Information as a Substitute for Bailouts in Sovereign Debt Markets

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Abstract

This paper argues that multilateral financial institutions (MFIs), such as the International Monetary Fund, play an important informational role in international financial markets. By providing low-cost and high quality information, that is otherwise very costly for private lenders to obtain, the MFI allows a private lender to form a more accurate estimate of the credit-worthiness of a sovereign borrower. This creates a positive externality for private lenders and for sovereign borrowers with low risk credit ratings that are revealed by the provision of MFI information. The MFI can choose to internalize the negative externality created for sovereign borrowers who are revealed to be a higher credit risk by providing stand-by commitments to the sovereign. We construct a formal model of the private lenders decision to purchase costly information about the sovereign borrower. The model suggests that the free provision of MFI information has greater positive effects on financial markets the less risk-averse the private lender, the less information the private lender already has, the greater the size of the loan, and the smaller the expected default probability of the sovereign borrower.

"… the International Monetary Fund, although it is not an international central bank, has undertaken certain important lender of last resort functions in the current system, generally acting in concert with other official agencies -- and that that role can be made more effective in a reformed international financial system."
Stanley Fischer[1]

"Through stronger surveillance, including encouragement of countries to make more timely data publicly available, the IMF would help to provide financial markets with the information that they need to form judgements concerning a country's creditworthiness…"
Paul R. Masson and Michael Mussa[2]

"It's time to kill the IMF."
Milton Friedman[3]

1. Introduction

Multilateral financial institutions (MFIs), such as the International Monetary Fund (IMF) and the World Bank, have come under increasing scrutiny regarding their lending practices, particularly in instances of a sovereign debtor nation facing a financial crisis. However MFIs serve other roles such as a provider of information concerning the credit worthiness of potential borrowing nations. Private lending institutions operating in competitive capital markets may not find it profitable to acquire detailed information for each potential borrower or may find the borrower unwilling to provide it. In this case, the IMF and the World Bank can act as intermediaries in the provision of costly information[4]. While broad aggregate indicators of economic performance can be obtained quite easily by private lenders through publications provided by official lenders (such as the IMF's International Financial Statistics and the World Bank's Global Development Finance), more detailed information is kept in confidence by official lending institutions. Private lenders may be able to "free ride" on this confidential information by observing terms for new commitments or reschedulings, for example, those completed by the IMF under Paris Club negotiations[5]. Keeping valuable information confidential can result in excessive speculation and eventually a speculative attack on a sovereign's currency and assets.

[1] Stanley Fischer, "On the Need for an International Lender of Last Resort", IMF Working Paper, 1999, p. 1.
[2] Paul R. Masson and Michael Mussa, "The Role of the IMF: Financing and its Interactions with Adjustment and Surveillance", IMF Pamphlet Series No. 50, 1997, p. 25.
[3] Milton Friedman, "Its Time to Kill the IMF", National Post, November, 1998.
[4] The concept of free riding on costly information is elucidated by Grossman and Stiglitz (1976). There the authors show that without free riders, product markets will fail to exist.
[5] Although IMF and World Bank commitments and loans are often made at concessional terms. Nevertheless the degree of concessions is often announced by the official lender, making it simple for private lenders to extract valuable information from the terms.

The objective of this paper is to construct a model in which the information role of a MFI can be investigated. We consider the optimal choice that an international private lender faces when an MFI is willing to provide either free information concerning the creditworthiness of a sovereign borrower, or a loan commitment that will guarantee repayment of a portion of the loan in the event of default, but not both. Risk-averse private lenders operate in a competitive market where the riskiness of the sovereign borrower is incorporated into the market spread above LIBOR. Each lender must charge this market spread but can invest in costly information to determine an optimal loan size. Information reduces the variance of the distribution of the true default probability, allowing for a more accurate assessment of the expected utility from a loan. Lenders cannot observe the true probability of default, which can change due to exogenous factors, but can observe the variance of its distribution. Exogenous shocks to the measured probability of default (measurement error) and the loan demand of the sovereign prevent free riders from inferring shifts in the distribution of the true default probability. We do not consider adverse selection problems and we do not treat the loan demand of the sovereign explicitly.

Research investigating the optimal acquisition of information by economic agents and firms can be roughly divided into three approaches: existence and uniqueness of rational expectations equilibria, imperfect competition models, and models of insider trading. Our paper utilizes the methodology of the first approach and that is where we focus our discussion. Examples of imperfect competition models that assess the welfare implications of information acquisition and first-mover problems can be found in Hwang (1995, 1993). A good review of insider trading models, and the existence of trading equilibria, can be found in Levine and Smith (2003). The rational expectations models typically assume a perfectly competitive market where a share of firms obtain a unit of information at a fixed cost which allows them to distinguish between demand and supply shocks to the market price. The rest of the firms are uninformed and only observe noisy market price signals. Grossman and Stiglitz (1980) demonstrated that an equilibrium can exist in such a market, albeit for the special case of normally distributed shocks and exponential utility. Verrecchia (1982) extends this work by assuming that information acquisition is continuous with increasing costs and is endogenous to output decisions. Ausubel (1990) uses a more general utility function and non-normal shocks to derive an equilibrium. Barlevy and Veronesi (2000) demonstrate that many previous results do not hold with more general assumptions, in particular, that greater information acquisition makes prices more informative. This class of papers focuses on the setup of information acquisition models, but investigates the existence and uniqueness of equilibria, rather than tradeoffs in information acquisition which is the focus of our analysis.

We model the lending process as a two-stage game. In the first stage, the private lender determines the optimal loan size and the optimal level of information acquisition, given the market spread, when the private lender faces costly information. We find that the optimal loan size is decreasing in the true default probability, the degree of risk aversion, information costs and the variance of the loan demand shock. The optimal level of information acquisition is increasing in the same factors. Partial loan guarantees offered by an MFI are exogenous. If partial loan guarantees are forthcoming, then they act as substitutes for costly information. In the second stage of the game, a choice of a free unit of information or an additional unit of loan guarantee is offered to all private lenders by the MFI. Partial loan guarantees serve the purpose of compensating sovereigns who will receive more onerous loan conditions from the revelation of negative information. To keep the model simple, in stage one we do not allow the private lender to form expectations of the amount of forthcoming free information or loan guarantee in stage two. We assume that the MFI has not demonstrated a systematic policy towards whether it "offers" in the second stage of the game, thereby preventing lenders from forming rational expectations in the first stage.

If private lenders are optimizing, we show that the provision of free information is preferred by lenders exhibiting relatively low risk and large sovereign loans. For very risky sovereign borrowers, the provision of free information, that reduces the variance of errors in estimating the true default probability, is secondary to the fact that the default probability is already large. Greater risk aversion and greater information costs make partial loan guarantees more attractive to private lenders. At first glance, these results suggest that there is little role for MFIs to provide free information to private lenders since it is most preferred only for relatively safe loans. In fact, estimated default probabilities for most sovereign borrowers are low enough to suggest that free information may play a very large role in improving the efficiency of sovereign lending markets. Given that even large MFIs face a limit to their resources, optimal resource allocation between information acquisition and provision, and partial loan guarantees is an important issue.

MFIs are coming under increasing pressure to engage in information provision. The informational role of official institutions in debt negotiations through the Paris Club is described in Lee (1993). There he argues that official institutions serve the role of avoiding market failure through imposing credit ceilings to avoid excessive lending and by conducting continuing analysis and surveillance to certify the credit-worthiness of the sovereign borrower. Eckaus (1982) (cited in Lee (1993)) notes that the IMF and World Bank perform tasks “that no market exists to do and that would not or could not be done even by perfect financial markets.” He further adds, “These missions generate data and arrive at mutual agreements which are not obviously achievable by private financial markets but which, nonetheless, appear to be useful to private institutions.”

Government attempts to establish monitoring agencies, outside the IMF and World Bank, for sovereign LDC loans have not faired well (Rodriguez (1992)). Prior to 1983 there was no comprehensive reporting by private banks on international exposure to LDCs. The Institute for International Finance was created by private banks to assess exposure and country credit-worthiness in 1983, but played only a minor role in international lending. The International Lending Supervisory Act (ISLA), approved by the U.S. Congress and Senate in 1983, outlined a five-point program to supervise international lending. Among the stipulations of the Act were continued access of the indebted nations to new funds, the provision of tools to discipline lending to countries failing to implement IMF adjustment programs, and to discourage international lending which serves to increase private banks assets at the expense of higher risk. Information provision fell well down the list of objectives. International banking groups used the provisions of ILSA to form a creditor cartel which imposed onerous conditionality policies on heavily indebted LDCs. Net transfers from Latin America abroad totaled some $125 billion US from 1982 to 1988. A recurring theme throughout this period is the recommendation by ILSA to improve information provision and risk analysis by private banks[6]. With the recent turmoil in financial markets, the IMF and World Bank have made extensive efforts to increase the amount of information available to credit markets and to improve on its quality[7]. In 1996, the IMF established the Special Data Dissemination Standard that sets standards for good practice in the dissemination of financial and economic data. In 1999, a joint World Bank – IMF surveillance project called the Financial Sector Assessment Program was established to further improve the financial monitoring of member countries.

[6] ILSA contained recommendations to force private banks to disclose information about foreign loans. In a 1988 report, the United States General Account Office recommended that forecasts be made for countries very likely to develop debt servicing problems and that deficiencies in the information used to determine loan ratings be eliminated.

[7] See Kester (2000) and Hilbers et al (2000).

The next section develops a model in which an MFI obtains and reveals valuable information concerning a sovereign borrower that would not otherwise be made available to private lenders due to prohibitively high costs. The market assesses the new information and perceives the participation by the MFI as an offset to any negative information that otherwise reduces the expected value of new loans. MFI information can change loan pricing via two mechanisms: information can shift the perceived probability of default, and; information can reduce the variance of the distribution of the perceived probability of default. Even if MFI information does not shift the distribution, it can make matters worse for the risky sovereign borrower by reducing its variance.

2. A Model of Lending with Uncertain Default Risk

The setup of our model is similar to Grossman and Stiglitz (1980) and Verrechia (1982), but also includes elements that are specific to the international lenders problem. Consider the problem of a risk-averse private lender[8] who maximizes expected utility from profits by determining the optimal size of a loan, L_t, to a sovereign LDC borrower. We consider a simple one-period environment in which the loan is used to purchase capital, not to purchase pure consumption goods. The lender faces a constant opportunity cost of r, here assumed to be the LIBOR rate, and receives a rate of return, ρ_t on the loan. For simplicity, all loans have a maturity of one period. The loan market is competitive, however different sovereign borrowers may face different loan rates due to varying risk characteristics.

The private lender forms an estimate of the probability that the sovereign borrower will fall into arrears, π_t, at the end of the time period when the loan, plus interest, is due. The actual amount of arrears as a proportion of the size of the loan, $a_t = A_t/L_t$, is assumed exogenous and independent of π_τ[9]. The default probability π_τ is formulated using an information set which is gathered at some cost C_t, independent of the loan size. If the fundamental probability of default is given by $\bar{p}$ which is assumed constant over the lifetime of the loan, then the estimated probability

[8] Private lending is not often performed by only one lender, rather a groups of lenders form a banking group who then assign a lead bank as the principal negotiator. We treat the banking group as a single lender here.

[9] This assumption could be easily modified but does not change the qualitative results of the model.

of default is given by $\pi_t = \bar{p}_t + m_{it}$ where m_{it} is a measurement error for the ith lender at time t, $m_{it} \sim N(0, s_m^2)$.

By acquiring costly information, the lender can reduce the variance of π_t that is the variance of the error term s_m^2[10]. The exact nature of how a "unit" of information reduces the variance is left unspecified. The cost function is assumed to take the following form.

$$C_{it} = d + \frac{b}{s_m^2} \tag{1}$$

The term $\delta > 0$ is a fixed cost of information acquisition. This is justified since just to be in the lending business, a lender must be able to form a value for π even without additional expenditures of information to reduce the variance of π. The term $\beta > 0$ partly determines the marginal cost of information.

The loan market is characterized by perfect competition, however each lender will have an incentive to gather an information set in order to estimate the probability of default. We assume the information set is unique to each lender. Lenders cannot benefit by free-riding on each others information sets. In the aggregate, we assume $\sum_{i=1}^{n} m_{it} = 0$ so that the market spread for each sovereign borrower reflects accurate information concerning the borrowers credit-worthiness. A potential lender sitting on the sidelines will observe changes in the market spread, s, that we assume to depend upon a function of the underlying fundamental probability of default and a demand shock so that $s_t = \bar{s}_t(\bar{p}_t) + d_t$, where d_t is a demand shock caused by an unexpected shift in the borrowers marginal product of capital. For convenience we assume $d_t \sim N(0, s_d^2)$. Current lenders will know this and will have an incentive to acquire more costly information to determine if their spread, in relation to other lenders, is the correct one[11].

An international agency, hereafter referred to as the IMF, possesses information concerning the riskiness of lending to sovereign borrowers that is not obtained by private lenders

[10] The information literature refers to the inverse of the variance as the "precision" of the information.

[11] A perfectly competitive lending market would allow lenders to simply sit on the sidelines and observe the market spread, which ideally would be a market average of the default probabilities estimated by each lender. Market failure could result with no lender investing in costly information. It is possible that the IMF exists to prevent this sort of problem, however we do not pursue that motivation here.

due to high acquisition costs. The IMF disseminates this valuable information to all private lenders at zero cost. The reason for this is that the IMF would like to promote an efficient capital market for sovereign lending in order to minimize it's involvements in potential sovereign defaults. When the IMF information is revealed, private lenders may revise their assessments of the sovereign borrower's riskiness, ie. the default probability π_t. If the information suggests the sovereign is in better economic health than estimated by private lenders, π_t will fall from the lender's initial estimate and the optimal loan size L_t* will increase. Any official IMF involvement will not be required for loans of this type. On the other hand, if the IMF information reveals a substantially riskier sovereign borrower, π_t will rise and the optimal loan size L_t* will be reduced, perhaps to zero.

While the effect of IMF information on π_t is uncertain, its presence always serves to reduce the variance of the measurement error of π_t, s_m^2. Uncertainty enters the model in two ways: through the uncertainty of which state will be revealed in period two, and through the risk in estimating π_t. All private lenders receive the IMF information so that there are no disadvantaged lenders. This differs from the approach assumed for information dissemination in equity markets by Levine and Smith (2003). In equity markets, an insider may provide valuable information to a small subset of traders, leaving all others disadvantaged. If too many traders are "informed", a market-maker will not be able to earn positive profits by matching traders and the market will fail. The welfare effects of information are difficult to assess when one trader has inside information he or she is willing to share with only a few other traders. In our approach, information has a distinctly positive effect on welfare.

The role of the IMF in our model does not end at simply providing valuable information. When information is revealed, some sovereign borrowers will benefit (higher L_t* at more favorable terms) and some will be made worse off (lower L_t* at harsher terms), but a necessary requirement for the role of the IMF in sovereign capital markets is that there be a net benefit overall. To avoid defaults forced upon sovereign borrowers by the dissemination of valuable information, the IMF provides compensation in the form of an immediate debt relief payment equivalent to the reduction in the expected profit of the private loan. The objective is to insure that sovereign borrowers still receive the same loan that would have been made had the IMF information not been revealed (L_t*). The payment is thus a fraction μ of the original loan and is paid directly to the sovereign borrower, which then finds its way back to private lenders through immediate debt service payments[12].

The private lender's total profit X_t from the two-period loan is given by

$$X_{it} = X_{it}^{G} - p_t X_{it}^{B} - (1+r)L_{it} - C_{it} \quad (2)$$

where X_t^G represents total profit in the good state,

$$X_t^G = (1 + r_t)L_{it} = ((1 + r + s_t)L_{it} \quad (3)$$

where X_t^B represents the loss in the bad state where the sovereign borrower defaults.

$$X_{it}^{B} = (1 + r_t)(a_t - m_t)L_{it} = (1 + r + s_t)g_t L_{it} \quad (4)$$

The term γ is the expected rate of return in the bad state. It is the difference between the percentage of the loan that falls into arrears (a_t) and the percentage of the loan that is covered by an IMF commitment (μ_t). In the worst case scenario for the lender, the bad state occurs at the end of period one so $a_t = 1$ and $\mu = 0$, and consequently $\gamma = 1$. The entire principle and accrued interest on the loan are lost. Generally bad states are characterized by partial defaults where $a_t < 1$.

The lender is assumed to possess an exponential utility function displaying constant absolute risk aversion[13].

$$u(X_{it}) = -e^{-aZ_{it}} = -e^{-a\left(X_{it} - (a/2)X_{it}^2\right)} \quad (5)$$

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[12] We do not address the question here of which private lenders will receive the IMF subsidy. Later in the paper we will assume that a private lender has a choice between free information or a subsidy, but not both. Since the lenders loan portfolio is composed of sovereign borrowers possessing different degrees of default risk, lenders will prefer a loan subsidy for some loan contracts, and free information for others.

[13] Although many functional forms will generate similar results for our model, this utility function displays the necessary curvature and is common in the literature (e.g. Grossman and Stiglitz, 1980.)

The utility function has the usual properties, u'>0, u"<0, and α is the Arrow-Pratt coefficient of absolute risk aversion. The profit function is given by substituting (4) and (3) into (2) and simplifying[14]

$$X_{it} = [s_t - p_t g_t]L_{it} - C_{it} = [\bar{s}_t + d_t - (\bar{p}_t + m_{it})g_t]L_{it} - C_{it} \qquad (6)$$

The market price for loans is given by $\bar{s}_t + d_t$, which is obtained from a reduced form expression that equates loan demand and supply[15]. With risk averse lenders, substituting (6) into (5) and taking expectations gives the Z_{it} as[16]

$$E(Z_{it}) = (\bar{s}_t - \bar{p}_t g_t)L_{it} - C_{it} - a\frac{1}{2}\left((\bar{s}_t - \bar{p}_t g_t)^2 L_{it}^2 - 2(\bar{s}_t - \bar{p}_t g_t)L_{it}C_{it} + C_{it}^2\right) - a\frac{1}{2}\left(s_d^2 + g_t^2 s_m^2\right)L_{it}^2 \qquad (7)$$

The lender maximizes the objective function in (7) by selecting an optimal loan size L_{it} and variance (information) s_m^2. The first order conditions are

$$\frac{\partial u}{\partial L} = \bar{V}_t - a\left(L_{it}\bar{V}_t^2 - C_{it}\bar{V}_t + \left(s_d^2 + g_t^2 s_m^2\right)L_{it}\right) = 0 \qquad (8)$$

$$\frac{\partial u}{\partial s_m^2} = -C_{it}' - \frac{a}{2}\left(2C_{it}C_{it}' - 2\bar{V}_t L_{it} C_{it}' + g_t^2 L_{it}^2\right) = 0 \qquad (9)$$

where $\bar{V}_t = (\bar{s}_t - \bar{p}_t g_t)$ and $C' = \partial C / \partial s_m^2 = -b / s_m^4$. Perfect competition implies that lenders earn zero profit after information costs, thus $\bar{V}_t L_{it} - C_{it} = 0$. To insure diminishing

[14] In the derivation of (6), higher order products – p?r or p?s – are discarded as likely to be "small" relative to the rest.

[15] We cannot obtain an exact solution for the market spread since we do not model sovereign loan demand. For the same reason, we also do not discuss whether an equilibrium loan contract exists, rather we simply assume one always does. Credit rationing may prevent a feasible loan contract from existing. In this case, the supply curve is backward bending with the assumption s =s(π, L) and π = π(s). If loan demand is everywhere above loan supply, a feasible loan contract may not be obtainable. See Kletzer (1984) for an example where an equilibrium loan contract is still feasible.

marginal utility in L_{it} and s_m^2, the following conditions must hold from the second derivatives of (7).

$$\bar{V}_t > \sqrt{s_d^2 + g_t^2 s_m^2} \qquad (10)$$

$$ab < 2s_m^2 \qquad (11)$$

The first condition insures that expected marginal profit from loans be above a geometric average of the two variances (when γ = 1), or more simply, that the variances cannot be too large. The second condition requires that neither the marginal cost of information (β) or the negative portion of marginal utility (α) is too large or utility will become negative.

Solving (8) and (9) for the solutions for L_{it} and s_m^2 gives

$$L_{it} = \frac{\bar{s}_t - g_t\left(\bar{p}_t + (2ab)^{1/2}\right)}{a s_d^2} \qquad (12)$$

$$s_m^2 = \frac{(2ab)^{1/2} s_d^2}{\left(\bar{s}_t - g_t\left(\bar{p}_t + (2ab)^{1/2}\right)\right)g_t} \qquad (13)$$

To insure that (12) and (13) yield positive solutions, α and β cannot be too large. In addition, we rule out $\gamma_t = 0$ (no loss in the bad state) to insure $s_m^2 < \infty$ (no information is purchased). Finally we also rule out $s_d^2 = 0$ since this would allow all private lenders to fully infer the true value of π_t from observing movements in the market spread.

An increase in the marginal cost of information (β) reduces the optimal loan size and reduces the optimal amount of costly information[17]. An increase in risk-aversion (α) reduces the optimal loan size, but also reduces the amount of information purchased. One normally thinks that more information reduces ones exposure to risk, hence lenders should acquire more information if they are more risk-averse. From (7), an increase in α reduces utility so the lender must undertake actions to minimize this loss. Since L^2 appears in the second term of (7), L must be reduced. Both

[16] In deriving (7), we have assumed that the covariance of m and d is zero: $COV(m_{it}, d_t) = 0$ and that these two shocks do not covary with the expected value of any other variables in the model.

[17] The statics are most easily checked by taking the natural logs of (12) and (13).

C^2 and s_m^2 appear in the second term as well, however the C^2 term has a larger coefficient, so reducing information costs is the optimal decision to minimize the loss in utility. An increase in the variance of the demand shock, s_d^2, increases the lenders exposure to risk. The correct response is to reduce the optimal loan size and reduce information costs for the same reasons as given for an increase in risk-aversion. An increase in the expected default probability, $\bar{p}$, reduces the expected profit from the loan through $\bar{V}$. The lenders optimal response is to reduce the loan size and spend less on information (since the marginal benefit of information is scaled by L).

These static results are not too surprising, with one exception. An increase in the expected loss per dollar of loan in the default state (γ) reduces the overall expected value of the loan. The lender responds by reducing the optimal loan size and *increasing* the amount of information purchased. The key is found in (7) again. Increasing γ unambiguously makes the second term in (7) larger, reducing utility. Reducing s_m^2 is the only option to the lender, even though this comes at a higher information cost. This result suggests that information and a partial loan guarantee (μ) are substitute goods to the lender. This substitutability result is important for the discussion in the next section.

3. IMF Participation

Would a private lender prefer that the IMF provide accurate information at zero cost or a bailout that lowers the value of γ, the expected return in the bad state? Both actions would raise expected utility for the lender and, obviously, the lender would prefer that the IMF provide both. As long as the IMF stood ready to provide financial assistance to sovereign borrowers whose probability of default is revealed to be higher than previously expected, the provision of free information would make financial markets better off in terms of utility. This in itself, provides one justification for the provision of IMF assistance as part of an information-assistance mandate.

Suppose we have a private lender who is maximizing utility according to (12) and (13). An MFI, like the IMF, approaches the lender and offers a choice. The offer is either an extra unit of high-quality information at zero cost, which will allow the lender to form a more accurate estimate of p_t and thus raise its utility by reducing risk, or an additional unit of loan commitment that reduces the lenders loss if the default state is revealed. The lender will choose the option with the higher marginal utility. Inserting the solutions in (12) and (13) into (7) gives the indirect utility function. The marginal utility of s_m^2 is given by

$$\frac{\P u^*}{\P s_m^2} = -C_{it}^*{}' - \frac{a}{2}\left(2C_{it}^* C_{it}^*{}' - 2\overline{V}_t L_{it}^* C_{it}^*{}' + g_t^2 L_{it}^{*2}\right) \tag{14}$$

With zero marginal information cost (β = 0), (14) reduces to

$$\frac{\P E\left(u^*\right)}{\P s_m^2} = -\frac{a g_t^2 L_{it}^{*2}}{2} \tag{15}$$

The marginal utility of γ, with costly information, is given by (after simplification)

$$\frac{\partial E\left(u^*\right)}{\partial g_t} = -\overline{p}_t L_{it}^* - a g_t L_{it}^{*2} s_m^{*2} + \left(\overline{V}_t - a g_t^2 L_{it}^* s_m^{*2}\right)\frac{\partial L_{it}^*}{\partial g_t} - \left(\frac{a}{2} g_t^2 L_{it}^{*2} - \frac{b}{\left(s_m^{*2}\right)^2}\right)\frac{\partial s_m^{*2}}{\partial g_t} \tag{16}$$

Lenders would prefer a partial bailout $(0 < \mu < 1)$ that lowers ą to more information (lower s_m^2) if the marginal utility of γ with costly information is greater than the marginal utility of s_m^2 with zero marginal information cost. Setting (15) greater than (16) and simplifying gives the following condition[18].

$$a g_t L_{it}^*\left(\frac{g_t}{2} - s_m^{*2}\left(1 + e_g^* - \frac{h_g^*}{2}\right)\right) + \frac{b h_g^*}{s_m^{*2}} > \overline{p}_t \tag{17}$$

where $e_g^* < 0$ and is the elasticity of L with respect to γ evaluated at the maximum, and $h_g^* < 0$ and is the elasticity of s_m^2 with respect to γ, also evaluated at the maximum.

Condition (17) provides a rich set of conclusions regarding the private lenders preference for more information instead of a larger loan guarantee. Everything else the same, higher risk

[18] The derivation of (17) incorporates the assumption $\overline{V}_t / L_{it} = 0$.

aversion (α) makes it more likely that the lender would prefer information to a larger loan guarantee. Looking at the condition another way, for two loans of identical risk aversion and expected default probability, but different sizes, the lender is more likely to prefer more information for the larger loan. From (17) it is clear that a higher expected default probability makes a partial loan guarantee more attractive. For very risky sovereign borrowers, the provision of free information that reduces the variance of errors in estimating the true default probability is secondary to the fact that the default probability is large. A partial loan guarantee (higher μ) has a much larger positive effect on utility and the expected value of the loan. Finally, the smaller the amount of information the private lender already has (large s_m^2), the more likely greater information will be preferred to a larger loan guarantee.

Condition (17) is a rather unruly expression since it contains implicit solutions for L and s_m^2. To evaluate its properties further, we simulated a system of equations including (12), (13) and (17). The initial parameter values, given by, given by $\alpha = 0.0001$, $\beta = 0.12$, $\gamma = 0.1$ ($\mu = 0$), $s_d^2 = 0.0001$, s = 0.01 and $\pi = 0.05$, were chosen so they satisfied the second order conditions in (10) and (11)[19]. With these parameter values, the solutions for L, s_m^2, Z and U(Z) were \$465,360 0.00074, 767.7 and –0.926 respectively[20]. The system was then simulated by incrementing the parameter values for α, β, s_d^2 and π separately. The results appear in Figures 1 to 3. The solutions for L and s_m^2 diminish as any of the four parameter values is increased. Since increases in any of α, β, s_d^2 and π reduce the lenders utility, the optimal response is to reduce the scale of lending and information investment. This summarizes the results for the private lender at the end of the first stage of the game.

In the second stage of the game, additional information and partial loan guarantees are free goods, however if the lender is forced to choose one or the other, the optimal choice will depend upon the marginal rate of substitution between the two options. The marginal rate of substitution is simulated as the ratio of the marginal utilities given in (15) and (16) and represents the rate at which the private lender would optimally substitute less information for a larger loan guarantee, given the optimal amount of information already purchased and the optimal loan size at

[19] We computed the ratio of arrears to the total stock of long-term debt for a large sample of LDCs to obtain a value for γ. (Source: 2002 Global Development Finance CD-ROM, The World Bank).

[20] Recall that the variances s_m^2 and s_d^2 measured as squared deviations of the loan spread.

the end of stage one of the game. The results appear in Figures 4. In Figure 1, as β increases, additional information becomes more costly if acquired privately in stage one. Not surprisingly, the partial loan guarantee (lower γ) becomes the preferred option at the start of stage two since the marginal rate of substitution diminishes and may fall below one at some value of β. We cannot determine if a private lender will choose the free information or the free partial loan guarantee at the start of stage two as the initial marginal rate of substitution is sensitive to the parameter values chosen at the start of stage one. We can only determine the direction in which the marginal rate of substitution moves with changes in the initial parameter values. With technological advancements and greater monitoring of sovereign borrowers, information costs for private lenders are probably falling quite rapidly, making the provision of free information more likely to be the preferred option.

Figure 4 also demonstrates that an increase in s_d^2 reduces the marginal rate of substitution, and thus the preference for more free information over a free partial loan guarantee. An increase in s_d^2 reduces the informational content of the market spread in determining the true default probability. As s_d^2 becomes very large, demand shocks completely dominate random measurement errors and any further information acquisition will have only a marginal effect on reducing the variance of the measured default probability. Since estimating a default probability accurately becomes very difficult, the private lender would prefer a partial loan guarantee. Greater absolute risk aversion (higher α) reduces the marginal rate of substitution so that the free partial loan guarantee becomes a more probably choice for the lender.

Figure 4 finally demonstrates the most powerful conclusion of the simulation results. As the true probability of default rises, the marginal rate of substitution falls quickly so that partial loan guarantees are preferred, even at moderate default probabilities[21]. This makes intuitive sense. If the true default probability were to increase to one, default is a certainty and the only way a private lender will lend any amount to the sovereign is with a gratis full loan guarantee. This is an extreme case, but if the true default probability is less than one but large, the distribution of the measured default probability will be centered on a large value, and the value of additional information to "home in" on the true default probability is slight. Essentially the mean measured default probability outweighs it variance since default is almost a certainty.

[21] If we modeled π as the weighted average default probability for the private lenders loan portfolio, the lender would accept free information for some loans, and free partial loan guarantees for the others, and adjust loan shares (and thus their risk exposure) in the portfolio until the marginal rate of substitution equaled one in Figure 3.

From (17) and the simulation results, we can construct a picture of the typical situation in which the IMF should consider providing accurate information at zero cost instead of greater participation in the loan package in the form of a partial commitment: A risk-averse private lender with little information is making a large loan to a sovereign borrower with a reasonably low probability of default. This scenario probably characterizes the bulk of private loans to sovereign borrowers. Barney and Alse (2001) estimate ex post default probabilities for a sample of 54 LDCs over the 1985-91 period, using four statistical methods[22]: OLS, Logit, a neural network, and a genetically trained neural network (GTO). Sovereigns tend to fall in the extremes when ex post probabilities are estimated. For sovereigns that did not default in a given year, the estimated default probability is below 0.14 for the best fitting GTO method, while the estimated default probability is greater than 0.86 for sovereigns that did default in a given year. Early warning type models that are forward looking would probably provide default probabilities in the intermediate range for some LDCs, although we could not locate any references that computed default probabilities[23]. Nevertheless for relatively safe sovereign borrowers, the probability of default is close to zero and our model suggests that a financial intermediary should allocate its scarce resources to providing valuable information, instead of providing free loan commitments.

The model also suggests curious possibility for international lending. By packaging several smaller loans to a single sovereign borrower into one large loan, assuming the default probability is not affected, the IMF may encourage the lender to prefer free information, rather than a partial loan guarantee. Since partial bailouts might provide an incentive for sovereign borrowers to default, or at least to pursue irresponsible domestic policies, larger loan packages accompanied by free IMF information may be beneficial to capital markets.

4. Conclusions

Institutions such as the IMF, the World Bank and others intrude on private lending, Their actions take place in a number of dimensions two of which we categorize under the rubrics of information and bailout. By providing a model of private lending that incorporates the impact that MFIs have on the private lender, we explore systematic environments in which one or another

[22] Default is defined as the need for a rescheduling of loan contracts.
[23] Laopodis (1999) is an example of a rather ad hoc early warning model. Default probabilities are not estimated.

MFI strategy is preferred by private lenders. We have developed a model that proposes conditions under which it is optimal (in the sense of increasing the utility of private lenders) for a MFI to provide information concerning the creditworthiness of a sovereign borrower free of charge to a private lender over providing a free partial loan guarantee. The best-case scenario in favor of information provision is that of a relatively low risk sovereign borrower with relatively certain loan demand requiring a large loan. The usefulness of this approach is that it highlights systematically the way in which MFIs intervene in markets and more generally raises the implicit question as to whether these institutions are themselves aware of the systematic tradeoffs. A more complete characterization of the international environment would be one in which there were explicit and identifiable objectives of the MFIs themselves. These could then be squared with the impact on the market actors with whom they interact, and a richer discussion of an optimum could then be addressed.

The model developed in the paper is only a partial equilibrium one. A more complete, general equilibrium model would incorporate the sovereign's loan demand explicitly, as well as the optimization problem facing the MFI. Borrowers and lenders could be allowed to form rational expectations of the amount of free information and partial loan guarantees that the MFI chooses to make available before negotiating a loan package. We anticipate that the optimal loan size would increase by moving to such a general equilibrium framework and that the lenders preference for information might be reduced. We leave the formal evidence for our conjectures to future research.

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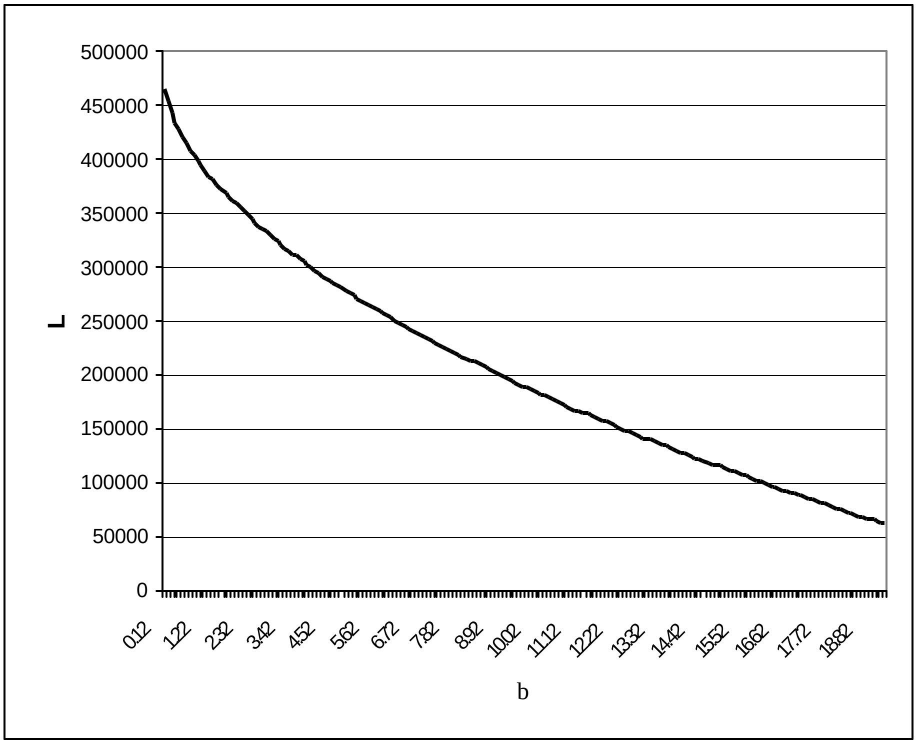
Figure 1
Simulated values over β



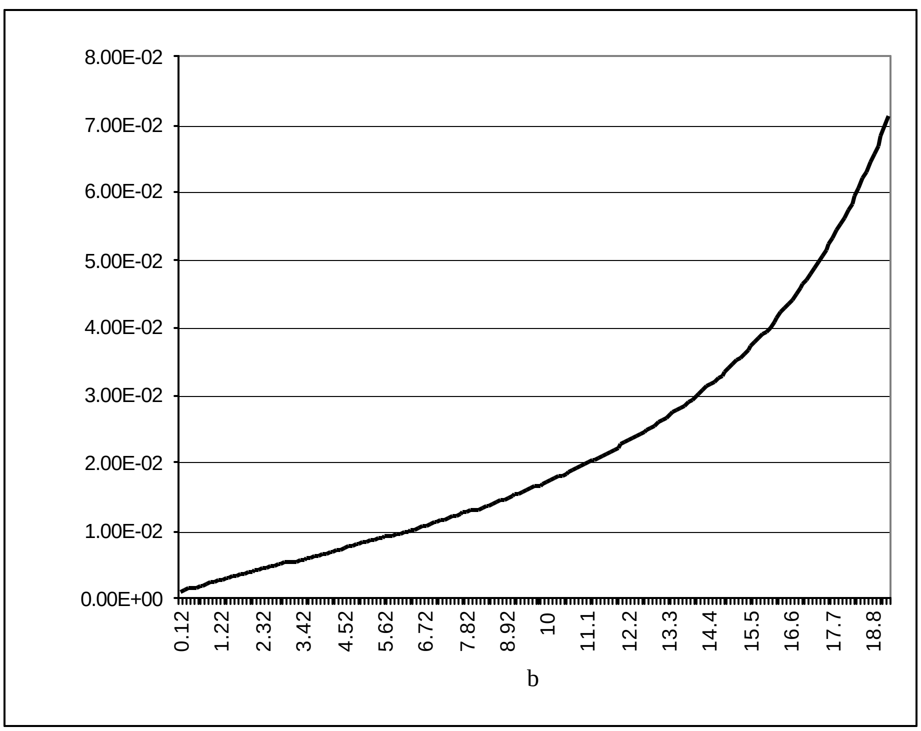
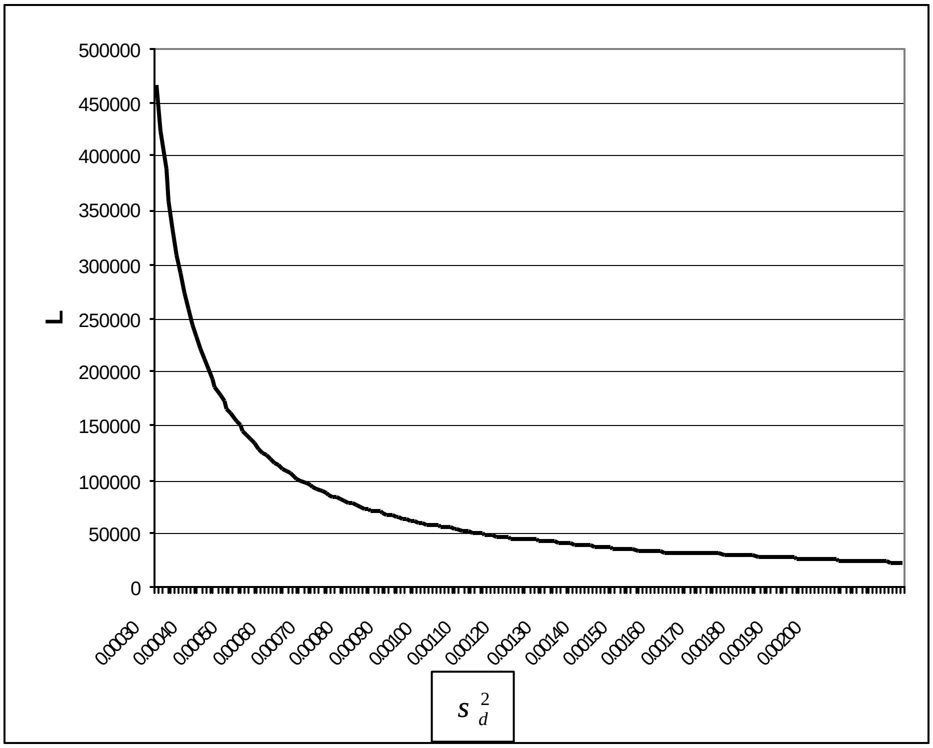


Figure 2

Simulated values over s_d^2



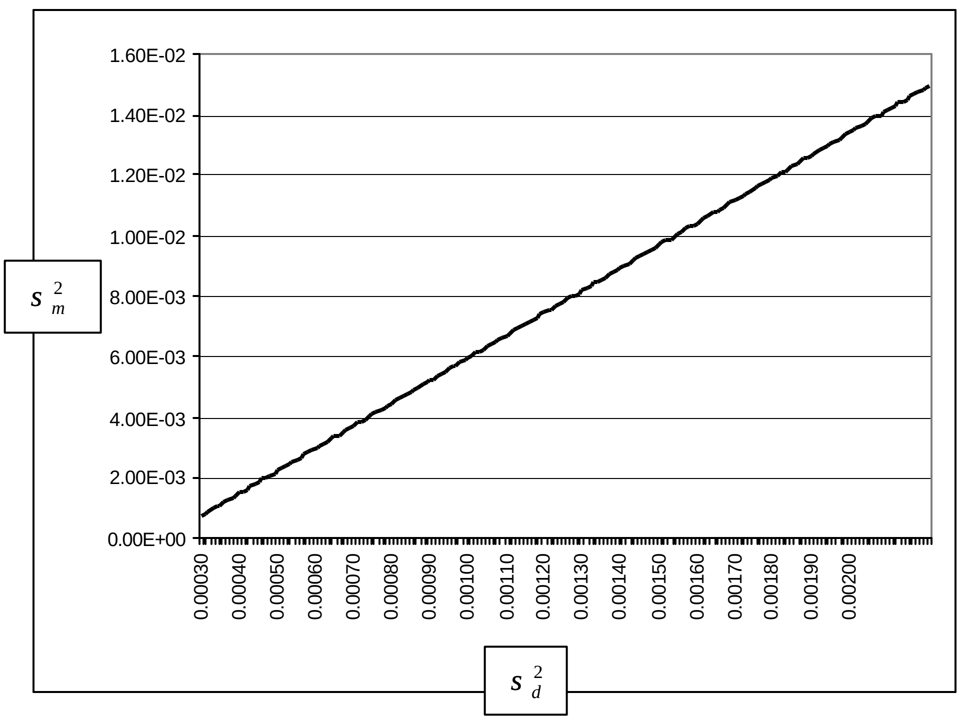
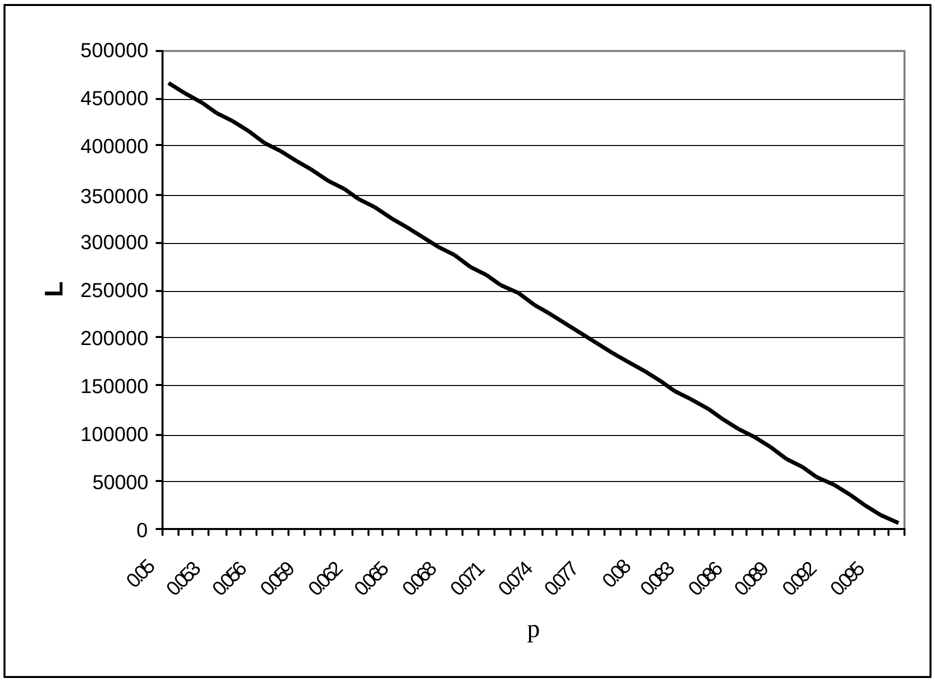


Table 3

Simulated values over π



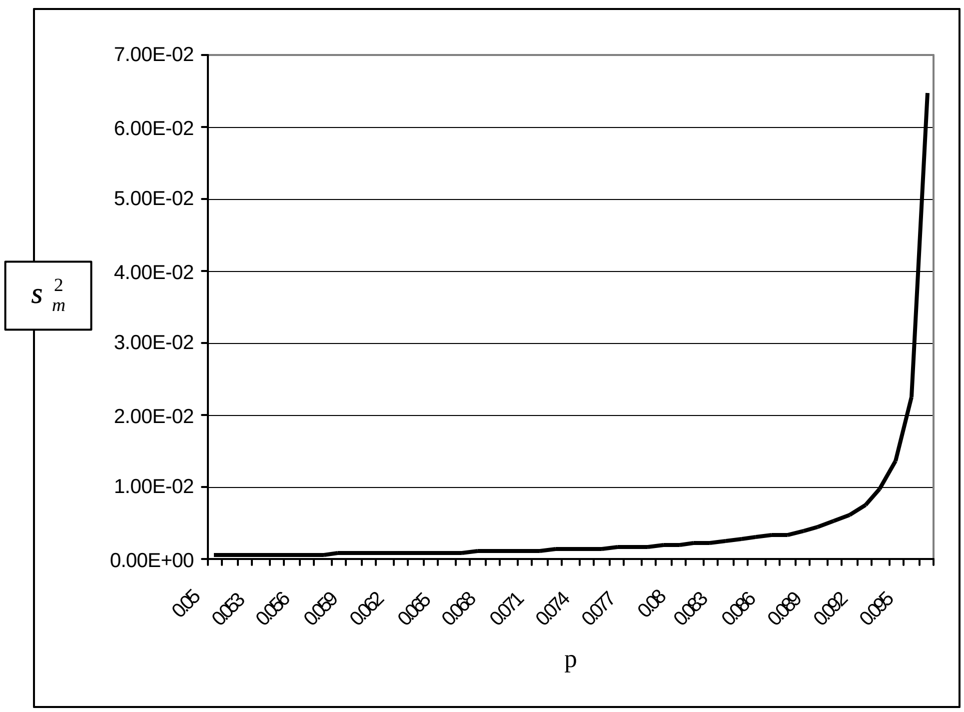
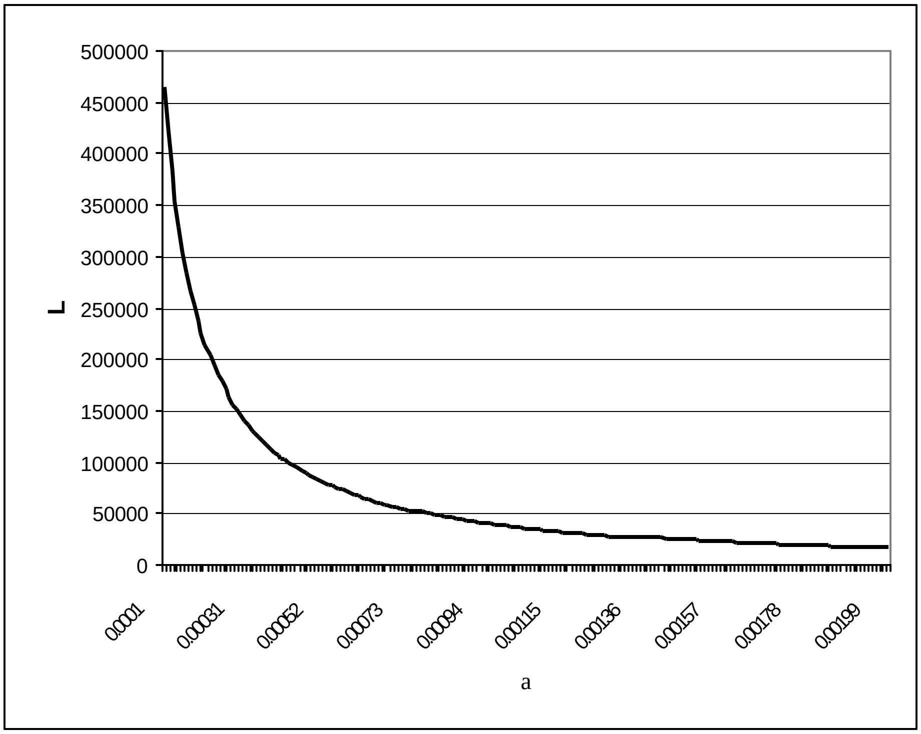


Figure 4
Simulated values over α



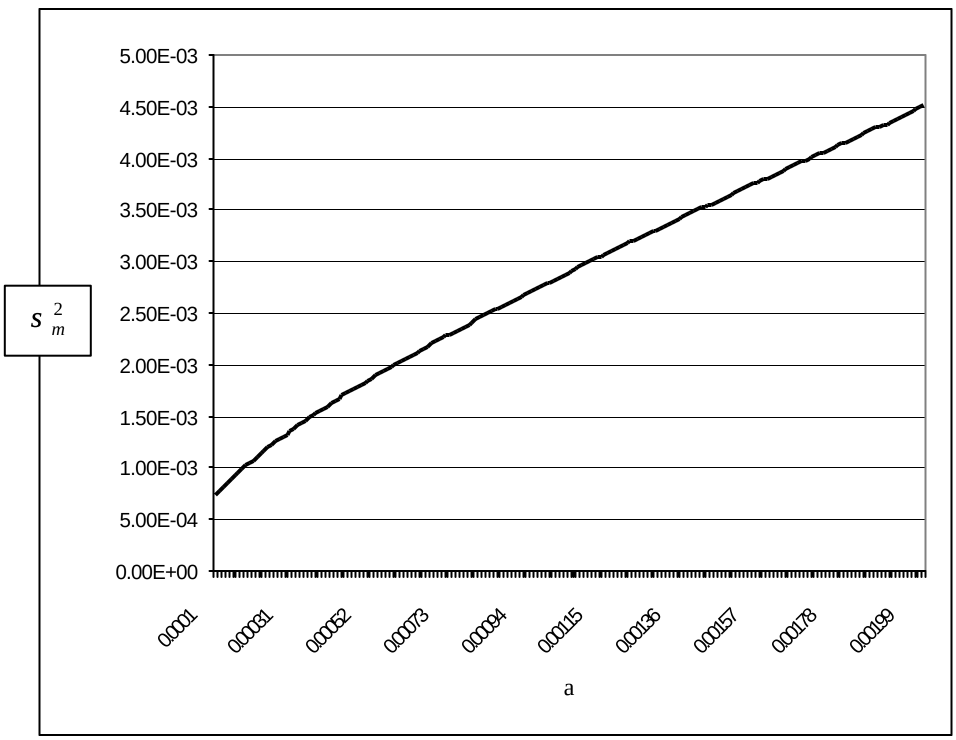
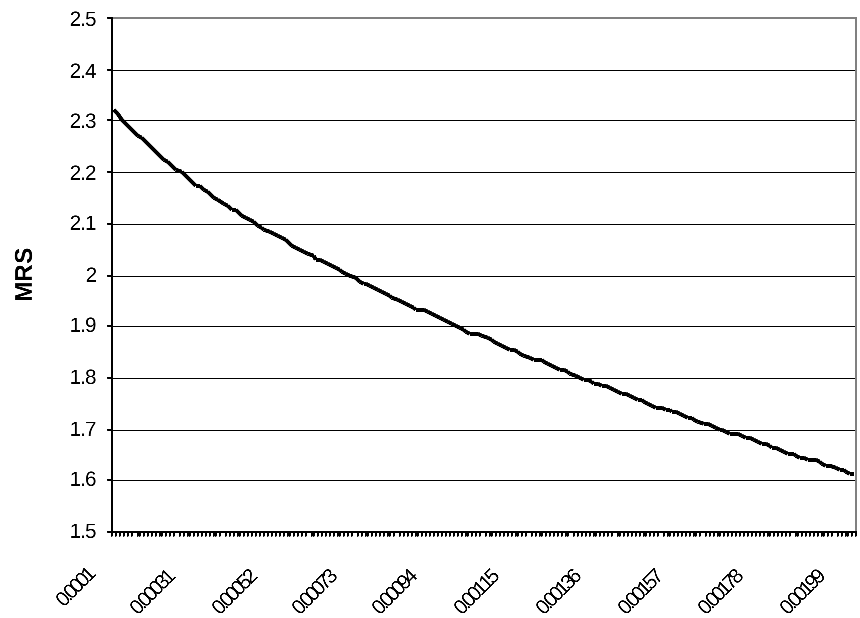


Table 4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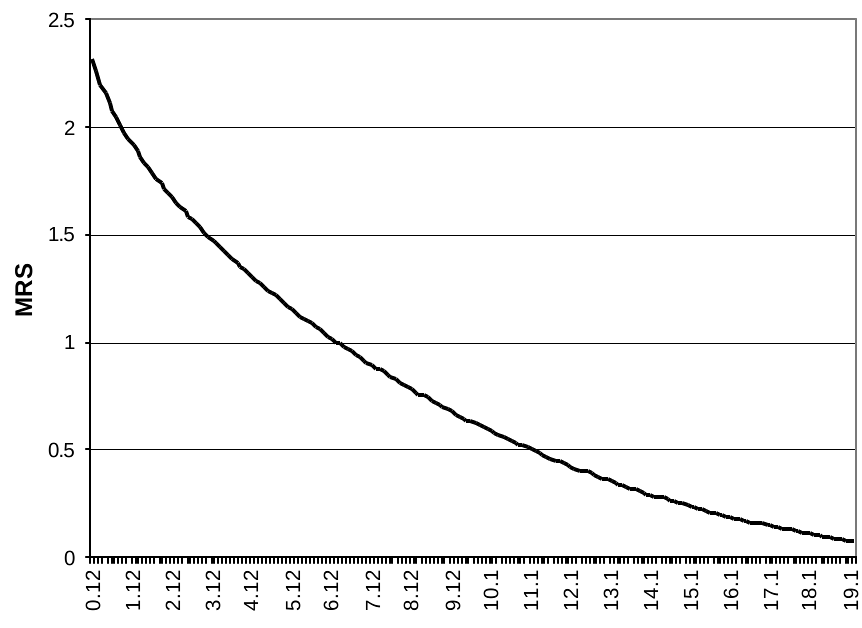
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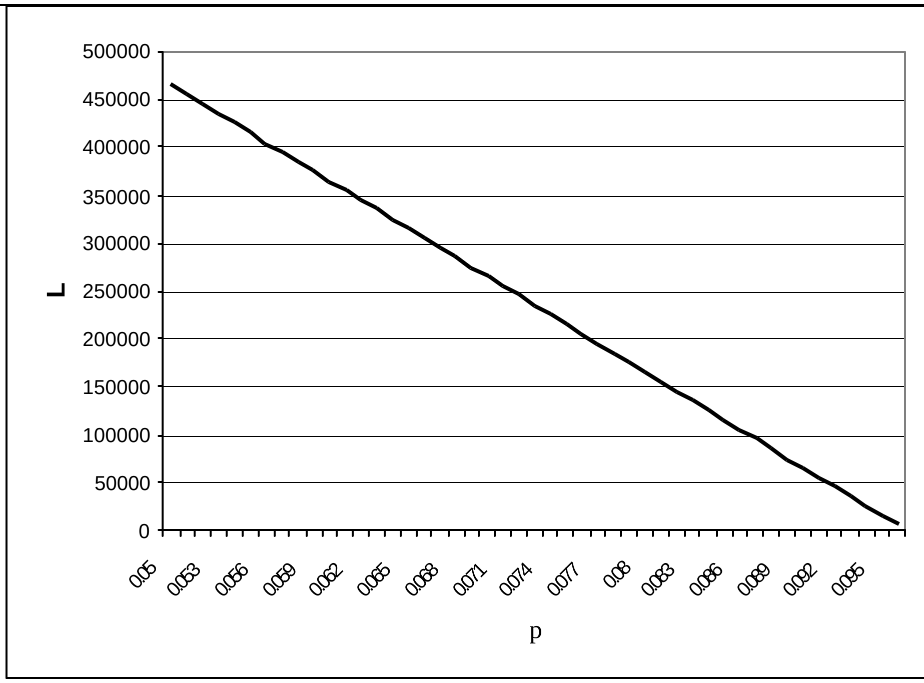
b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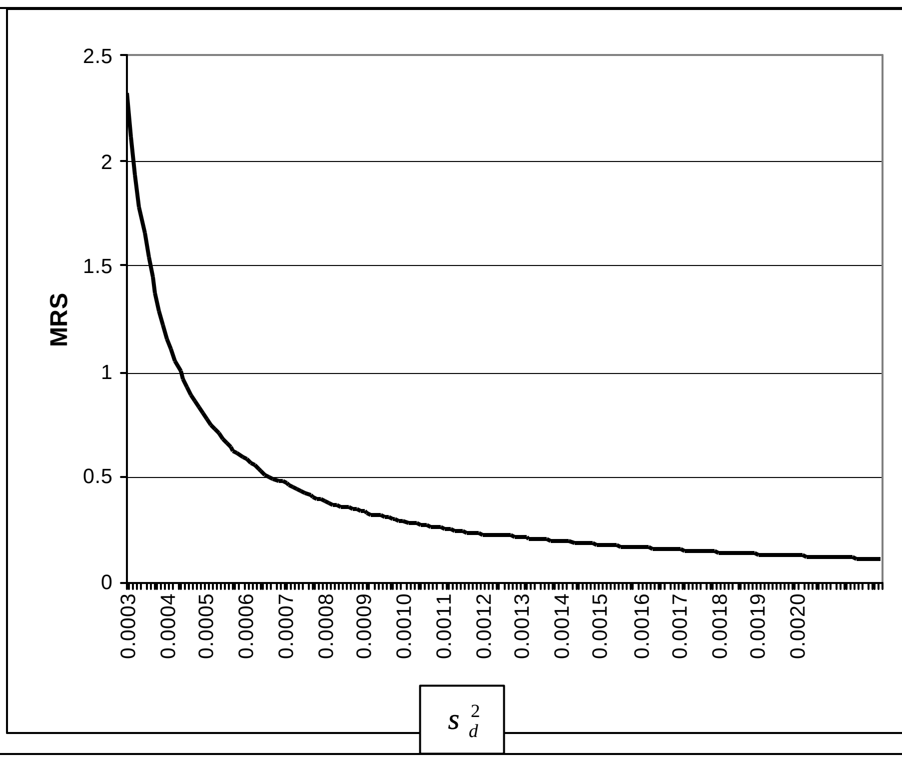
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s_d^2