across countries or not. The level of productivity is observed in period 1. The total cost of investing  $k$  is  $k + f(k)$ , where  $f(\cdot)$  is increasing and concave.

Emerging market countries have no wealth in period 0, so that the investment must be financed by borrowing abroad. We assume that  $k$  is financed by short-term debt maturing in period 1. The size of the debt repayment coming due in period 1 is denoted by  $d$ . This debt is held by a continuum of atomistic foreign investors who have liquidation rights in period 1. A creditor who is not fully repaid in period 1 can liquidate a small fraction of the investment, subject to a sequential service constraint.<sup>2</sup>

The total liquidation value of the investment is  $\lambda \theta k$  with  $\lambda < 1$ , implying that liquidation is never efficient.

In period 1 the country has no income and must roll over its short-term debt by issuing new debt maturing in period 2. The country can pledge (credibly promise to repay) a fraction  $\alpha$  of its output to the new lenders. This fraction is lower than 1 because of limited contract enforcement (as in the sovereign debt literature), or country moral hazard (as in Holmstrom and Tirole, 1998).

The utility of any agent (i.e. residents of emerging market countries as well as foreign investors) is given by

$$c_0 + c_1 + c_2.$$

The residents of an emerging market country have no income in periods 0 and 1, and consume in period 2 only. Their welfare, thus, is equal to their expected final consumption (period 2 output minus debt repayment). International lenders are risk neutral and lend

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<sup>2</sup> This debt structure can be endogenized (see, e.g., Jeanne 2004). We take it as given in this paper.

provided that the expected return is nonnegative. There is a zero return safe technology allowing investors to store their wealth between periods.

We make the following assumption, which will be one of the two pillars supporting our main result on IMF-induced moral hazard (the Mussa Theorem).

**Assumption A1.** The emerging market country is run by a benevolent policymaker who chooses  $k$  so as to maximize the welfare of the representative resident.

The equilibrium is characterized by a pair  $(k^*, d^*)$  that maximizes domestic welfare conditional on the participation constraint of foreign lenders. We define ex ante (period 0) global welfare per country as the sum of the welfare of the representative resident,  $U_0$ , and of the foreign lenders,  $V_0$

$$GW_0 = U_0 + V_0.$$

We will be interested in the question of how IMF bailouts affect the welfare of debtor countries and their lenders, taking into account their possible effect in terms of moral hazard. But first, let us look at the equilibrium when there is no IMF, that is in a situation of complete laissez-faire.

### B. Laissez-Faire

There is a rollover crisis if the debt coming due in period 1,  $d$ , is larger than the output that the country can pledge to private lenders,  $\alpha\theta k$ . In this case, creditors run for the exit and the investment is completely liquidated if  $d \geq \lambda\theta k$ . We assume that this condition is satisfied because  $\lambda$  is very small. Hence, one of the following two things happens in period 1: either there is no liquidation (if  $d \leq \alpha\theta k$ ), or there is complete liquidation (if  $d > \alpha\theta k$ ).

A rollover crisis occurs in period 1 if  $\theta$  falls below a threshold  $\theta^*$ .<sup>3</sup> Thus,  $\theta^*$  is defined as the minimum level of productivity at which debt  $d$  can still be serviced, given a level of investment  $k$ ,

$$d = \alpha\theta^* k. \tag{1}$$

The zero-profit condition for lenders is (assuming that  $\lambda$  is so small that the payoff that creditors derives from liquidation can be neglected on the right-hand-side):

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<sup>3</sup> In addition there could be *self-fulfilling* rollover crises. For simplicity we leave this possibility aside. It could be, added, however: considering liquidity crises in which the IMF lends in last resort would strengthen the results, by adding a motive through which IMF lending helps avoid inefficient outcomes.

$$k = d \int_{\theta^*}^{+\infty} g(\theta) d\theta. \quad (2)$$

Equation (2) says that the real interest rate,  $d/k$  is inversely proportional to the equilibrium probability of repayment. Note that this probability and the interest rate  $d/k$  do not depend on  $k$ . This property, which comes from the linearity of the production function, simplifies the algebra a great deal.

Combining (1) and (2) to substitute out  $d$  and  $k$ , one obtains

$$1 = \alpha \theta^* \int_{\theta^*}^{+\infty} g(\theta) d\theta. \quad (3)$$

We assume that this equation has solutions  $\theta^*$  (it may have several ones, in which case the economically relevant solution is the lowest one). Importantly, this solution depends on the level of  $\alpha$ , i.e., the degree to which output can be pledged for repayment. The equilibrium interest rate—given by equation (1)—is decreasing with  $\alpha$ .

The welfare-maximizing level of  $k$ , denoted  $k^*$ , is the solution to

$$\max_k U(k) = \int_{\theta^*}^{+\infty} \theta g(\theta) d\theta k - k - f(k), \quad (4)$$

implying

$$1 + f'(k^*) = \int_{\theta^*}^{+\infty} \theta g(\theta) d\theta. \quad (5)$$

In the laissez-faire equilibrium, the debtor country's welfare is given by

$$U_0^{lf} = \left( \int_{\theta^*}^{+\infty} \theta g(\theta) d\theta - 1 \right) k^* - f(k^*).$$

Since in equilibrium investors demand a zero expected return on their wealth, their ex ante welfare is simply

$$V_0 = W,$$

implying the following expression for global welfare (per debtor country)

$$GW_0^{lf} = \left( \int_{\theta^*}^{+\infty} \theta g(\theta) d\theta - 1 \right) k^* - f(k^*) + W.$$

Global welfare is equal to the net surplus of the investment in the emerging market country plus the wealth of investors. Notice that global welfare is lower than the first-best level, defined as the level that would arise if the country could raise foreign capital through an equity contract that removes the risk of liquidation by promising foreign investors a share of

domestic output rather than a fixed repayment.<sup>4</sup> In that case, there would be no liquidation, and global welfare would be given by

$$GW_0^{fb} = (E(\theta) - 1)k^{fb} - f(k^{fb}) + W,$$

with  $k^{fb}$  given by

$$1 + f'(k^{fb}) = E(\theta).$$

The first-best level of capital is higher than the level under laissez-faire. Capital flows are inefficiently low under laissez-faire because of the liquidation risk, which reduces the expected productivity of the investment.

### C. The Effect of IMF Lending

We now introduce the IMF an institution that collects funds from international investors (or equivalently, rich countries that tax international investors) in period 0 and may lend them to emerging market countries with rollover crises in period 1. We assume that in period 2 the repayments to the Fund are redistributed to its financiers in proportion to their contributions.

We assume that in period 1 the country can pledge a fraction  $\beta$  of its output to the IMF, where  $\beta$  is in general different from  $\alpha$ . In the remainder of this paper, we assume that  $\beta > \alpha$ . In other words, in this paper we interpret the critical difference between the IMF and private lenders as being that the maximum repayment that the IMF can claim from a country, as a fraction of output, is higher than that which the private sector can claim.<sup>5</sup> Countries are willing or able to sacrifice a larger fraction of their output to repay the IMF than they are to repay the private sector. This could be because of IMF conditionality or because the IMF can punish defaulting countries more severely than private creditors. As a result, the IMF may be able to lend in a rollover crisis, without incurring a loss, when private lenders cannot.

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<sup>4</sup> The share of output pledged to foreign investors may have to be larger than  $\alpha$  in order to avoid credit rationing. There are two sources of inefficiency in this model. First, there is the risk of liquidation, which can be removed by equity-like contracts in which creditors are promised a share of the final output  $y$  (for example, long-term GDP-indexed bonds, as proposed by Borensztein and Mauro, 2004). Second, there is the fact that the country cannot pledge all its output but only a share lower than  $\alpha$ . This could result in credit rationing in the international financial market even if the equity-like contracts mentioned above were possible.

<sup>5</sup> Another critical difference between the IMF and individual private lenders might simply be its size, which enables it to overcome coordination problems (see Jeanne and Zettelmeyer, 2002). We do not highlight this because we ignore self-fulfilling crises in this paper.

We assume that although it is a monopoly, the IMF lends at the actuarially fair interest rate (i.e., it does not extract any monopolistic rent from crisis countries and its expected profit is equal to zero). This implies that investing in the IMF provides the same return (zero) as investing in the debt market, and that the creation of the Fund leaves the welfare of rich country investors unchanged. Whether, as an empirical matter, this is a realistic assumption or not will be discussed in the next section.

**Assumption A2.** The IMF lends at the actuarially fair interest rate.

The IMF lends under the same conditions as private lenders would if they could extract  $\beta y$  from the country, instead of  $\alpha y$ . The equilibrium in period 0, hence, is the same as if private creditors had a power of extraction  $\beta$ . (It does not matter to period 0 lenders whether their claims will be rolled over with public or private money, provided that they are repaid.) Then the equilibrium relationships remain (1)-(2), except that  $\alpha$  is replaced by  $\beta$  and  $\theta^*$  by  $\tilde{\theta}$ .

Because  $\theta^*$  is decreasing with  $\alpha$ ,  $\beta > \alpha$  implies  $\tilde{\theta} < \theta^*$ . The IMF, therefore, lends in equilibrium to countries with  $\theta$  falling in a range  $[\tilde{\theta}, \theta^*]$ , that is, to countries that are not solvent enough to roll over their debts with private creditors, but solvent enough to borrow from the Fund.

As a result, in the presence of IMF lending, in period 1 a country is in one of the following three cases:

- if  $\theta \geq \theta^*$ , the country can roll over its debt with private lenders;
- if  $\theta \in [\tilde{\theta}, \theta^*]$ , the country repays its debt with an IMF loan—the IMF “bails out” private creditors;
- if  $\theta < \tilde{\theta}$ , the IMF lets the rollover crisis result in a liquidation of the investment.

Replacing  $\theta^*$  by  $\tilde{\theta}$  in equation (5) gives the equilibrium level of capital,  $\tilde{k}$ . It is larger than  $k^*$ , but remains smaller than the first-best level  $k^{fb}$ . The impact of the IMF on the size of the debt repayment

$$\tilde{d} = \beta \tilde{\theta} \tilde{k},$$

is ambiguous because of two opposite effects: the risk premium (and hence  $\tilde{\theta}$  relative to  $\theta^*$ ) is lower, but  $\beta$  and the amount borrowed in period 0 are larger.

How large does the IMF need to be in order to implement this policy? This depends on the cross-country correlation in the shocks  $\theta$ . If the shocks are perfectly correlated, the IMF must be large enough to bail out all the countries at the same time, i.e., it needs at least  $\tilde{d}$  per country. If, to take the other extreme, the shocks are totally uncorrelated and the number of



countries is large enough to apply the law of large numbers, the IMF needs only  $\Pr(\tilde{\theta} < \theta < \theta^*)\tilde{d}$  per country (the average bailout per country). In general, the minimum size of the IMF will have to be between these two values. We assume that this is possible.<sup>6</sup>

Note that the presence of the IMF produces the symptoms commonly associated with “investors’ moral hazard”:

- the anticipation of IMF bailouts increases capital flows to emerging market countries ( $k$  is larger);
- it lowers the interest rate at which these countries can borrow abroad (for any given  $k$ ,  $d/k$  is smaller);

However, there is no moral hazard *stricto sensu* in this model. There is no hidden action that is distorted by the insurance provided by the IMF. The larger capital flows and lower interest rate are the reflection of optimal insurance, not moral hazard. This point seems to be misunderstood in many discussions of IMF-induced moral hazard (in particular those that emphasize “investors’ moral hazard”). These discussions tend to confuse the *nondistortive* impact of insurance on the equilibrium of the credit market with the possible (but not necessary) *distortive* consequences of insurance.

An insurance that does not generate any distortion is optimal. Under the assumptions we have made so far, the presence of the IMF unambiguously increases the ex ante (period 0) welfare of all agents. It leaves the welfare of rich country investors unchanged and it strictly increases the welfare of the residents in emerging market countries. More formally, in the presence of the IMF global welfare per country,

$$GW_0^{imf} = U_0^{imf} + V_0^{imf},$$

is higher than under laissez-faire because  $U_0^{imf} > U_0^{lf}$  and  $V_0^{imf} = V_0^{lf}$ .

#### D. Mussa’s Theorem

Having looked at the impact of IMF lending on capital flows and interest rates, let us now focus on the side of the borrower, i.e., the incentives of the domestic policymaker to take actions that reduce the probability of a crisis. We now assume that the distribution of  $\theta$  is a function  $g(e, \cdot)$  where  $e$  is a policy effort that costs  $h(e)k$  to the representative resident

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<sup>6</sup> A sufficient condition is that this is possible even when the shocks are perfectly correlated. This is the case if  $W > \tilde{k} + \tilde{d}$ . Then the wealth of investors is sufficient to finance both the investment,  $\tilde{k}$ , and the contribution to the IMF,  $\tilde{d}$ , in period 0.

(with  $h(\cdot)$  increasing and convex). Increasing the effort raises the probability that  $\theta$  be above any given threshold, that is

$$\forall \theta, \frac{d}{de} \int_{\theta}^{+\infty} g(e, \theta') d\theta' > 0. \quad (6)$$

One question is whether the policy effort is decided at the same time as, or after, foreign investors lend to the country—that is, whether the country can commit to the effort level in the context of its relationship with private lenders. If commitment were not possible, the debt contract with private lenders would be affected by debtor moral hazard. Because we are interested in moral hazard specifically generated by IMF lending, we look at a situation in which this brand of debtor moral hazard is absent. We assume, therefore, that the country can commit to  $e$  at time 0, when it borrows from private investors.<sup>7</sup>

Under laissez-faire, the threshold in  $\theta$  triggering a rollover crisis is still given by equation (3),

$$1 = \alpha \theta^* \int_{\theta^*}^{+\infty} g(e, \theta) d\theta, \quad (3')$$

which, using (6), implies that  $\theta^*$  is a decreasing function of  $e$ ,

$$\frac{d\theta^*}{de} < 0.$$

Other things equal, increasing the effort reduces the default risk premium, and consequently the interest rate. Higher effort thus reduces the probability of a crisis through *two* channels: directly—by increasing the probability of high productivity draw  $\theta$ —and indirectly by reducing the interest rate and so the ex post burden of the debt.

Under laissez-faire the country's ex ante welfare is given by

$$U_0(k, e) = \left( \int_{\theta^*(e)}^{+\infty} \theta g(e, \theta) d\theta - 1 - h(e) \right) k - f(k). \quad (7)$$

where we have used the fact that the expected repayment to lenders must be equal to  $k$ .<sup>8</sup> Given  $k$ , the optimal effort under laissez faire is the solution to the problem

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<sup>7</sup> The case without commitment will be analyzed in the next version.

<sup>8</sup> Here we use the fact that the country can commit to its effort level at the time the debt contract is signed. Thus, the nominal repayment  $d$  is adjusted to  $e$  at time 0 so as to keep the expected repayment equal to  $k$ .

$$e^* = \arg \max \int_{\theta^*(e)}^{+\infty} \theta g(e, \theta) d\theta - h(e). \quad (8)$$

Notice that  $e^*$  does not depend on  $k$ .

With the IMF, the country's welfare and optimal effort would be given by (7) and (8) in which  $\theta^*(e)$  is replaced by  $\tilde{\theta}(e)$ . Does the presence of the IMF increase or reduce the domestic policy effort? As shown by Corsetti, Guimaraes and Roubini (2003) and Cordella and Levy Yeyati (2004), the answer to this question is ambiguous in general. The expectation of IMF bailouts could decrease or increase the level of effort.

This question can be studied in a specification of our model. For simplicity, let us assume that  $\theta$  can take just three values,  $\theta_l$ ,  $\theta_m$  and  $\theta_h$  with

$$\theta_l < \theta_m < \theta_h.$$

We assume that the values of the parameters are such that under laissez-faire, there is a rollover crisis if the state is low or medium, and that the superior enforcement technology of the IMF allows it to rescue a country if the productivity state is medium (but not if it is low).

The probability of a particular state  $s = l, m, h$  is denoted by  $p(e, s)$ . First, let us assume that effort shifts probability from the medium to the high state. More specifically, the probability of the low state,  $p_l$ , does not depend on  $e$ , the probability of the medium state is  $(1 - p_l)(1 - e)$ , and the probability of the high state is  $(1 - p_l)e$ . Then applying equation (8), the effort levels with and without the IMF are given by

$$\begin{aligned} e^{imf} &= \arg \max (1 - p_l)(\theta_h - \theta_m)e - h(e) \\ e^* &= \arg \max (1 - p_l)\theta_h e - h(e), \end{aligned}$$

from which it follows that the level of effort is lower with the IMF,

$$e^{imf} < e^*.$$

By exercising effort, the country can increase the likelihood of ending up in the high state rather than the medium state. Without the IMF, the only way of avoiding a rollover crisis and inefficient liquidation is to end up in the high state. With the IMF, however, the country is protected from a rollover crisis even in the medium state. Hence the incentive to apply effort in order to avoid the medium state are higher without the IMF.

Note, however, that this result can easily be reversed by making different assumptions on the way in which the state probabilities depend on effort. For example, let us assume that the probabilities of the low, medium and high states are respectively given by  $(1 - p_h)(1 - e)$ ,

$(1 - p_h)e$  and  $p_h$ . The effort shifts probability from the low state to the medium state, keeping the probability of the high state unchanged. Now the efforts are given by

$$\begin{aligned} e^{imf} &= \arg \max e(1 - p_h)\theta_m - h(e) > 0, \\ e^* &= \arg \max(-h(e)) = 0 \end{aligned}$$

The level of policy effort is now higher with the IMF. In the absence of IMF the optimal effort is zero: the project is liquidated regardless of whether the low or the medium state realizes, so there is no benefit to increasing the probability of the latter state. With the IMF, by contrast, the project is liquidated in the low state but not in the medium state, so that it pays off to increase the probability of the latter. IMF bailouts now act as a prize inducing more effort, rather than as a cushion reducing the punishment for low effort.

This ambiguity notwithstanding, it remains true that in our model, the anticipation of IMF bailouts may reduce the domestic policy efforts to avoid a balance of payment crisis. This phenomenon is generally interpreted as “moral hazard”.

However, our model also shows that this interpretation is incorrect. Although effort may indeed be lower in the presence of the IMF, this is not moral hazard in the usual sense of reducing effort to a second-best level. Under the assumptions made—in particular, A1 and A2—the IMF reduces the effort level from a level that is inefficiently high under *laissez faire*. Without the IMF, the policy effort was too high because the discipline provided by the market—the threat of liquidation in the medium state—was excessively harsh. The presence of the IMF reduced the level of effort *from* a second best level *to* its first-best level (given the available repayment technology  $\beta$ ).<sup>9</sup> In short, under the assumptions made, lower effort is not the reflection of a distortion. It is simply an efficient response to an improved repayment technology; much like faster driving may be an efficient response to better roads, or the existence of airbags.<sup>10</sup>

The welfare of the country and global welfare, furthermore, are strictly increased by the IMF. The *ex ante* welfare is increased by the expected output loss that is avoided with IMF bailouts,

$$U_0^{imf}(k, e) = U_0^{lf}(k, e) + k \int_{\tilde{\theta}(e)}^{\theta^*(e)} \theta g(e, \theta) d\theta.$$

<sup>9</sup> Another way of seeing that there is no moral hazard *stricto sensu* in this model is that there is no strict benefit to endowing the country with the ability to commit to action  $e$  (as would be the case in a model with moral hazard) since the country can already commit to this action in period 0.

<sup>10</sup> That is, assuming that the costs of having an accident are fully borne by the driver. This is the equivalent of assumption A2, which rules out a transfer from the IMF to the country.

Thus, irrespective of the IMF's impact on the level of effort, it necessarily increases the ex ante welfare of the country. Since the ex ante welfare of the country's creditors remains equal to their wealth  $W$  in equilibrium, the IMF also increases global welfare.

These results can be summarized in Mussa's theorem.

**Mussa's theorem.** *Under assumptions A1 and A2, the anticipation of IMF crisis lending increases the volume of capital flows to emerging market countries and reduces the cost of borrowing for these countries. In addition, the anticipation of crisis lending may decrease the domestic efforts to avoid a crisis. However, the IMF does not generate moral hazard stricto sensu. The expectation of IMF lending unambiguously increases the welfare of recipient countries at no cost to the rest of the world.*

Although Mussa's Theorem was stated in a setting which only allows countries to exercise effort that prevent crises, it could easily be extended to a setting in which we introduce some crisis prevention action on the side of investors. For example, we could allow investors to engage in costly "research" efforts in order to find out ahead of time whether a country will end up in the medium state or in the high state. We could assume that early withdrawal by investors in response to such a signal mitigates crises in the sense of reducing liquidation costs. In the presence of the IMF, investors would not have any incentives to conduct this research, but that would be efficient.

### **E. Two Doors for Moral Hazard to Come Back**

The logic behind the Mussa theorem is very strong. If IMF lending increases the country's welfare at no cost to the rest of the world, it cannot induce a distortion, even if it might produce all the symptoms of moral hazard. However, this result was obtained under two strong assumptions. We show in this section how relaxing these assumptions open doors for moral hazard to come back.<sup>11</sup>

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<sup>11</sup> We focus on the two assumptions that were highlighted as A1 and A2. In addition to these, it is possible to relax other assumptions in our basic model with the effect that the presence of the IMF might magnify a previously existing distortion. For example, negative output externalities across countries might imply that effort could be suboptimally low under laissez-faire. This might be aggravated by the IMF even if IMF lending does not contain a subsidy (see Weithöner, 2003). However, in a broader sense, this example confirms the logic of Mussa's theorem, namely that IMF lending cannot cause moral hazard unless lending occurs at the expense of a third party that is not involved in the actual lending decision. In this case, there would be an additional third party to consider.

First, there was the assumption that the domestic decisions over  $k$  and  $e$  were taken by a benevolent policymaker. Some, like Charles Calomiris (1998) have argued that IMF lending might aggravate the domestic distortions coming from the fact that domestic policymakers are not, in reality, benevolent. The IMF, according to this argument, might increase the scale of domestic expropriation in emerging market economies because of its ability to extract more repayment from the domestic taxpayers than private lenders could. Mike Mussa has referred to this problem as “indirect moral hazard” (Mussa, 2004).

There are different ways this story can be told in our model. The simplest may be to assume that the domestic policymaker maximizes his own utility rather than the welfare of the representative taxpayer, and that he is able to divert a given fraction of the capital inflows for his own consumption. Some of the external debt, then, becomes “odious” in the sense of Kremer and Jayachandran (2002). One can think of more indirect ways for policymakers to divert the domestic fiscal resources towards specific groups (e.g., providing implicit guarantees on the liabilities of “crony capitalists”) but the logic of the argument would remain essentially the same.

The objective of the policymaker, in that case, would simply be to maximize capital inflows. Assume that the level of capital inflows is excessive under laissez-faire (i.e., the welfare of the representative resident decreases with capital inflows). Then the IMF, by allowing the policymaker to attract even more capital inflows, could end up decreasing domestic welfare.

Another way the IMF could induce a distortion is by lending at an excessively low interest rate, that implies a transfer from the IMF financiers to the recipient countries (i.e., assumption A2 is violated). In that case, the moral hazard distortion would be of the same nature as that generated by deposit guarantee in a domestic banking context. The fact that the cost of a crisis will be subsidized by a third party (here, the financiers of the IMF) may induce emerging market countries and their lenders to indulge in excessively risky behavior. In this case, those who ultimately suffer from the distortion are not the domestic taxpayers in crisis countries but the financiers of the IMF (presumably the international taxpayer) who lose part of their contribution to the Fund.

To make this point formally, we revisit the first specification of the three-states model (in which the effort shifts the probability from the medium state to the high state). Let us assume that an IMF bailout in the medium state involves a subsidy (a transfer from the IMF to the rescued country) of size  $\sigma \leq \tilde{d}$ . (The transfer is equal to  $\tilde{d}$  if the country never repays anything to the IMF, but it cannot be larger.) Now the effort levels with and without IMF are respectively given by

$$e^{imf} = \arg \max e(1 - p_l)(\theta_h - \theta_m - \sigma) - h(e)$$

$$e^* = \arg \max e(1 - p_l)\theta_h - h(e),$$

The subsidy reduces the effort by making the medium state more attractive relative to the high state. But in this case, it reduces the effort below the first-best level (which is achieved

in the absence of subsidy). The IMF, therefore, reduces the effort from a laissez faire level that is too high to a level that is too low. It increases the welfare of the emerging market countries, but reduces the welfare of the rest of the world, and could decrease welfare as a whole, if the subsidy  $\sigma$  is large enough.

Finally, to return to a point made in the introduction, it is worth noting that even when the assumptions of the Mussa theorem are violated and the IMF does in fact generate moral hazard, this does not imply that this moral hazard is excessive. For example, it could be that the domestic political agency problem is mild enough that on balance, the IMF remains beneficial. Or it could be that the transfer in IMF lending is small enough that the induced distortion does not reduce global welfare. However, in the latter case, one has to worry about the redistributive consequences of IMF lending. The IMF does not induce a Pareto improvement in global welfare, since the welfare of emerging market countries is increased at the expense of rich countries. Some would say, of course, that this is redistribution in the right direction.

### **III. IMPLICATIONS OF MUSSA'S THEOREM**

#### **A. Implications for the Empirical Literature on IMF Induced Moral Hazard**

The Mussa Theorem does not prove that there is no IMF induced moral hazard. It merely states conditions—which may themselves be quite restrictive—under which IMF lending cannot give rise to moral hazard. However, as we have shown, even if these conditions are satisfied, and there is no IMF induced moral hazard, IMF lending will generally have implications such as increasing capital flows or lowering the interest rates at which countries borrow—not because it creates moral hazard, but simply because it makes the world a safer place.

This implications of this insight for the empirical literature on moral hazard are quite profound. There is by now an extensive literature that claims to “test for moral hazard” by looking at the effect of actual or expected IMF lending on either country risk or capital flows (among others, Zhang, 1999, Lane and Phillips, 2000, Dell’Ariccia, Schnabel and Zettelmeyer, 2002, Kamin, 2002, Burkhalter, 2003, Haldane and Taylor, 2003, Zoli, 2004 and Bai and Wei, 2004; see also Dreher, 2004, for a comprehensive survey and additional references). Without exception, the tests performed in this literature are incapable of distinguishing whether the effects of the IMF on market variables (to the extent that any are found) are a sign of moral hazard or simply an indication that the IMF is doing its job. This is not to say that these papers may not be valuable—clearly, the question of whether the IMF has an impact on international capital markets in the direction predicted by standard models (including models without any moral hazard) is an important one. However, they are not tests of moral hazard.

The same objection applies to a (much smaller) literature that looks at the effect of IMF lending on debtor country policies from the perspective of testing for moral hazard. For example, Dreher and Vaubel (2001) find that, controlling for the state of a country's

economy, countries that had obtained IMF credit ran more expansionary monetary and fiscal policies the less they had exhausted their borrowing potential in the IMF and the more credit they had received. But it is the *intended purpose* of IMF lending to allow countries experiencing balance of payments difficulties to run more expansionary fiscal and monetary policies than they otherwise could. Whether or not this is efficient or a source of moral hazard will depend on whether in the absence of IMF lending monetary and fiscal policies would be inefficiently tight (because countries cannot smooth consumption by borrowing in international capital markets) or whether IMF lending exacerbates an expansionary bias on the part of the authorities.

A more fruitful strategy in “testing for moral hazard” is to examine whether the assumptions of Mussa’s Theorem are satisfied or not. In particular, Mussa’s theorem establishes a precise empirical standard to determine whether or not IMF lending contains a subsidy or not. Note that this standard differs markedly from the standard proposed by some IMF critics, which is to compare IMF lending rates to *market* interest rates faced by the crisis countries to which the IMF lends. As stated by assumption A2, avoiding moral hazard requires only that the IMF lend at an interest rate that is high enough to cover its repayment risk, which may be substantially lower—as a result of the IMF’s political clout or its ability to directly affect a country’s solvency by imposing conditionality—than that the risk borne by private lenders. By this standard, does IMF lending carry a subsidy or not?

A first step in answering this question is to look at the rate of return that the IMF has actually received in its lending to various groups of countries over the past decades. To the extent that the IMF either charged subsidized interest rates or suffered major non-repayment problems, the rate of return should be lower than the international risk free rate, and in this case, IMF lending would undoubtedly carry a subsidy. Joshi and Zettelmeyer (2004) show that this is indeed the case for lending to low income countries, which carried an average annual rate of return, in the 1973-2003 period, of about 400 basis points below the rate that the IMF would have received from lending the same amount to industrial countries at comparable maturities. This largely reflects a combination of deliberately concessional lending and debt relief under the Highly Indebted Poor Countries (HIPC) initiative. In contrast, the spread between IMF rates or return and lending rates by industrial countries has been approximately zero for upper middle income countries (the group usually referred to as “emerging markets”). This is not surprising given that, with the exception of a few arrears cases in the 1980s, none of these countries have ever defaulted on the IMF, and the interest rate charged by the IMF in lending to these countries is calculated in terms of a spread over short term money market interest rates in industrial countries.

By this test, then, the IMF seems to have been lending at an actuarially fair interest rate to emerging market countries. However, it is a fairly weak test, since Joshi and Zettelmeyer’s exercise *assumes* that currently outstanding credit to the IMF will be repaid in line with IMF repayment projections. Is this assumption justified? According to our earlier work in this area, the answer—perhaps surprisingly—is positive. In Jeanne and Zettelmeyer (2001), we compared the length of currently open IMF “lending cycles” (uninterrupted periods of strictly positive obligations to the Fund) to the length of lending cycles that had been fully repaid in



the past, using a maximum likelihood procedure to decide whether currently outstanding IMF loans “looked” like they would eventually be repaid or not.<sup>12</sup> The upshot of the exercise was that because there have been many long lending cycles with emerging markets that eventually resulted in full repayment, the vast majority of the currently open lending cycles to these countries (about 95 percent) were predicted to be eventually repaid in full.

Like any exercise that focuses on the IMF’s repayment record, our 2001 characterization of emerging market lending as virtually subsidy free is convincing only if one assumes that the past is a good guide to the future. It is here where the potential problem lies. On the one hand, the shift to large-scale crisis lending that began with the 1995 Mexican loan does not seem to have constituted a structural break with the respect to the IMF’s repayment record: all large scale crisis loans made between 1995 and 1999 have by now been fully repaid, or are well on their way to being repaid.<sup>13</sup> On the other hand, as Mike Mussa has argued on several occasions, more recent large scale loans, such as the loans to Argentina in late 2000 and 2001, might be a different matter (could we cite Rogoff here, we don’t cite him at all). What differentiates the loans to Argentina is that they were made at a time when Argentina already had substantial outstanding obligations to the Fund, and that they were not made in response to a capital account crisis (as was the case for Mexico in 1995 or the Asian crisis loans) but rather in response to fiscal problems which carried the *risk* of a capital account crisis. This eventually materialized anyway, impacting all of Argentina’s creditors including the IMF. To the extent that this brand of large scale lending carries a higher risk of default than was typical for either standard lending or large scale crisis lending in the past, it would clearly imply a subsidy under current lending terms, and hence could be a source of moral hazard.

The other assumption in Mussa’s theorem is that debtor country governments act in the best long-run interests of their taxpayers. One does not have to be a cynic to doubt that this is the case. The question is how systematic the problem is in relation to IMF lending, i.e., whether large scale IMF lending has tended to go to countries whose pre-crisis policies, subsequent crises, adjustment, and repayment of the IMF had the joint effect of redistributing wealth at the expense of the average domestic taxpayer. One area of research related to this question is on the distributional effects of IMF programs (see Vreeland, 2003, Chapter 6). However, the literature in this area has tended to be focused narrowly on the effects of IMF conditionality,

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<sup>12</sup> More technically, we formulated a duration model in which the probability of observing an IMF lending cycle of length  $t$  was modeled in terms of the probability of either observing an “infinite lending” cycle that would never be repaid or the probability of observing a “finite” cycle that had not been repaid yet but would be repaid with some hazard rate. The probability of being in an “infinite” cycle and the parameters of the hazard function were then estimated using the available data on the length of both completed and incompleting cycles.

<sup>13</sup> Brazil’s 1998-99 loan had been largely paid off before it received new assistance from the IMF in mid 2001. Indonesia’s obligations to the Fund peaked in September of 2000 and have since then declined by about 20 percent.

rather than on the broader and more difficult issue of whether the combination of ex ante financial guarantees that may primarily benefit a small financial and entrepreneurial elite although it is backed by the average taxpayer has important distributional effects. This could be the case even without any IMF conditionality. IMF induced moral hazard through this channel remains an underexplored, and in our view critical, area of empirical research.

### **B. Implications for IMF Lending Policies**

From the perspective of avoiding moral hazard in IMF lending, the policy implications of Mussa's theorem are straightforward: avoid lending at terms and in circumstances that would lead to a violation of assumptions A1 and A2. The question is how this can be done in practice.

As far as avoiding implicit transfers in IMF lending is concerned, Mike Mussa has argued—and we agree with him—that this would be achieved under the IMF's current interest charges provided that lending is “temporary” and takes place “under adequate safeguards,” as envisaged in the Articles of Agreement. Indeed, the IMF's current rules imply that lending from its general resources (as opposed to deliberately concessional lending funded through special facilities) should not contain a transfer element. In particular, the IMF is only allowed to lend to countries that will, in all likelihood, be in a position to repay the Fund in the medium term. Furthermore, according to new guidelines issued in February of 2003 it is allowed to lend in large amounts (exceeding the usual limit of 100 percent of quota in any given year and 300 percent of quota in total) only when a “member is experiencing exceptional balance of payments pressures on the capital account resulting in a need for Fund financing that cannot be met within the normal limits,” when “a rigorous and systematic analysis indicates that there is a high probability that the debt will remain sustainable,” and when “the member has good prospects of regaining access to private markets within the time Fund resources would be outstanding.” These guidelines are meant to insure that large scale crisis lending—the suspected source of moral hazard with regard to emerging market countries—does indeed remain temporary and that adequate safeguards are in fact in place.

However, while most instances of large scale IMF crisis lending since 1995 would have satisfied the 2003 guidelines, the most recent cases—ironically, the only instances of large scale crisis lending that took place after the guidelines were issued—did not (see IMF, 2004). The reasons for this could reflect, in some combination, the fact that these criteria were tailored too narrowly to the capital account crises of the 1990s, a standard time consistency problem—lending might be optimal ex post even though refusing it is optimal ex ante—and, as Mike Mussa would put it, “geopolitical concerns.” Regardless of the cause, this experience shows that criteria that are meant to limit the circumstances in which large scale IMF crisis lending can occur could be violated. This could be a source of moral hazard.

Avoiding the “indirect moral hazard” that may arise when the IMF supports governments that fail to act in the best interests of their taxpayers is conceptually harder than avoiding a subsidy in lending. As Mussa has pointed out, it would obviously go too far to refuse

financial assistance to all but the most virtuous and competent governments. From the perspective of avoiding IMF induced moral hazard, the key issue is not so much pre-crisis policy mistakes *per se*, but rather whether the distributional implications of these mistakes—and thus the propensity of governments representing special interests to commit such “mistakes”—might be magnified by the prospect of IMF liquidity support. In those cases, the IMF should not lend.

How can this be operationalized? For one thing, as Mussa has argued, the IMF must not support “gamble for resurrection”: desperate pre-crisis measures which benefit the government and the ruling elites by maintaining a possibility that the crisis could be avoided, at enormous expense to the taxpayer in the event that the attempt fails. Others, including the Council on Foreign Relations Task Force (1999), the International Financial Institution Advisory Commission (2000), and ourselves in our 2001 paper, would take a broader and more ambitious view of the desirable link between pre-crisis policies and access to IMF lending, perhaps including the level and structure of outstanding debt, its transparency with respect to data, the quality of institutions regulating the financial sector, and its responsiveness to IMF surveillance. Again, the key challenge in creating such a link in practice is to overcome the time consistency problem that it inevitably raises.

#### IV. CONCLUSIONS

The Mussa Theorem is a statement of conditions under which official crisis lending does not have adverse incentive effects. It is pivotal to understanding the welfare implications of crisis lending as distinct from conventional forms of insurance involving conditional transfers. Whether it holds empirically is an open issue—quite possibly it does not. But this does not lessen its importance. Like the Modigliani-Miller theorem, which undoubtedly does not hold, the importance of the Mussa Theorem consists in defining an intellectual benchmark. By defining the conditions under which IMF induced moral hazard *cannot* exist, it establishes a set of potential channels or mechanisms through which moral hazard could in fact arise in practice.

The Mussa Theorem’s practical significance is hard to overstate. By pointing out that lower borrowing costs or larger capital flows are the expected consequence of any crisis lending mechanism regardless of whether it leads to moral hazard or not, it implies that the standard “test for moral hazard” used in the empirical literature is not meaningful. What this literature does is to test whether IMF crisis lending has effects on international capital markets in the direction that most models of the IMF would predict—with or without moral hazard. The same applies to papers that observe that IMF lending allows countries to run more expansionary policies than they otherwise could. This may be the intended consequence of IMF lending, and is not proof of moral hazard. However, the Mussa theorem is also constructive: it suggests an alternative empirical approach, which is to test for the validity of its conditions directly.

In the policy arena, perhaps the most important contribution of the Mussa theorem is to define, in precise terms, the meaning of a moral hazard inducing “subsidy” in IMF lending.

Time and time again, this has been a subject of misunderstanding, with IMF critics arguing that IMF lending incorporates a subsidy at the expense of creditor country taxpayers to the extent that its interest charges are lower than those charged by private borrowers (see Higginbotham and Schuler, 2002, for a recent example). The Mussa theorem shows that this is an incorrect standard, except in circumstances where the IMF faces the same default risk as private borrowers. From the perspective of avoiding moral hazard, what matters is whether IMF interest rates are actuarially fair in the sense that they cover the risk faced by the IMF. This will generally be lower than that faced by private borrowers.

Finally, the Mussa theorem suggests that the IMF could be a source of moral hazard to the extent that its lending amplifies pre-existing moral hazard problems in borrowing countries. In avoiding this source of moral hazard, the general principle must be to relate access to IMF financing to country policies prior to the crisis. However, this is easier said than done, particularly because it raises a time consistency problem. Whether or not this problem can be satisfactorily dealt with will largely determine whether incentives-friendly large scale lending is feasible, and poses a major challenge for the future.

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