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Interest Rate Policies, Stabilization, and Bank Supervision
in Developing Countries: Strategies for Financial Reforms

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Abstract

This paper identifies macroeconomic stability, effective bank supervision, and an appropriate sequencing of stabilization, banking regulations, and interest rate policies as common characteristics of the relatively successful experiments in financial sector liberalization. Recent theoretical developments help to explain why interest rates in free markets for bank credit may fall short of market-clearing levels, or may rise to risky levels with adverse consequences for financial institutions and the economy at large. To prevent such outcomes, macroeconomic stabilization and improved bank supervision should generally precede complete removal of control on bank interest rates.

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	<u>Contents</u>	<u>Page</u>
I.	Introduction	1
II.	Financial Liberalization: A Review of Major Issues	2
	1. Theoretical developments	4
	a. Imperfect information and credit rationing	4
	b. Risk-sharing and macroeconomic stability	5
	c. The problem of moral hazard	8
	2. Policy strategies	10
III.	Experiences with Different Liberalization Strategies	12
	1. The case of rapid interest rate liberalization	12
	2. The case for gradual liberalization of interest rates	16
IV.	Conclusions	18
Appendix:	Models of Credit Rationing and Implicit Contracts	20
Table 1:	Suggested Sequencing of Macroeconomic and Financial Sector Policies	11
Figure 1:	Determination of Bank Equilibrium Interest Rate	6a
References		28

I. Introduction

During the past two decades, many developing countries have implemented financial liberalization policies aimed at removing credit controls and achieving positive real interest rates on bank deposits and loans. The objective of such policies was to mobilize domestic savings, attract foreign capital, and improve efficiency in the use of financial resources. Initial economic and financial conditions across countries varied significantly, and affected subsequent performance. There were nonetheless certain characteristics common to the relatively successful countries. These patterns included the establishment of an appropriate macroeconomic framework, the prudential supervision of the banking system, and the sequencing of stabilization, banking regulations, and interest rate policies. Specifically, those economies that largely avoided the adverse consequences from large-scale financial liberalization--sharp increases in interest rates, bankruptcies of financial institutions, and loss of monetary control--were characterized by stable macroeconomic conditions, a strong and effective system of bank supervision, and a gradual removal of controls on interest rates. How stabilization, prudential supervision, and pace of liberalization affect financial reforms is the focus of this paper.

The particular mechanism for attaining positive real interest rates has tended to depend on individual country circumstances. In some cases there was an outright liberalization or deregulation of interest rates in a short period, while in other cases it involved gradual liberalization over the medium run in which frequent adjustments in regulated interest rates were made. Taiwan Province of China, Singapore, and the Republic of Korea (and to some extent Sri Lanka) engaged in a gradual and flexible management of interest rates that resulted in positive real levels. Chile, Argentina, Uruguay, Philippines, Malaysia, and Turkey liberalized interest rates within a relatively short period (generally three years or less). Of these, only Malaysia appeared to have avoided any adverse consequences from the liberalization, such as a sharp run-up in real interest rates. In the others in this group, output declined owing to bankruptcies of firms (banks and non-financial firms), inflation worsened, and external imbalances widened. These contrasting experiences between the two groups would suggest that, *ceteris paribus*, a gradual approach to interest rate reforms is more likely to be successful.

In the past, conventional wisdom was that credit rationing and low interest rates were solely the result of government intervention, and that removal of controls would lead to a more healthy, dynamic, and efficient financial system. Recent literature, however, has significantly increased our understanding of how commercial bank credit markets actually operate, in particular how asymmetric information between lenders and borrowers may

lead to efficient credit rationing and optimal interest rates that are below market-clearing levels, even in a competitive, multibank structure and in the absence of interest rate ceilings. We now have a theoretical rationale of how the interaction of macroeconomic instability with inadequate bank supervision (the decision of banks to undertake risky lending in the presence of deposit insurance, sometimes referred to as "moral hazard") often results in an immediate increase in real interest rates to risky levels. Progress has also been made involving the application of implicit contract theory to bank credit markets, demonstrating the critical importance of stable economic conditions in the smooth functioning of such markets, and showing that bank lending rates in a stable macroeconomic environment tend to be fairly rigid in relation to the (opportunity) costs of loanable funds, such as interest rates on treasury bills, deposits, inter-bank lending, and so on. Although such analytical breakthroughs have been developed in the context of commercial bank credit markets in the advanced countries (e.g. the U.S.), little effort has been made to apply this analysis to financial reforms in developing countries.

The experiences of developing countries over the last two decades and recent advances in the theoretical analysis of bank credit markets raise the following major questions: what are the respective roles of imperfect information, risk-sharing, macroeconomic instability, and moral hazard in the determination of bank lending interest rates? And what is the appropriate sequencing of interest rate liberalization, macroeconomic stabilization, and financial regulatory policies? This paper is an attempt to address these questions, leading to a reassessment of interest rate policy and financial liberalization strategies.

Section II of the paper has two parts. The first part reviews the recent theoretical literature relevant to interest rate and other financial sector policies. The second part draws key policy considerations in the design and sequencing of such policies. Section III reexamines the historical experiences in the Southern Cone countries of Latin America, several Asian countries, and Turkey, in the light of the theoretical policy discussion. The final section summarizes the analysis and provides some concluding observations.

II. Financial Liberalization: A Review of Major Issues

This section reviews the key issues in the renewed debate on the benefits and pitfalls of interest rate and financial liberalization policies. The literature on this topic is very extensive, and only four major issues will be taken up in this brief survey. These are the roles of imperfect information and risk-sharing in the allocation of credit and the determination of interest rates, and the implications of the inter-

action between macroeconomic instability and moral hazard in the banking system for the sequencing of interest rate liberalization, monetary stabilization, and prudential supervision. Before discussing these issues in detail, it is useful to summarize the standard thinking on the need for interest rate and financial liberalization policies in countries undergoing structural economic adjustment.

"Financial repression" is a phrase popularized by McKinnon (1973) and Shaw (1973) to describe policies that distort domestic capital markets through a variety of measures--ceilings on interest rates, high reserve requirements, overall and selective credit ceilings, etc. In a financially repressed economy, real deposit and lending rates are often negative, with adverse consequences for the development of the financial system and for saving and investment generally. As a remedy, the standard approach suggests establishing positive real rates of interest on deposits and loans by, among other measures, eliminating interest rate ceilings and direct credit allocations, and pursuing price stabilization through appropriate macroeconomic and structural policies. The true scarcity price of capital could then be seen by savers and investors, leading to a reduced dispersion in profit rates among different economic sectors, improved allocative efficiency, and higher output growth.

While the adoption of the above standard strictures produced positive results in Malaysia in the 1980s (Cho and Khatkhate, 1989), the outcome was far less satisfactory when tried in Chile, Argentina, and Uruguay during the seventies (Corbo and de Melo, 1985), and during the eighties in the Philippines, Indonesia (Cho and Khatkhate, 1989), and Turkey (Atiyas, 1989). In fairness, in these countries inappropriate exchange rate and domestic financial policies and the significant weakening of government supervision of bank lending when the profitability of the business sector was particularly adverse, all contributed to the failure of interest rate and financial sector liberalization. ^{1/} Special mention must also be made of the political turmoil and external debt crisis in the Philippines. Nonetheless, some economists have begun to question the traditional approach to interest rate policy and financial liberalization.

^{1/} The importance of macroeconomic stability, in particular price stability, has been emphasized by Dornbusch and Reynoso (1989). Given large fiscal imbalances and unrealistic exchange rates, these authors have argued that financial liberalization could lead to higher inflation. They then presented empirical evidence that high inflation, in turn, is growth-retarding through its adverse effects on net investment and efficiency of resource use.

1. Theoretical developments

Ronald McKinnon (1986; 1988), an original contributor to the standard approach to financial liberalization, has recently analyzed its failure in the Latin American experiments. On the basis of an analysis of credit markets that incorporates imperfect information and moral hazard, he has modified his earlier position, suggesting that "the government should probably impose a ceiling on standard loan (and deposit) rates of interest" to overcome the bank's moral hazard--the tendency to provide risky loans at high interest rates in the expectation that large losses will be covered by deposit insurance, explicitly or implicitly provided by the government. ^{1/} The very cause of financial repression--an immature bank-based capital market--imposes limits on the levels to which interest rates can be raised without incurring undue "adverse risk selection" among borrowers (Stiglitz and Weiss, 1981). McKinnon then demonstrates that "macroeconomic instability reduces the socially desirable level of real interest rates in the banking sector, and makes financial liberalization more difficult." ^{2/}

a. Imperfect information and credit rationing

Research by Stiglitz and Weiss (1981) has shown that the limits to which interest rates can be raised are a direct consequence of imperfect or asymmetric information between lenders and borrowers, defined as a situation in which borrowers have greater information about their own default risks than do lenders. The basic intuition of Stiglitz and Weiss is that, while moderate increases in the lending interest rate normally would elicit a higher volume of lending, further rate increases beyond a certain level would prompt a lower level of lending activity by changing adversely the quality of the pool of borrowers in favor of those in the high-risk category. Thus, when faced with an excess demand for loans, the optimal response of a properly regulated bank (with adequate provisions for loan losses) is to limit lending to potential borrowers and to charge an interest rate level that maximizes the bank's expected profits (net of defaults). The reason is that raising the interest rate beyond this level would lower the bank's overall return by triggering two effects.

First, safe--that is, more creditworthy--borrowers would be discouraged and likely to drop out of the market (the adverse selection effect). Second, other borrowers would be induced to choose projects with higher probability of default, because riskier projects are associated with higher expected profits (the adverse incentive effect). Therefore,

^{1/} McKinnon (1988, p. 408).

^{2/} McKinnon (1988, p. 388). This issue is taken up later in this paper.

there would always be an interest rate for the bank beyond which its expected return declines. Although at this rate there may exist an excess demand for credit, a bank in general would not raise the interest rate to eliminate it. ^{1/}

The above results can be described with the help of Figure 1. Quadrant I in Figure 1 shows the demand for (L^D) and supply of (L^S) loanable funds as functions of the loan interest rate (r). As normally assumed, the demand for credit is a negative function of the loan interest rate. The supply of loanable funds is a positive function of the loan interest rate up to a certain interest rate level, r^* . Increases in the interest rate beyond r^* trigger adverse selection and adverse incentive effects, which, by reducing the expected rate of return to the bank, would lead to decreasing amounts of credit offered to borrowers. Thus, the relationship between the interest rate and the supply of loanable funds turns negative, and the value of L^S in quadrant I decreases to the right of r^* . A similar line of reasoning produces the nonmonotonic relationship between the expected rate of return to the bank (ρ) and the rate of interest as shown in quadrant II. The expected rate of return to the bank is the product of the interest rate and the repayment probability. Owing to the adverse selection and adverse incentive effects of a rise in the interest rate, the repayment probability declines by more than the increase in the interest rate beyond a certain interest rate level r^* . Quadrant III displays the positive relationship between ρ and the supply of loanable funds, as a higher expected rate of return would elicit a greater amount of bank lending. Quadrant IV shows a 45-degree line mapping of the equilibrium loan amount (L) and (L^S). The credit rationing equilibrium occurs at the interest rate (r^*), where the expected return to the bank is at its maximum level. At this interest rate, however, there is an excess demand for loans of amount Z . The market-clearing equilibrium interest rate is r_m . This rate, however, is not optimal for the bank, because at r_m bank profits are less than at r^* . The market-clearing rate is also inefficient, because at this interest rate the borrowers with high repayment probabilities drop out and are replaced by those with high default risks. On the other hand, the nonmarket-clearing interest rate r^* is both optimal and efficient, because bank profits are at a maximum level and because risky borrowers are rationed out.

b. Risk-sharing and macroeconomic stability

The preceding discussion has shown that under imperfect information lending rates at below market-clearing levels can be observed even in competitive banking markets, so long as banks are properly regulated.

^{1/} Similar results are reported by Mankiw (1986). For a formal summary of the Stiglitz-Weiss model, see the appendix.

And such nonmarket-clearing lending rates reflect an efficient response to profit opportunities.

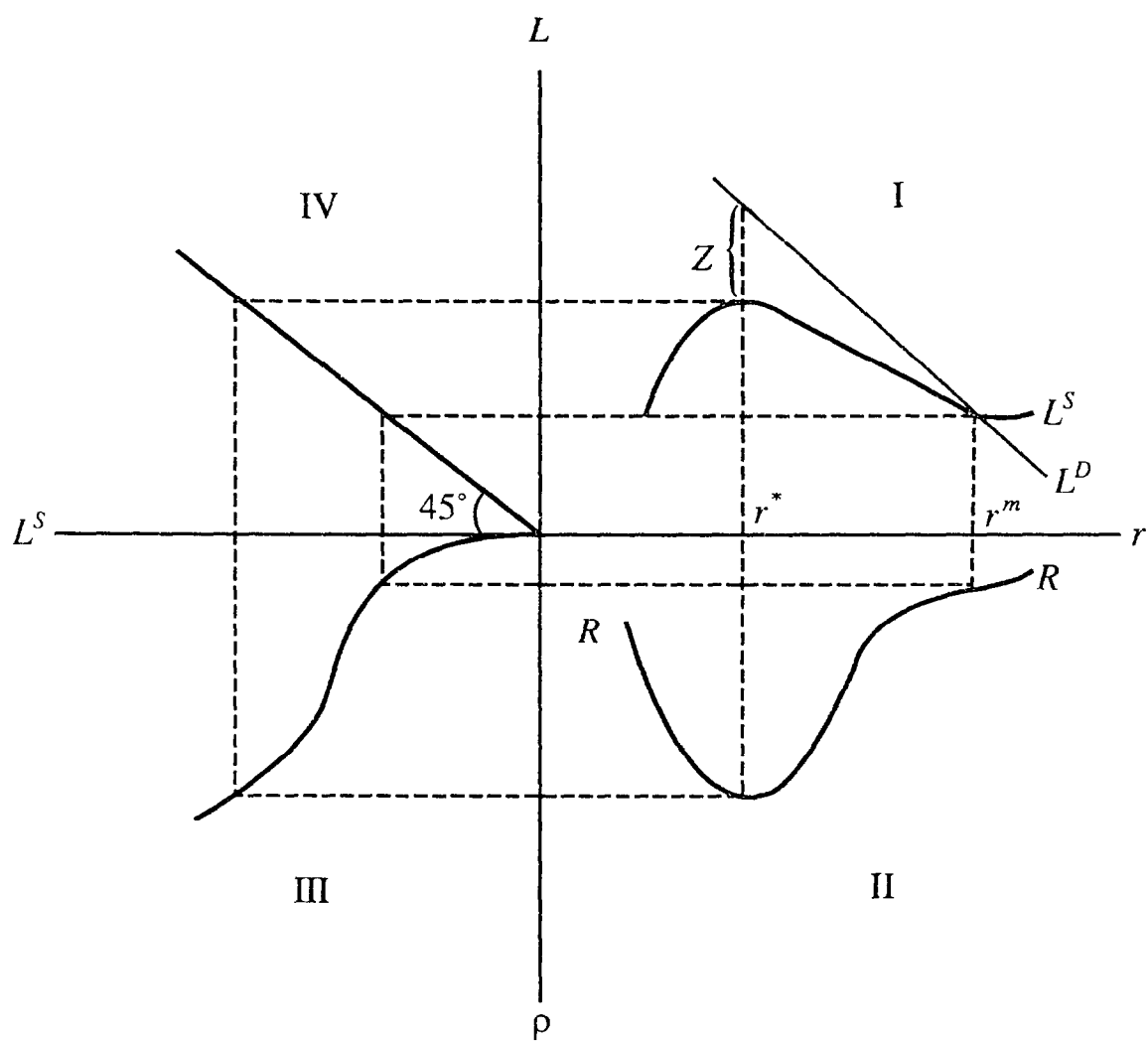
The analysis so far has assumed a stable economic environment. This means a situation in which macroeconomic conditions such as moderate changes in goods and factor prices are presumed not to affect the constant variance and zero covariances in the returns from borrowers' projects. A failure of one project does not lead to a generalized system-wide crisis. If the number of borrowers in each risk class is large, such that there is a predictable number of defaults, expected bank profits per dollar lent can be determined. Banks simply select an interest rate which maximizes expected profits (such as r^* in Figure 1), and then ration credit; the Stiglitz-Weiss results hold.

If there is macroeconomic instability--a situation in which large changes in prices of goods and factors of production lead to increased variance and positive covariances in project returns--all projects would be affected adversely (favorably) by poor (good) macroeconomic performance. Let us assume that any potential moral hazard in the bank itself that may be induced by economic instability is effectively contained by strict official supervision and prudential regulation requiring sufficient reserves against loan losses; and that deposit insurance (explicit or implicit) is either absent or appropriately priced. The bank therefore behaves as if it were risk-averse. In this case, the higher reserves against defaults required by the government in response to macroeconomic instability would lower the expected profit function of the bank at any given loan interest rate (in quadrant II of Figure 1, the RR curve shifts upward toward the r -axis and to the left). Owing to higher variance in project returns, increased adverse risk selection lowers the optimal loan interest rate, leading banks to become more risk-averse; the Stiglitz-Weiss results are reinforced. In this case banks further lower interest rates on loans--in Figure 1, r^* moves to the left--and ration credit more severely.

Therefore, where macroeconomic instability is a problem, the socially desirable equilibrium lending rate is reduced further. In this case, low real lending interest rates may well be (and indeed have been) observed. Where macroeconomic instability interacts with ineffective bank supervision in the presence of moral hazard ^{1/} banks may well set interest rates at higher and riskier levels (as indeed observed in several developing countries in Latin America and Asia).

^{1/} This issue is taken up in the next subsection.

Figure 1. Determination of Bank Equilibrium Interest Rate.



Yet the real benefit from macroeconomic stability is its favorable impact on risk-sharing relationships between banks and their borrowers. 1/ Such relationships tend to be preserved in a stable economic environment -- a situation of moderate fluctuations in the opportunity costs of money. 2/ This is what makes macroeconomic stability so essential, because of its predictable effects on the cost and availability of bank credit. In addition, stable economic conditions ensure that under risk-sharing contracts, the bank lending rate is more rigid than the opportunity cost of loanable funds, as long as the bank is less risk-averse than its borrowers. 3/ This explains why lending rates, even for medium-term loans, may be fairly low and stable in comparison with other market interest rates.

These points can be elaborated. Greater possibilities of diversifying portfolios and the existence of deposit insurance allow a bank to be less risk-averse than its borrowers. This systematic difference in risk-aversion leads to financial arrangements (implicit contracts) through which banks absorb risks that would otherwise be borne by borrowers. Implicit contracts assure greater profit stability for both borrowers and banks than does the spot market. 4/ Borrowers benefit from stable interest rates and, because the rates are known with certainty, long-term investment plans can proceed smoothly. Banks gain because they economize on information costs through knowledge of the borrower accumulated over time. The result is often speedy approval of loan proposals, benefiting the borrower, while increasing the number of loans banks can safely make.

But credit markets dominated by implicit contracts can be extremely sensitive to changes in the attitude of banks and borrowers toward risks, administrative costs of banks, returns to investments made by firms for which funds were borrowed, and variations in the total loan size (see the appendix). Any shock to the financial system that affects these factors will change the variability of profits accruing to banks and their borrowers. The larger (smaller) is the risk aversion of the bank in relation to that of the borrower, the less (more) stable are the profit levels of either party and the lending rate, and therefore the less (more) is the incentive for risk-sharing. That is, the more (less) conservative is a bank, the higher (lower) is the probability of loan turndowns for some borrowers at fixed lending rates.

1/ For a derivation of these relationships as optimal responses of a bank and its borrowers under uncertainty, see section 2 of the appendix.

2/ See the appendix, in particular equation (8).

3/ See the appendix for proof, in particular equation (20).

4/ See the appendix for proof, in particular equations (18) and (19).

Floating-rate loans are certainly possible (and do exist), where the risk from future changes in interest rates is borne fully by the borrower. In this case, fluctuations in the market interest rate are reflected completely in fluctuations in the lending interest rate, thus contributing to the vulnerability of profits and uncertainty of investment decisions of borrowers. Since the fortunes of banks and borrowers are intertwined, the soundness of the banking system may be in jeopardy in the long run, and the outlook for long-term business investments could turn bleak. In addition, for banks to enter into and maintain implicit contracts with their borrowers they must have some degree of certainty about the range of future opportunity costs of funds. 1/ Any factor, foreign or domestic, that creates uncertainty about the future costs of funds would introduce instability into the system (Smith (1984)) and undermine the willingness of banks to enter into or maintain implicit contracts with long-time customers. Examples include generalized domestic macroeconomic instability--which may result in large changes in interest rates on government securities, deposits, and interbank lending--and fluctuations transmitted by interest rate developments abroad.

c. The problem of moral hazard

The preceding analysis has assumed that prudential supervision of bank lending is effective and that deposit insurance (explicit or implicit) is either absent or appropriately priced. Let us now relax these two assumptions. Suppose that the system of prudential regulations is weak either in design or enforcement or both, such that the levels of bank capital (in relation to risk assets) and provisions for loan losses are inadequate. In addition, assume that the government provides free deposit insurance (explicit or implicit). Combined with these policy elements, an unstable macroeconomic environment would intensify and strengthen the problem of moral hazard in the banking system. This appears to be what happened in the Southern Cone countries of Latin America (Le Fort, 1989), Philippines, Indonesia (Cho and Khatkhate, 1989), and Turkey (Atiyas, 1989). Banks observed that in good times they kept all their profits and in bad times walked away from large losses, the bulk of which was covered by the government. 2/ In addition, in a majority of these countries (with perhaps the exception of Indonesia) unsound banking practices went unabated. Where penalties existed, they were neither made explicit nor enforced. Consequently, banks had an incentive to provide

1/ See equation (8) of the appendix.

2/ If the economy is stable, such moral hazard problems would not affect bank behavior because the default rates of a large number of borrowers are uncorrelated. Moreover, so long as regulation is fairly stringent, banks would be prevented from concentrating loans to a few large borrowers.

high-interest rate and, therefore, risky loans. In Figure 1, the variable ρ now represents the expected return per amount lent net of anticipated bank losses to be covered ex post facto by deposit insurance. The bank now behaves as if it were a risk-taker; its expected profits are uniformly higher than those of a risk-averse bank that is properly regulated. The RR curve shifts downward away from the r-axis and to the right (see Figure 1). McKinnon (1988, p. 407) has aptly put it by describing the bank as beneficiary of an unfair bet against the government. The bank can keep extraordinary profits without having to pay the full cost of large losses from bad loans.

It is now apparent that the most crucial argument in McKinnon's anatomy of liberalization failure relates to the inadequate prudential regulation of the banking system in the presence of moral hazard, not macroeconomic instability per se. Moral hazard in the banking system is a consequence of the presence of full and costless deposit insurance, implicit or explicit, and asymmetric information. The removal or a significant relaxation of prudential regulations makes it easier for banks to exploit the existence of moral hazard, and may lead to financial breakdown, even in a stable macroeconomic environment. ^{1/} It is likely, however, that macroeconomic instability increases the system's susceptibility to shocks, leading to an increased probability of default and an accelerated financial collapse.

When moral hazard is present and bank supervision is loose, macroeconomic instability increases "distress borrowing" at higher interest rates from firms needing to roll over maturing debt as well as from those near bankruptcy. Deposit insurance creates an expectation among banks and their borrowers that either higher interest rates would hold for only a short period, or the government would rescue everyone (Diaz-Alejandro (1985)). The result may be a perverse situation in which a sharp increase in interest rates actually causes the demand for credit to be inelastic, with an increasing number of firms unable to service debt obligations and therefore forced to capitalize interest at higher rates. As this process continues, many firms would exhaust their capacity to borrow and non-performing loans carried by banks would begin to grow rapidly. Excessive risk-taking, which is unchecked owing to poor government supervision, is undertaken by banks in the expectation that failure would pose no problem because the government will bail them out, while success would mean substantial profits to their shareholders.

^{1/} The United States during the mid-1980s and, more recently, the case of the failed Lincoln S&L (a California thrift institution), provide examples of this possibility.

2. Policy strategies

Although the analytical results from the above recent studies focused on mature banking systems, mainly those in the U.S., they are applicable with even greater force to the bank-based capital markets of developing countries. The critical elements--asymmetric information, macroeconomic instability, moral hazard, implicit contracts--are far more common in developing countries. In these countries equity markets are generally shallow or nonexistent, making virtually all financial contracts bank-based debt instruments. The costs of collecting information to screen and monitor debtors are extremely high, and in some cases prohibitive. By the time information is collected, both banks and borrowers have already invested heavily in "informational capital."

Examining the policy sequencing issues in the light of modern financial theory, four theoretical policy strategies may be identified, depending on whether the initial macroeconomic environment is stable (SM) or unstable (UM), and whether bank supervision is adequate (AS) or inadequate (IS) (see Table 1): 1/ (1) UM/IS strategy, where macroeconomic instability interacts with weak bank supervision (column 1); (2) UM/AS strategy, where the potential interaction between economic instability and moral hazard is largely offset by effective bank supervision (column 2); (3) SM/IS strategy, where the economy is stable but moral hazard in banks presents a potential problem because of inadequate supervision (column 3); and (4) SM/AS strategy, where the economy is stable and the banking system is adequately supervised. The actual policy experiences in several developing countries corresponding to each of these strategies are examined in detail in the next section.

In all four situations, macroeconomic stabilization and stringent bank supervision must occur before complete interest rate liberalization. In only one situation--where the economy is stable and the banking system is already effectively supervised--is full and simultaneous interest rate liberalization likely to be successful. In the remaining three cases,

1/ For purposes of Table 1, effective bank supervision should be taken to cover the following policies, among others: adequate reserves against loan losses; adequate bank capitalization; limits on bank exposure to shareholders, personnel, and large borrowers; limits on foreign exchange exposure; a deposit insurance scheme with appropriate costs that reflect the riskiness of the individual bank's loan portfolio; adequate number and skills of bank examiners and supervisors; and the absence or minimization of political and other interference with the enforcement of bank supervisory and regulatory controls. For details, see Dooley and Mathieson (1987) and Snoek (1989).

Table 1. Suggested Sequencing of Macroeconomic and Financial Sector Policies

	Country Initial Conditions <u>1/</u>			
	UM/IS	UM/AS	SM/IS	SM/AS
<u>Policy sequencing</u>	<u>Step 1</u>			
	stabilize economy and strengthen supervision, while regulating interest rates.	stabilize economy and maintain supervision; begin gradual interest rate liberalization.	maintain economic stability and boost supervision; while enhancing supervision, temporarily regulate interest rates.	maintain economic stability and supervision; can liberalize interest rates simultaneously.
	<u>Step 2</u>			
	liberalize interest rates.	liberalize interest rates.	liberalize interest rates.	

- 1/ SM: stable macroeconomy
 UM: unstable macroeconomy
 AS: adequate bank supervision
 IS: inadequate bank supervision

regulated though flexibly managed interest rates should be the rule while awaiting the full benefits from either economic stabilization or improved bank supervision or both. However, where bank supervision is adequate and effective, some initial steps toward interest rate liberalization might be tried at the same time as stabilization measures. Where the rate of inflation is particularly high and variable, a strong and credible stabilization program and an equally strong set of prudential regulations offer the best policy package, and postponing the removal of interest-rate regulations may be appropriate until the monetary situation has been stabilized and banking supervision strengthened. Under these circumstances, adjustments in the regulated interest rates must be preannounced so that banks and borrowers alike know the new interest rate with certainty. ^{1/}

III. Experiences With Different Liberalization Strategies

Two post-liberalization episodes are reexamined in this section. The first is the strategy of complete interest rate liberalization implemented in a very short period. The experiences of Chile, Argentina, Uruguay, the Philippines, Malaysia, and Turkey fit in this category. The second strategy is a gradual liberalization, where even though interest rate regulations were removed or administered rates were set at high levels, the process was spread out over a longer period. The experiences of Indonesia, Sri Lanka, and Korea are illustrative of this strategy.

1. The case of rapid interest rate liberalization

The experiences of Chile, Argentina, and Uruguay have been well documented in a volume edited by Corbo and de Melo (1985). In all three countries, severe macroeconomic imbalances existed when interest rate reform and financial liberalization policies were implemented. Rates of growth of output, saving, and investment were all low; inflation rates were high; and the external current account deficits were large in relation to national income.

^{1/} The appendix shows that an economically efficient interest rate policy generally establishes a bank lending interest rate greater than a representative risk-free interest rate. Thus, for example, taking the market-determined treasury bill rate (ρ) as the risk-free interest rate, the monetary authority would set an upper limit to the bank lending interest rate (r) equal to $(\alpha + \rho)$. To provide greater incentives for bank lending, the parameter (α) could be raised to a new level. This action, however, should be preannounced so that existing implicit contracts can be renegotiated between banks and their borrowers.

The liberalization strategy followed by these Latin American countries involved completely and abruptly removing interest rate ceilings and credit controls, and relaxing government supervision over the banking system. These measures were accompanied by virtually free deposit insurance, explicit or implicit. ^{1/} In these countries the interaction between loose banking supervision and an unstable macroeconomic environment intensified moral hazard in the banking system. Such a strategy led to an immediate run-up in real interest rates on deposits and loans and increased uncertainty about future costs of funds, i.e., increased variability of interest rates. Banks raised lending interest rates to higher and riskier levels in the expectation that deposit insurance would (and did) cover any unusual losses.

Excessively high interest rates forced many low-risk firms to drop out of the market, and the quality of bank loans thus suffered. High-risk firms took up the slack and undertook high-interest rate loans (Velasco, 1988). Riskier projects were associated with higher expected returns, which were expected to cover higher levels of interest payments. Under greater macroeconomic uncertainty and given deposit insurance and inadequate supervision, banks took excessive risks and provided credits to firms with high default probabilities. In Argentina, Corbo and de Melo (1985, p. 864) point to the provision of full and free deposit insurance and the accompanying lack of supervision on the quality of loans as creating incentives for destabilizing behavior. Nonperforming loans rapidly developed and many firms were forced to bankruptcy. In Chile, the number of bankruptcies rose from 2 corporate enterprises in 1978 to 75 in 1982, and from 75 general establishments in 1974 to 810 by 1982. Loans to the financial and manufacturing conglomerates (grupos), which represented about one fifth of the banking system's portfolio, reflected the dominance of these groups and the lack of adequate supervision of bank lending (Luders, 1985; Hanna, 1987; Velasco, 1988). Most of the bankruptcies occurred among these grupos. These bankruptcies adversely affected bank incomes, cash flows, and financial positions. Loan defaults in the financial system (commercial banks plus finance companies) represented nearly 19 percent of loan portfolio by 1983, compared to only 2 percent in 1981. ^{2/} In Argentina, bad and doubtful debt as a ratio of total bank loans rose from less than 2 percent in 1975 to over 9 percent in 1980. The trend was similar in Uruguay (Cho and Khatkhate, 1989).

^{1/} Inasmuch as the existence of nearly free deposit insurance was partly responsible for the distorted financial behavior of banks and firms in these countries, a case can be made for an imposition of a variable bankruptcy penalty on banking activity or an actuarially fair insurance premium adjusting to changes in the riskiness of the individual bank's loan portfolio. See Le Fort (1989) for an elaboration of this point.

^{2/} See Behrens (1985), taken from Luders (1985).

Besides not insulating borrowers from the risk arising from future increases in interest rates, banks also insisted on shorter maturities on new loans. Both these developments reflected the derailment of implicit contracts. By 1980-82, on average 64 percent of Chilean peso loans had maturities of less than one year (Arellano, 1983).

As noted in the theoretical discussion, firms tend to step up "distress borrowing" at high interest rates as macroeconomic instability unfolds and when moral hazard is present and unchecked by government regulatory policies. In all three Southern Cone countries, business firms increased their leverage during the financial liberalization period. Increasing indebtedness at first did not pose any problem; many firms generated sufficient operating earnings to cover real interest rates of up to 25 percent and still showed positive profits. When real interest rates soared to the 40 percent range, however, rising indebtedness reflected distress borrowing just to pay interest, and many firms eventually went under (Corbo and de Melo (1985)). The severity of moral hazard and the ultimate breakdown of implicit contracts was manifested in the willingness of banks to extend more loans to shaky firms at high interest rates that reflected a complete passthrough of the high opportunity costs of money. By 1982, in Chile the rollover of bad loans and capitalization of interest was estimated to be about 72 percent of outstanding peso loans (Velasco, 1988).

Much the same pattern of events--macroeconomic instability interacting with severe moral hazard--occurred in the Philippines and Turkey as documented, respectively, by Cho and Khatkhate (1989) and Atiyas (1989). ^{1/} According to these studies, the deterioration in the quality of bank portfolio in these countries could be traced to the high levels of real lending interest rates in relation to the marginal productivity of capital, combined with relatively high gearing ratios of the corporate sector. In both countries, interest rate liberalization was carried out in a period when the business sector's financial position was fragile. The further decline in profitability of the private sector and the banking system following financial liberalization was particularly sharp in these countries. Also, like in Chile, serious moral hazard problems in the Philippines and Turkey reflected the existence of interlocking firms in which banks had close interest, a phenomenon that was facilitated by "universal" banking in the Philippines and explained by the establishment of private banks by industrial groups controlled by individual families

^{1/} Interest rate ceilings were lifted in July 1980 in Turkey and in mid-1984 in the Philippines.

in Turkey. 1/ In the case of Turkey, Atiyas (1989, p. 30) concludes that an inadequate regulatory framework allowed insolvent banks to avoid bankruptcy by offering high rates to depositors, using mobilized funds to refinance nonperforming loans. On the other hand, firms that made losses increased their leverage even though the cost of borrowing had gone up.

The story is entirely different in the case of Malaysia. Here, long periods of economic stability and a strong tradition of banking supervision enabled the government to liberalize interest rates fully in less than three years without the adverse consequence of an immediate increase in interest rates. 2/ Cho and Khatkhate (1989, p. x) observe a modest impact of financial liberalization on domestic interest rates in Malaysia because market forces prior to liberalization already had a strong influence on interest rate levels. Positive real levels were achieved that were consistent with both enhanced credit flows to the borrowing sector at stable interest rates and a generally sound loan portfolio of the banking system. Nonperforming loans never posed a serious problem and the corporate sector was never exposed to the shocks of high interest rates (Cho and Khatkhate, 1989, p. xiii).

In sum, referring to Table 1, Chile, Argentina, Uruguay, the Philippines, and Turkey, although appropriately placed in the UM/IS policy column (first column) at the beginning of the adjustment program, followed exactly the opposite sequencing of policies. In liberalizing interest rates completely and in a relatively short period, these countries failed to first stabilize their domestic economies, improve the private sector's profitability, and strengthen their systems of prudential regulations over the banking sector. By contrast, Malaysia's interest rate liberalization succeeded by strictly adhering to the SM/AS sequencing strategy (the last column in Table 1).

1/ One exception is Turkiye Is Bankasi, which is the largest private bank.

2/ In October 1978 commercial banks were allowed to set their own interest rates on deposits and loans, except the prime rate which was controlled by the monetary authority. Late in 1981, commercial banks were allowed to determine their own lending rates on the basis of their own cost of funds, signalling the virtual disappearance of controlled lending rates.

2. The case for gradual liberalization of interest rates

The experiences of Korea, Sri Lanka, and Indonesia have been studied in detail by Cho and Khatkhate (1989). ^{1/} All these countries suffered macroeconomic imbalances in varying degrees on the eve of financial liberalization. Financial reforms were undertaken in the context of overall economic liberalization and generally strong adjustment programs. In addition, the system of bank examination and supervision either remained intact or was considerably strengthened.

The sequence of liberalization followed by these countries involved policy strategies described in the first three columns of Table 1. In these countries, in particular Korea and Sri Lanka to a much greater extent than Indonesia, positive real interest rates were achieved and maintained mainly through credible macroeconomic policies that successfully reduced inflation to low levels. While stabilizing the economy and boosting effective bank supervision, these countries also made incremental adjustments in regulated nominal interest rates to maintain a positive real level. Positive real interest rates stimulated bank deposits, thereby increasing the amount of credit available to productive firms.

Cho and Khatkhate (1989) describe the Korean approach to the deregulation of interest rates as pragmatic, noting that lending interest rates were quickly adjusted downward when the financial position of the corporate sector turned out to be affected adversely. Such concern for the financial vulnerability of the corporate sector may be interpreted as a policy intent not to undermine implicit contracts between banks and their corporate borrowers. At the same time, a strengthened system of examination and supervision ensured that banks did not take excessive risks and that bankruptcy was costly. Only later, when macroeconomic stability was firmly established and a permanently effective system of prudential regulations was in place and enforced, did the government fully liberalize interest rate rates in particular financial markets. By this time the interest rate liberalization presented no shock, as evidenced by lower

^{1/} Also see World Bank (1989). Korea began its liberalization in 1981 when the government divested its shares in commercial banks. From 1982 onwards interest rates became positive in real terms owing to stabilized inflation. To date interest rate ceilings, albeit flexibly managed, are still maintained except in the markets for interbank transactions, unguaranteed commercial bills and corporate bonds. Sri Lanka's liberalization, began in 1977 when regulated interest rates were sharply adjusted upwards, was basically similar to Korea's in its accent on price stabilization. By contrast, Indonesia's interest rate reform, started in 1983, lifted the ceilings on nearly all bank deposits and loans before stabilization and effective bank supervision were fully achieved.

inflation rates, stable interest rates, and firmly established implicit contracts.

In Sri Lanka, the treasury bill rate was used as a benchmark for adjusting interest rates (Cho and Khatkhate, 1989). In the course of a gradual liberalization of interest rates, the interbank market also played a key role in the operation of the market for commercial bank loans. Later, domestic interest rates generally moved with foreign interest rates adjusted for actual exchange rate changes. As in Malaysia, because of strong prudential regulations and timely official policy actions, non-performing loans remained manageable. All these favorable developments were also influenced by the economic stability achieved during the adjustment process.

The stability of lending interest rates in Korea and Sri Lanka meant that adverse selection and adverse incentive effects were largely avoided through the preservation of implicit contracts. Greater certainty of interest rates and enhanced supervision enabled banks to continue to engage in risk-sharing with the corporate sector. As prices, interest rates, and wages stabilized and credit availability increased, the environment for domestic investment improved and sharp swings in resource allocation were largely avoided. Output growth remained high in these countries.

Although Indonesia's liberalization strategy was more gradual than that of the Philippines and Turkey, the records were generally similar in all three countries. Indonesia's initial situation could be appropriately described by the unstable/adequately supervised column in Table 1. Indonesia took the first step in the liberalization sequence indicated by that strategy. Measures were implemented to stabilize the economy and, while maintaining bank supervision, Indonesia gradually liberalized interest rates. The problem was with the second step in the policy sequence. Despite failing to achieve macroeconomic stability, the government liberalized interest rates completely. Inflationary pressures and destabilizing capital flows, combined with expectations of devaluation, resulted in high and volatile domestic interest rates that often exceeded, as in the Philippines and Turkey, the rates of return to domestic fixed investments, and that also led, as in Chile, Argentina, and Uruguay, to destabilizing behavior of the banking system. The deterioration in the financial position of the business sector followed, and the volume of bad and doubtful debts grew.

IV. Conclusions

This paper has reviewed some major issues in interest rate reform and financial liberalization with particular reference to the developing countries. The relevance of recent theories to the operation of the bank-based capital market in such countries was discussed and the liberalization experiences and strategies of several countries reexamined. Modern financial analysis suggests that a reassessment of interest rate policies and financial reforms in the context of economic adjustment programs appears warranted. Several conclusions can be drawn with respect to the sequencing and modality of such policy reforms.

First, the approach to interest rate policy and financial sector liberalization generally should take into account the initial state of the economy, in particular the financial position of the private sector, and the quality of prudential regulations over the financial system. If the macroeconomic environment is unstable (impacting adversely on the private sector's profitability) and bank supervision is ineffective, the approach to interest rate liberalization should be gradual, to avoid the possible disruption to long-standing financial contracts that can emerge from a sudden removal of interest rate regulations. At the same time that strong macroeconomic policies to stabilize the economy and reinvigorate the private sector are being pursued, strict supervision of the banking system must be maintained or strengthened, to minimize moral hazard in the banking system. The importance of strong banking regulatory and supervisory policies needs to be underscored, not only for ensuring the viability and health of the banking industry, which is their traditional microeconomic justification, but also for the effectiveness of interest rate liberalization. This can be done in several ways. Besides the standard provisions for capital adequacy and reserves against loan losses, one way to reform deposit insurance schemes, where they exist implicitly or explicitly, is to impose a bankruptcy penalty on bank activity or an actuarially fair insurance premium on bank liabilities, in direct proportion to the riskiness of a bank's loan portfolio.

Second, institutional changes should be in the forefront of financial sector reforms in developing countries. These should include a strong supporting infrastructure that will provide for adequate information flow, credit appraisal and rating, and legal and accounting systems; and the development of equity markets. Such institutional reforms will help reduce the dependence of firms on bank credit and help orient them toward equity financing. Firms' vulnerability to interest-rate shocks would then be reduced, allowing more room for interest rate liberalization.

Third, in terms of the specific interest-rate strategy, two types of situations may be considered: one is where inflation is low and the other is where it is unacceptably high. A gradual program of interest rate

liberalization that maintains positive real rates can proceed in the low-inflation countries, provided that banking supervision is strong and effectively enforced and that demand-management and other policies are appropriate to maintain economic stability. Within this group, countries with relatively long periods of price stability achieved largely through sound and credible macroeconomic policies are good candidates for full interest rate liberalization, subject to a strengthened system of prudential regulations over the banking system. For a low-inflation country that already liberalized interest rates, the appropriate policies are to maintain economic stability and continually improve bank supervision.

In high-inflation countries, a strong and credible stabilization program and an equally strong set of prudential regulations are generally the best initial policy measures. Postponing the removal of interest-rate regulations may be appropriate until the monetary situation has been stabilized and banking supervision strengthened. The empirical evidence suggests that successful countries have combined price stability with flexible, even if regulated, nominal interest rates. When interest rates are raised, they must be preannounced so that banks and borrowers alike know the new interest rate with certainty.

For a high-inflation country that has already deregulated interest rates, the appropriate policies are to implement a strong and credible stabilization program that will stimulate the private sector, and to strengthen the system of prudential controls over the banking sector. Failure to integrate and effectively implement such policies in programs of financial liberalization could lead to financial instability, as the experiences of the Southern Cone of Latin America, the Philippines, Indonesia, and Turkey have shown. This, in turn, could exacerbate macroeconomic instability. In the interim, if interest rates appear to get out of control (which may reflect increasingly severe moral hazard problems unchecked by existing prudential regulations) it may be necessary to go back to regulating nominal interest rates, as long as they are maintained at positive real levels that are, where possible, not much below an appropriate loan rationing equilibrium, or at (nominal) levels greater than any interest rate determined freely in organized domestic or foreign financial markets. Once confidence in the banking system is restored (here, an appropriate set of prudential regulations will play a key role), a firm basis for the resumption of implicit contracts is laid, policies aimed at price stabilization bear fruit, and the financial position of the business sector is improved, the regulations on lending rates can then be safely removed.

Models of Credit Rationing and Implicit Contracts

The purposes of this appendix are to describe more formally the Stiglitz-Weiss, Fried-Howitt, and Mankiw models, provide formal proofs of the basic propositions used in the text, and derive optimal rules in setting lending interest rates under asymmetric information.

1. The Stiglitz-Weiss model

Assume each project requiring funding has a distribution of gross payoffs, $F(R, \theta)$, where R is the project return and θ is some measure of riskiness of the project such that a larger value of θ represents greater risk, in the sense of mean preserving spreads (Rothschild and Stiglitz (1970)). The borrower receives a fixed amount of loan (L) at interest rate (r) and defaults on the loan if the project return (R) plus collateral (C) are insufficient to repay the loan. The bank receives either the full contracted amount ($L(1+r)$) or the maximum possible ($R+C$). The return to the bank (Π_1) is given by (1):

$$(1) \quad \Pi_1 = \text{Min} [(R+C); (1+r)L]$$

Stiglitz and Weiss show that for a given interest rate, r , there is a critical value of θ , say $\hat{\theta}$, such that a firm will borrow if, and only if, $\theta > \hat{\theta}$; that is the interest rate serves as a screening device. The value of $\hat{\theta}$ for which expected borrower profits (Π_2) are zero satisfies (2):

$$(2) \quad \Pi_2(r, \hat{\theta}) = \int_0^{\infty} \text{Max} [R - (1+r)L; -C] dF(R, \hat{\theta}) = 0$$

An increase in interest rate triggers adverse selection effect by increasing the riskiness of the mix of applicants, i.e.,

$$(3) \quad \frac{\partial \hat{\theta}}{\partial r} = \frac{L \int_{-\infty}^{\infty} dF(R, \hat{\theta})}{\frac{\partial \Pi_2}{\partial \hat{\theta}}} > 0$$

which indicates that the critical value of θ increases as the rate of interest increases. An increase in r has an adverse selection effect because less risky borrowers opt out of the market, leaving only the riskier borrowers with higher expected returns on their projects. This has a negative effect on the lender's expected profit that may dominate the positive effect of an increase in the interest rate. ^{1/} Thus, the rate of returns to the bank may not be a monotonic function of r as shown in text Figure 1.

2. The Fried-Howitt model ^{2/}

Let us assume that the bank and the borrower have utility functions with constant absolute risk aversion:

$$(4) \quad U_1[\pi_1(\rho)] = -e^{-\alpha\pi_1(\rho)}$$

$$(5) \quad U_2[\pi_2(\rho)] = -e^{-\beta\pi_2(\rho)}$$

where U_1 and U_2 are the utility functions and π_1 and π_2 are the profits of the bank and the borrower, respectively; and α and β are the bank's and the borrower's degrees of absolute risk aversion, respectively. It is assumed that $\beta > \alpha > 0$, to reflect the greater risk aversion of the borrower. The opportunity cost of lending per unit is represented by ρ with a density function $q(\rho)$ defined on the interval $I = [\underline{\rho}, \bar{\rho}]$.

^{1/} The bank's expected profit may also decline if, for a fixed rate of interest, the collateral is increased (Stiglitz and Weiss (1981; 1983) and Wette (1983)).

^{2/} This model is a modified version of the original Fried-Howitt model (1980) and is taken from Osaro and Tsutsui (1985).

The bank enters into an ex-ante arrangement with the borrower before the realization of ρ , which must be observed even after ρ is realized. The contract must permit the borrower to at least attain a market-determined utility level λ . The bank incurs administrative costs which are assumed to be a convex increasing function of its total lending amount, n , $C = C(n)$, where n is a function of ρ , $n = n(\rho)$. That is, for any $n \geq 0$, $C(0) = 0$, $C'(n) > 0$ and $C''(n) > 0$. It is assumed that C'' is constant. The profits of the bank for a given ρ , π_1 , are expressed as:

$$(6) \quad \pi_1(\rho) = n(\rho)[r(\rho) - \rho] - C[n(\rho)]$$

where $n(\rho)$ represents the loan size and $r(\rho)$ is the loan interest rate when the opportunity cost of lending per unit is equal to ρ . The profits of the borrower, $\pi_2(\rho)$ are represented by equation (7),

$$(7) \quad \pi_2(\rho) = R[n(\rho)] - n(\rho)[1 + r(\rho)]$$

where R , as before, is the project return such that for any $n \geq 0$, $R' > 0$, and $R'' < 0$. It is assumed that $R(0) = 0$ and R'' is constant.

The optimal contract whose terms are $\{r(\rho), n(\rho)\}$ is derived by solving the following problem,

$$(8) \quad \max_{\{(r(\rho)), n(\rho)\}} \int_{\underline{\rho}}^{\bar{\rho}} U_1\{n(\rho)[r(\rho) - \rho] - C[n(\rho)]\} q(\rho) d\rho,$$

subject to:

$$(9) \quad \int_{\underline{\rho}}^{\bar{\rho}} U_2\{R[n(\rho)] - n(\rho)[1+r(\rho)]\} q(\rho) d\rho \geq \lambda.$$

Equation (8) represents the expected utility of the bank, while inequality (9) reflects the constraint that in order for the bank to attract and retain its borrowers it must assure them of the attainment of at least an expected utility level λ .

The first order optimality conditions are:

$$(10) \quad \alpha e^{-\alpha\pi_1} - \phi \beta e^{-\beta\pi_1} = 0$$

$$(11) \quad (r - \rho - C')\alpha e^{-\alpha\pi_2} + \phi(R' - 1 - r)\beta e^{-\beta\pi_2} = 0$$

where ϕ is the constraint multiplier. Substitution of (10) into (11) yields

$$(12) \quad (r - \rho - C' + R' - 1 - r)\alpha e^{-\alpha\pi_1} = 0.$$

Since the term $\alpha e^{-\alpha\pi_1} \neq 0$, for (12) to be satisfied, the optimality condition can be rewritten as:

$$(13) \quad R' - 1 = C' + \rho$$

which implies that the marginal revenue of the loan for the borrower is equal to the marginal cost of the loan for the bank. The bank can use interest rate r as a risk-sharing device to dampen the variations in the borrower's profits.

To show that risk-sharing can be used to stabilize the borrower's profits, it can be demonstrated that variations (as measured by the standard deviation) in the profits of the bank and the borrower are influenced by the degree of their absolute risk aversion.

Recalling the definition of the profit functions of the bank and the borrower, and taking logarithms of both sides of (12) we have $\alpha[(r - \rho)n - C(n)] - \beta[R(n) - (1 + r)n] = \log \alpha - \log \beta - \log \phi$ which, when rearranged, yields

$$(14) \quad nr = \frac{1}{\alpha + \beta} \{ \alpha[n\rho + C(n)] + \beta[R(n) - n] + \log \alpha - \log \beta - \log \phi \}$$

A Taylor series expansion of the administrative cost function $C(n)$ and the revenue function $R(n)$ yields the following approximations,

$$(15) \quad C(n) \approx nC'(n) - (1/2) n^2 C'', \text{ and}$$

$$(16) \quad R(n) \approx nR'(n) - (1/2) n^2 R''$$

The profits of the bank are given as:

$$\pi_1(\rho) = (r - \rho)n - C$$

Using equations (13)- (16) in the above equation and simplifying, we have,

$$(17) \quad \pi_1(\rho) = \left(\frac{\beta}{\alpha + \beta}\right) \left(\frac{n^2}{2}\right) (C'' - R'') + \frac{1}{\alpha + \beta} (\log \alpha - \log \beta - \log \phi)$$

From equation (17) we derive the standard deviation of the bank's profits as:

$$(18) \quad \sigma(\pi_1) = \left[\int_{\underline{\rho}}^{\bar{\rho}} [\pi_1(\rho) - E \pi_1(\rho)]^2 q(\rho) d\rho \right]^{1/2}$$

$$= \frac{1}{2} \left(\frac{\beta}{\alpha + \beta}\right) (C'' - R'') \sigma(n^2)$$

where E denotes mathematical expectation. Using a similar procedure (from equations (14), (15) and (16)), we derive an equation for the standard deviation of the profit function of the borrower: 1/

1/ For details, see Osano and Tsutsui (1985).

$$(19) \quad \sigma(\pi_2) = \frac{1}{2} \left(\frac{\alpha}{\alpha + \beta} \right) (C'' - R'') \sigma(n^2)$$

Equations (18) and (19) imply that the variations in the profits of both the bank and the borrower are functions of their attitude toward risk, the variations in the size of the loan, and the parameters of the cost function of the bank and the revenue function of the borrower. First, the more conservative (i.e., the more risk-averse) is a bank (the larger is α), the more stable would be its profits. At one extreme, a bank that is infinitely risk-averse would show no variability of profits simply because it would make no loans. Analogous statements apply to borrowers. Second, the variability of profits accruing to banks and borrowers is positively related to the administrative costs of the bank and negatively related to the project returns to the borrower. Third, the more variable is the total loan size, the more variable are the profits of both bank and borrower.

To prove the proposition that under implicit contracts the loan interest rate is more rigid than the opportunity cost of lending, let us assume that the loan size is independent of ρ and compute the standard deviation of the loan interest rate from equation (14),

$$\begin{aligned} (20) \quad \sigma(r) &= \left[\int_{\underline{\rho}}^{\bar{\rho}} [r(\rho) - E r(\rho)]^2 q(\rho) d\rho \right]^{\frac{1}{2}} \\ &= \frac{\alpha}{\alpha + \beta} \left[\int_{\underline{\rho}}^{\bar{\rho}} (\rho - E\rho)^2 q(\rho) d\rho \right]^{\frac{1}{2}} \\ &= \left(\frac{\alpha}{\alpha + \beta} \right) \sigma(\rho) \end{aligned}$$

where $\sigma(\rho)$ is the standard deviation of the opportunity cost of lending. Since the borrower is assumed to have risk-averse preferences, $\beta > 0$, we conclude that $\sigma^2(r) < \sigma^2(\rho)$. That is, the lending interest rate is more rigid than the opportunity cost of funds.

3. The Mankiw model

The Mankiw (1986) model can be used to derive general principles in setting the optimal lending interest rate under asymmetric information. The two equilibrium conditions of the model are given by:

$$(21) \quad \Pi r = \rho$$

$$(22) \quad \Pi(r) = E[P; R > Pr]$$

Here, R is the expected return on a project, and P is the repayment probability, with a given density $f(P, R)$; neither R nor P can be observed by the bank or the government. Π is the average probability of repayment, i.e., average of P for those firms that actually borrow at an interest rate, r . The expected payment to the bank is therefore Πr , which must be equal to the risk-free interest rate ρ (such as the interest rate on Treasury bills) if the bank is to make any business loans (eq. (21)); ρ is exogenous to the model. The investment condition, eq. (22), states that investors decide to invest and borrow as long as R exceeds the cost of capital Pr . For any density $f(P, R)$, the function $\Pi(r)$ is a well-defined conditional expectation.

Two general principles for the optimal interest rate, r^* , can be derived. First, r^* is never less than the risk-free return ρ . A value of r^* below ρ would induce inefficient investments. Second, r^* is always greater than ρ . To establish this proposition, define social surplus as follows:

$$\text{Social Surplus (SS)} = \int_0^1 \int_{Pr}^{\infty} (R - \rho) f(P, R) dR dP.$$

Taking the derivative of social surplus with respect to the interest rate r , and evaluating the derivative at $r = \rho$,

$$dSS/dr = \int_0^1 -P(Pr - \rho) f(P, Pr) dP > 0,$$

as long as $f(P, R)$ is nonzero everywhere. Thus, an economically efficient interest rate policy generally establishes a lending interest rate greater than the risk-free interest rate.

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