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FINANCIAL CRISIS IN DEVELOPING COUNTRIES AND STRUCTURAL WEAKNESSES OF THE FINANCIAL SYSTEM

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Abstract:

This paper examines the generation of financial crises in developing economies and shows that the microeconomic structure of the financial sector is a crucial factor in creating the conditions for a crisis. Structural problems of the financial system in developing countries, including implicit insurance on bank liabilities, limitations of capital markets, and lack of appropriate regulations, are sources of financial fragility. The paper concludes that the intervention of a supervisory agency is needed to eliminate these distortions, and the optimal intervention consists of charging a fair insurance premium on bank liabilities or imposing an adjustable bankruptcy penalty on banking activity.

I. Introduction

This paper studies, from an analytical point of view, the generation of financial crises in developing economies. Financial crises can be considered a leading cause in the amplification and propagation of recessions, and of disruptions in the intermediation of savings, with adverse consequences for economic growth. The purpose of the paper is to show that deficiencies of the micro-economic structure of the financial system are source of financial fragility and increase the probability of financial crises. Existing deficiencies including limited capital markets, implicit insurance on bank liabilities, and inappropriate regulations encourage banks to take excessive risk in their loan portfolios.

Several experiences of financial crises under full insurance of bank liabilities have developed in the last 10 years. Many of the developing countries that underwent external

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debt crises during the early 1980s also suffered domestic financial crises that required a bail out of insolvent banking institutions at an important cost for the peoples of these countries. To different degrees this was the case of Argentina, Brazil, Chile, and Uruguay. Similarly, in recent years the United States has been affected by limited financial crises and the Government has had to bail out financial institutions including commercial banks and thrift institutions.

Banks and other financial institutions offer to the public fixed-exchange-rate liabilities (deposits) that have a value in terms of currency that is independent of the result of the financial activity. For some reason to be discussed below, governments explicitly or implicitly provide a virtually free full insurance to these fixed-exchange-rate liabilities that result in excessive risk taking by banks. Under these conditions of fixed exchange rate liabilities and full government insurance banking activity should be regulated. Bank supervision should be established to preserve the stability of the financial system by implementing a system of fair insurance premiums on bank liabilities; in this system, the premium is tied to the risk of the loan portfolio. An equivalent result is obtained by imposing optimal bankruptcy penalties to banking activity in the form of adjustable capital requirements.

The plan of the paper is as follows. The next section discusses the characteristics of financial crises in developing countries and analyzes the structural deficiencies of their financial systems. Section III presents a simplified model of financial intermediation to illustrate the problem of excessive risk taking resulting from deficiencies in the structure of the financial system. Some concluding remarks are offered in the last section. Alternative solutions to the model of financial intermediation are presented in an Appendix.

II. Financial Crises and the Financial System in Developing Countries

This section describes a financial crisis, explains its consequences, and discusses how they are generated with special emphasis on the structural factors that cause financial fragility. The approach taken consists of a review of the literature that can be classified into two categories, descriptive of historical episodes and theoretical or interpretative of aspects of financial crisis[1].

1. Characteristics of financial crises

There is no concise or precise definition of financial crises, although there are numerous lengthy descriptions of the events that characterize them. Paraphrasing Kindleberger (1978), financial crises are macroeconomic phenomena difficult to define, but recognizable on sight. The main events that characterize them include the failure of banks and other important financial intermediaries, sharp reductions of asset values, including stocks and real assets, widespread over-indebtedness of domestic agents, speculation against the domestic currency, and international capital flight[2].

Bank failures are prompted by runs on deposits that may or may not be founded in a deterioration in the performance of loan portfolios. The run on deposit can be the result of the anticipation of depositors of the deterioration in the bank's loan portfolio or of the reduction in the real value of the collateral backing the loans. Even if this anticipation is not well founded the loss of confidence of the depositors can lead to bank failures as banks are forced to sell their assets at a loss to acquire the liquidity needed to respond to the run. In practice, however, unfounded runs are generally prevented by the intervention of Central Banks that fully guarantee bank deposits and cover bank losses[3].

The widespread over-indebtedness of domestic agents and the tightening of the liquidity constraints are also characteristic of financial crises. The tightening of liquidity constraints forces domestic agents to adjust their investment and consumption levels, to borrow in distress (waiting for an improvement of external conditions), and eventually to declare bankruptcy. International capital flight and the external debt problem also characterize financial crises in developing economies. The external debt problem develops as creditors attempt to reduce their exposure because of the perceived deterioration in the domestic agents' ability to pay. Capital flight and the external debt problem amplify the crisis. The reduced availability of foreign credit further depresses asset prices and economic activity, thereby impairing debt-servicing capacity.

1.1 Effects of financial crises

Financial crisis result in a contraction in economic activity because of the increase in the cost of financial intermediation. Even hypothesis that disregard financial factors as generators of the business cycle, accept that a crisis in the financial sector plays an important role in the amplification and propagation of the effects of real shocks[4]. Other macroeconomic schools recognizes the importance of financial factors in the generation of the economic cycle. Consider for example, monetary models under which a sudden and unanticipated monetary contraction prompts a transitory reduction in economic activity. The monetary contraction induces an unexpected reduction in the price level that is confused with changes in relative prices, causing output to fall[5]. Alternative models postulate that a reduction in the availability of credit prompts a contraction in activity. These models assume that production takes time and that firms finance the purchase of inputs with bank loans. A financial crisis creates a reduction in credit for the financing of working capital, causing firms to restrict production[6].

Higher financial intermediation costs reduce the efficiency of the financial system to perform risk-sharing and inter-temporal transactions, resulting in welfare losses as otherwise feasible economic transactions cannot be performed. The higher costs of financial intermediation are the result of the loss of confidence in the financial system, and also of higher costs of gathering information as the crisis distorts the significance of past records[7].

1.2 Origins of financial crisis

The origins of financial crisis are in general traced to shocks expanded into a crisis because of the fragility of the financial system. Macroeconomic shocks, including exogenous disturbances and policy inconsistencies, can generate wide swings in relative prices that increase the proportion of non-performing bank loans and lead to bank failures. In general, banks have to bear part of the costs suffered by agents that are adversely affected by the relative price change, and that cannot service their debts in previously agreed terms[8].

There are different views about financial fragility and the structural weaknesses of the financial system. On the one hand, fragility is considered an intrinsic characteristic of the financial system in market economies always prone to crises. On the other hand, structural weaknesses of the financial system can be made consistent with rational behavior and linked to limited information, externalities and inadequate incentives and regulations. The intrinsic fragility hypothesis has been defended by Minsky (1982) and Kindleberger (1978). In their view, crises are the result of a mechanistic cycle that

gears economic units to increasingly speculative forms of financing, leading to a generalized crisis[9]. The weaknesses of the financial system can, however, be explained in a setting consistent with rational behavior of economic agents under limited information. The main elements of financial crises, including deviation of asset prices from market fundamentals –speculative bubbles– and runs on bank deposits, have received interpretation consistent with rational behavior. In addition, the moral hazard effect of deposit insurance schemes that increases the probability of bank failures have also been shown to be consistent with rationality[10].

2. Structural Problems of the Financial System

There are several structural problems that affect the financial systems of developing countries. Deposit insurance schemes, including those in which the insurance is not explicit but agents expect that the government will bail out depositors in case of a crisis, foster excessive risk-taking by insulating the cost of financing loans from the risks of the loan portfolio. Limitations of the capital markets reduce the possibilities of risk-sharing and affect the stability of the financial system. Finally, the lack of adequate rules and regulations to allocate losses that may arise under different contingencies leaves ample room for government discretion, that in turn leads to resource misallocation and wrong signals for the future operation of the system.

2.1 Externalities and insurance schemes

The externality derived from the public confidence in the financial system has led to the provision of deposit insurance to prevent runs on deposits. Even when an explicit deposit insurance scheme has not been established, economic agents have counted on an implicit central bank guarantee for the full amount of their deposits. The social costs associated with a generalized run on banks justify the government intervention in the event of failure of a financial institution, and provide rationality of expecting such intervention. In addition, after crisis of the 1930s, the strong link between financial crisis and economic activity became evident and governments began to fully insure deposits of failing financial institutions to prevent any further erosion in the public's confidence in the financial system. This intervention can be considered a compensatory distortion; the loss of confidence in the financial system is critical in both creating a crisis and in determining its intensity and duration[11].

In developing countries foreign credit to private financial institutions has, in practice, exhibited a remarkable similarity with domestic deposits in this respect. Reductions in the ability of local borrowers to service their commitments increase the "country risk" perceived by foreign creditors, making foreign credit more scarce and more expensive. In the event of failure of an individual local borrower, the increase in "country risk" changes the perceived ability to pay of the country as a whole. This externality could be considered among the factors that has led some developing countries to implicitly insure foreign credit to private financial institutions, and to give ex-post explicit public sector guarantees to private foreign debt.

The provision by the public sector of implicit or explicit insurance for local deposits and foreign credit of domestic financial institutions results in a moral hazard problem. Insurance schemes isolate local depositors and foreign creditors from the risks taken by local banks in their loan portfolio, leading to excessive risk-taking by financial institutions, distortions in the allocation of credit, and to a higher probability of a financial crisis[12].

2.2 Limitations of the capital markets

A second source of structural fragility of financial systems consist of the limitations of the capital markets. These limitations reduce the ability of the financial system to perform risk-sharing activities and increase the relative importance of fixed exchange rate liabilities like banks' deposits in financial intermediation. Among the hypotheses used to explain the limitations of the capital markets are the distortions imposed by the tax system, and the asymmetries of information between managers and external equity holders.

The incentives for holding equity are largely reduced by a tax system that imposes a heavier levy on equity returns than on deposit returns. First, because in some cases equity returns are subject to double taxation –corporate taxes and personal income taxes– and second, because the degree of income tax evasion is larger for deposit returns than for equity returns. In most developing countries banks are not required to report to the tax authorities their interest payments to individuals, while the dividens paid by corporations and the stock transactions must be reported.

The information asymmetry between managers and outside equity holders is aggravated in developing countries where government controls and restrictions are widespread. In these economies, illegal or quasiillegal transactions –including tax evasion, dealings in parallel foreign exchange and credit markets, and smuggling– are common and profitable practices. Under those conditions the public accounting systems of firms do not convey accurate and relevant information. This widens the information asymmetry and reduces the incentives to hold external equity. Moreover, when firms are involved in illegal activities, equity holders have an incentive for limiting the dissemination of information about their operations. This information asymmetry is also an incentive for the development of economic conglomerates which allow a group of investors to keep control over several firms while reducing risks by diversifying the activities within the group.

2.3 Financial system regulations

The regulations imposed on financial systems in developing countries leave ample room for government discretion in the event of a crisis. The use of government discretion to solve conflicts and allocate eventual losses leads to misallocation of resources, and sends wrong signals for the future operation of the system. The reliance on governmental discretion fosters rent-seeking behavior of private agents, which in itself represent an inefficient allocation of resources. The lack of rules to be applied in the event of a crisis can also jeopardize the future operation of the system by leaving unpunished the decisions and actions that were the cause of bank failures[13].

The control of financial institutions by economic conglomerates creates distortions in the allocation of credit as financial institutions become agents of the debtors. A socially efficient financial system requires financial institutions to act as agents of depositors in the process of finding adequate borrowers and establishing a well-diversified loan portfolio[14]. The control of financial institutions by the debtors, generally by economic conglomerates, results in excessive risk-taking by the financial institution and in a concentration of the loan portfolio in loans to the conglomerate[15].

Solutions to the problems created by the provision of deposit insurance have already being proposed based on the idea of eliminating or restricting the issuance of fixed exchange rate liabilities by banks. Henry Simons (1948) proposed the imposition of 100 percent reserve requirement on fixed exchange rate liabilities, the rest of the financial

system would consist of investment units, where deposits receive a variable and uncertain yield. In the context of Islamic banking, see Khan (1986) among others, fixed exchange rate liabilities are ruled out and banks are allowed only to issue equity type instruments for the funding of investments and cannot charge a fixed interest rate to customers. However, this is not the line followed by this paper where the basic postulate is that banks will always issue fixed exchange rate liabilities and that governments will always fully those liabilities. What is needed then is to find mechanisms to avoid the distortions created by such a financial system.

III. A Simple Model of Financial Intermediation

In this section we specify a simple model of financial intermediation in a developing economy to illustrate the problems arising from government insurance of bank liabilities (local deposits and foreign credit). The model considers two periods and rational optimizing agents including a representative consumer, a representative financial institution, a representative foreign bank, and M firms. An additional agent is the government whose behavior is not explicitly modelled. However, economic agents expect the government to intervene in the event of bankruptcy of the domestic financial institution, and to effect the transfer of resources needed to fulfill all commitments of the failing institution. The model shows that under those conditions the unrestricted banker's optimization leads to distortions in credit allocation and excessive risk-taking by the bank. The optimal credit allocation is obtained when the expected marginal productivity of capital all the M sectors is equal to the expected rate of return of deposits. This optimal credit allocation can be reached using corrective policies based on the external supervision of the bank loan portfolio. Theoretically, an external supervisory agency can eliminate the distortions by charging a fair insurance premium on bank liabilities or by imposing a bankruptcy penalty equal to the expected value of the bank losses.

The main assumptions of the model are the following:

(a) The firms' managers are risk-neutral and maximize expected profits by investing in a single risky project that give yields in the second period. They do not contribute to the accumulation of deposits.
(b) Information costs prevent firms from seeking direct financing and firms are completely financed by loans of local banks. The firms cannot obtain insurance against productivity shocks.
(c) The consumer is risk-averse and maximizes inter-temporal utility, selecting present consumption and holdings of local and foreign deposits.
(d) The elementary utility function is quadratic.
(e) The foreign banker is risk-neutral and the alternative cost of funds is given.
(f) The representative local banker is risk-neutral, and banking is a competitive activity. The banker maximizes expected profits by selecting a portfolio of loans to the M firms and a composition of financing between local deposits and foreign credit. The banker does not contribute to the accumulation of deposits.
(g) The representative local bank has no equity and is completely financied by local deposits and foreign credit.
(h) The government imposes lump-sum taxes and effects transfers so as to insure local deposits and foreign loans.

1. Production, consumption and bank financing

Production activity takes time and has an uncertain outcome, it is performed by M different firms using a single input working capital K_i ($i = 1, ..., M$). The production function (equation (1)) is twice differentiable, K_i represents firm's "i" purchase of inputs in the first period and Y_i represents firm's "i" output obtained in the second period. The production process is subject to random shocks that can wipe out the entire output of a firm. The supply shocks (Φ_i) in equation (2) can take value of one or zero with probability π_i and $1-\pi_i$, respectively, and are independent across sectors.

$$Y_i = f_i\,[K_i] \qquad \Phi_i \quad (i = 1, ..., M) \tag{1}$$

$$\Phi_i = \left\{1,\ 0;\ \ \pi_i,\ \ 1 - \pi_i\right\} . \tag{2}$$

Firms maximize expected profits subject to the restriction that working capital (K_i) is completely financed with bank loans (L_i). The demand for bank loans is obtained through equalizing the marginal productivity of working capital ($f'[K_i]$) with one plus the interest rate charged on loans (R_i). If the production process of firm "i" succeeds, profits of firm "i" would equal the excess of output over bank repayments. If the production process fails, profits would be equal to zero and the bank would lose the whole amount lent to firm "i". Providers of inputs would always receive their contractual payment because they are paid before the result of the production process is known using the proceeds of the loans.

$$FP_i = \left\{f_i[K_i] - R_i\,L_i,\ \ 0;\ \ \pi_i,\ \ 1 - \pi_i\right\} \tag{3a}$$

$$R_i = f_i'\,[K_i]\ ; \tag{3b}$$

$$L_i = K_i \tag{3c}$$

The representative consumer maximizes expected utility by allocating initial wealth (W_1) and non-interest income (I) to present consumption (C_1) and to holdings of local deposits (D) and foreign assets (F). The returns of deposits and foreign assets are used to finance future consumption (C_2). Equations (4a) and (4b) below represent the budget constraint for each period where W_1 is initial wealth, R_D represents the contractual payment of local deposits (one plus the interest rate), R_F is one plus the interest rate paid on foreign deposits, and I is non-interest income[16]. Equations (4c) and (4d) represent the expected value and variance of future consumption[17].

$$C_1 = W_1 + I - (D + F) \tag{4a}$$

$$C_2 = R_D D + R_F F \tag{4b}$$

$$[C_2]^e = [R_D]^{eD} + [R_F]^{eF} \tag{4c}$$

$$S^2[C_2] = D^2 S^2[R_D] + F^2 S^2[R_F] + 2(DF\ S[R_D, R_F] \tag{4d}$$

The optimal asset holding is reached when the expected return of each asset, corrected for risk, equals the subjective marginal rate of substitution of expected future consumption and present consumption. The correction for risk depends on the degree of absolute risk aversion (ARA) and on the marginal contribution of each asset to the variance of future consumption ($S[C_2]_D$, $S[C_2]_F$)[18]. The marginal rate of substitution between expected future consumption and present consumption on the rate of time preference (δ) and the ratio of marginal utilities (MRS)[19]. This result was obtained using a mean variance approach according to which expected utility is a function of present consumption, and the expected value and variance of future consumption[20].

$$R^e_D - ARA\ S[C_2]_D = (1 + \delta)\ MRS \tag{5a}$$

$$R^e_F - ARA\ S[C_2]_F = (1 + \delta)\ MRS \tag{5b}$$

$$[U]^e = (1 + \delta)\ v(C_1) + v([C_1]^e) + v''(C_2)\ S^2[C_2]/2 \tag{5c}$$

In the absence of insurance to bank liabilities, the contractual compensation demanded by consumers to provide a given amount of local deposits (the supply function of deposits (6)) differs from the expected return of deposits due to the probability of bank failure. The supply of deposits is a function of the expected return of deposits, the probability of bank failure (1 – P), and the expected rate of return of deposits in the event of bank failure ($[g_C]^e$)[21].

$$R_D = (1/P) * \left\{R^e_D - [g^C]^e * (1 - P)\right\} \tag{6}$$

In the absence of insurance on bank liabilities, the contractual compensation demanded by foreign banks to supply a given amount of *foreign credit* (7) exceeds the expected return of foreign credit (R_F). The compensation demanded is a function of the expected return of alternative foreign assets (R_F), the probability of bank failure (1 – P), and the expected rate of return of foreign credit conditional on bank failure ($[g^C]^e$):

$$R_{FC} = (1/P) * \left\{R_F - [g^C]^e * (1 - P)\right\} \tag{7}$$

It is assumed that foreign bankers are risk-neutral and that the expected return of an alternative foreign asset is given[22].

2. Bank intermediation, insurance and distortions

Government insurance of bank liabilities increases the confidence in the financial system at the cost of creating distortions in credit allocation and excessive risk-taking by financial institutions. The insurance increases the stability of the financial system by insulating the holders of bank liabilities from the risks of the bank's loan portfolio preventing a run on bank deposits because in the event of bank failure the government would take the loss in order to pay off bank liabilities. However, the insurance also creates new incentives for the banker that result in distortions in the allocation of credit and in excessive risk-taking: the expected marginal productivity of capital differs across

sectors and the loan portfolio tends to be concentrated in a few sectors, thus becoming riskier though more profitable. A formal presentation of the model and derivation of the main results are included in the Appendix.

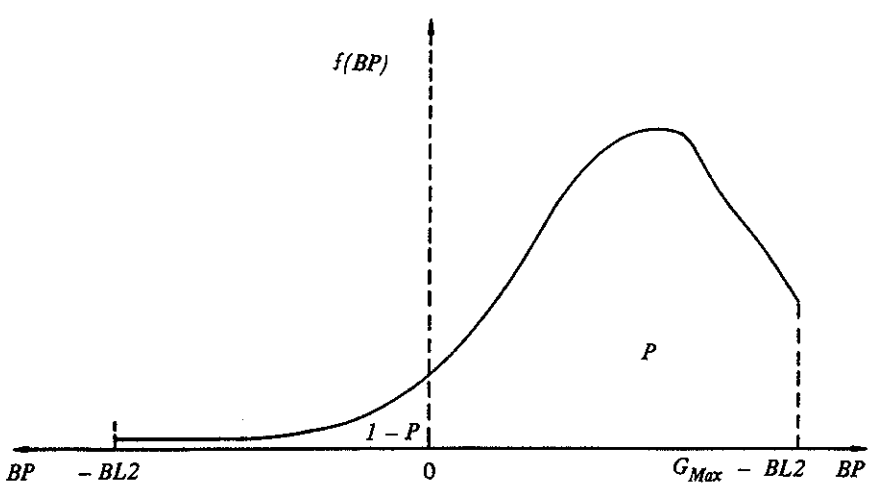
Banks maximize expected profits over a truncated profit density function, the excluded portion of which corresponds to the loan returns that result in bank failure. The bank lends to different sectors using funds collected through deposits and foreign credit. The banker decides the level and composition of bank financing and the composition of the bank portfolio so as to maximize truncated expected profits. In this model, the result of the intermediation process is uncertain, but it can be summarized by two different states: no-failure if loan repayments (G) are enough to cover bank liabilities ($G \geq BL2 = R_D D + R_{FC} FC$), and failure if loan repayments fall short and the bank fails ($G < BL2$)[23].

If loan repayments cover bank liabilities the banker's profits are the excess of credit repayments over bank liabilities. However, if loan repayments fall short, the banker's profits are zero and depositors and foreign creditors accept the losses by sharing net loan repayments. Expected bank profits ($[BP]^e$) are presented in equation (8) where P is the probability of no-failure, and $[G^N]^e$ are expected loan returns in the no-failure state[24]. The probability of no-failure (P) can be defined as the area below the density function of bank profits, f(BP), lying to the right of the critical value represented by the level of bank liabilities (BL2), (see equation (9) and Figure 1)[25].

FIGURE 1:

DENSITY FUNCTIONS FOR BANK PROFITS

$$\textit{Bank Profits: } BP = \sum_{i=1}^{M} R_i, L_i \Phi_i - (R_D D + R_{FC} FC) = G - BL2$$



$$[BP]^e = P([G^N]^e - R_D D - R_{FC} FC) \quad (8)$$

$$P = \text{Prob}\left\{G \geq BL_2\right\} = \int_{BL_2}^{G\max} f(G)\,dG = 1 - F(BL_2) \quad (9)$$

A competitive financial system without government insurance to bank liabilities and where these liabilities are in effect flexible exchange rate liabilities –referred here as a laissez-faire system– is a benchmark where the market mechanism attains the optimal credit allocation and the optimal bank risk-taking position. In this model it is assumed that in a competitive financial system market-wide conditions are given for the individual bank, while bank-specific conditions are adjustable variables in the optimization process. Market-wide conditions include the expected rate of return of deposits and foreign loans, the variance of deposit returns, and the interest rates charged on local loans. Bank-specific conditions include the probability of bank failure, and the expected rate of return of bank liabilities in the event of bank failure. The decision variables used by the bank in the optimization process are the amounts of each type of loans, local deposits, and foreign credits. In a laissez-faire financial system, depositors and creditors react to actions of individual banks that modify the bank-specific conditions by requiring changes in their contractual payments (R_D and R_{FC}) as presented in equations (10) and (11)[26].

$$R_D = (1/P)\left\{[R_D]^e + (1-P)[g^C]^e\right\} \quad (10)$$

$$R_{FC} = (1/P)\left\{R_F + (1-P)[g^C]^e\right\} \quad (11)$$

In a laissez-faire financial system the banker's optimization leads to an allocation of bank credit, such that the expected return of each type of loans equals the expected return of deposits. This result implies that the expected marginal productivity of capital is equal in all sectors, and thus that expected output is maximized[27]. In addition, the composition of bank financing is such that the contractual return of deposits equals the contractual return of foreign credit.

$$R_i\pi_i = [R_D]^e \; ; \quad (12a)$$

$$R_D = R_{FC} \quad (12b)$$

Assuming instead that the government fully insures bank liabilities at no charge, the bank optimization process leads to the concentration of the portfolio of bank loans, and hence to distortions in credit allocation and excessive risk-taking by the bank. When deposits and foreign credit are fully insured, their supply prices do not depend on the risk of the loan portfolio, because depositors and creditors would receive their contractual returns even in the event of bank failure[28]. The optimization conditions for the bank under full insurance (equation (13) and (14) imply that the portfolio of loans tend to be concentrated in sectors where the joint probability of loan success and bank failure (q_i) is low because loan repayments in the event of failure do not affect the cost of bank financing. Moreover, loans are also concentrated in sectors where additional lending results in reduction of the probability of no-failure ($P_D + P_i$) < 0 and, thus, in lower expected bank liabilities.

$$R_i\pi_i = R_i q_i + (P_i + P_D)BL2 + PR_D \quad (13)$$

$$R_D = R_{FC} \quad (14)$$

Thus, under full insurance of bank liabilities, distortions in credit allocation and excessive risk-taking arise, the expected marginal productivity of capital differs across sectors, and a moral hazard problem leads to a higher probability of bank failure. More credit than the optimal amount will be allocated to some sectors resulting in a level of expected output that is lower than the maximum (see equation (15)). In addition, the concentration of loans in sectors with a smaller probability of yielding returns in the event of failure (small q_i) implies that the success of loans in individual sectors becomes critical to avoid bank failure, thus increasing the probability of bankruptcy. The moral hazard problem arises because the banker does not have to bear all the possible outcomes of the loan portfolio selected (bankruptcy and limited liability), and because the insurance insulates the cost of bank financing from the riskiness of the loan portfolio. In the event of failure the shortfall between total bank commitments and loan repayment is borne by the insurer (the government).

$$\pi_i f'[K_i] - R_D = R_i q_i + (P_i + P_D)BL2 - (1-P)R_D \quad (15)$$

The distortions created by the full insurance of bank liabilities also result in domestic over-intermediation and foreign over-borrowing by banks. The full insurance system eliminates the risk of bank liabilities, increasing the quantity supplied of deposits and foreign credit at the same interest rate. In addition, the moral hazard problem also implies that the banker can increase the size, risk, and return of the loan portfolio and offer higher interest rates to obtain additional financing[29].

3. Corrective policies

Corrective policy instruments are needed to offset the distortions created by fully insuring bank liabilities. The elimination of the insurance on bank liabilities is ruled out because of externalities that induce economic agents to expect government intervention in case of a bank failure. The policy instruments considered are a bankruptcy penalty and an insurance premium on bank liabilities. The optimal credit allocation and bank risk-taking can be obtained by imposing an adjustable bankruptcy penalty in the form of capital requirements, or a "fair" insurance premium that compels the banker to consider the entire range of consequences of their portfolio selection.

A pecuniary bankruptcy penalty can be represented in this model by capital restrictions to banking consisting of equity requirements and minimum holdings of a certain riskless asset. These capital restrictions are in effect in virtually all countries in the form of minimum equity requirements and legal reserve requirements. However, these requirements are not effective in correcting the distortions created by the insurance on bank liabilities because they are imposed independently from the characteristics of each institution's loan portfolio. In the event of bankruptcy, defined as loan repayments falling short of bank liabilities, the government uses the riskless asset to cover bank liabilities[30]. The optimization conditions for the bank when a bankruptcy penalty (Z)

is imposed, presented in equation (16), depend critically on the response of the penalty to changes in the composition of the loan portfolio and to changes in the level of deposits $(\frac{dz}{dL_i} + \frac{dZ}{dD})$.

$$R_i\pi_i = R_iq_i + (P_i + P_D)(BL2 - Z) + PR_D + (1 - P)\left(\frac{dZ}{dL_i} + \frac{dZ}{dD}\right). \quad (16)$$

$$R_D = R_{FC} \quad (17)$$

The imposition of a fixed bankruptcy penalty does not eliminate all sources of distortions in credit allocation, and the expected marginal productivity of capital still differs across sectors. The imposition of a fixed bankruptcy penalty acts as an incentive to reduce bank risk-taking because expected bank liabilities also include the expected value of the bankruptcy penalty. However, unless the penalty changes with the level of deposits and with the loan composition, the expected rates of return of loans would differ across sectors, implying a sub-optimal credit allocation.

In principle, the supervision of the bank loan portfolio could be used to design an adjustable bankruptcy penalty Z that would respond to changes in the riskiness of that portfolio. This optimal bankruptcy penalty (Z*) is equal to the expected value of the loss or the difference between bank liabilities in the second period and expected credit repayments conditional on bankruptcy (18). The imposition of Z* leads to the optimal credit allocation and bank risk-taking; then the bank optimization conditions (19) consist of equating the expected returns of loans in each sector with the return of deposits and foreign credit.

$$Z^* = (BL_2 - [G^C]) \quad (18)$$

$$R_i\pi_i = R_D = R_{FC} \quad (19)$$

To avoid the distortions created by fully insuring bank liabilities, a second corrective policy is to charge an insurance premium on bank liabilities, the value of which must be deducted from the amount of funds available for lending. Insurance premiums for local deposits are in effect in several countries; however, the way in which the premium is calculated is not appropriate to deal with this distortion because the premium is independent from the riskiness of each institution's loan portfolio. The first-order conditions for bank optimization when an insurance premium (w) is imposed are presented in equations (20) and (21)[31]. The effect of the premium on the system's risk depends critically on the premium response to changes in the level of deposits and in the composition of the loan portfolio. The imposition of a fixed insurance premium does not eliminate the distortions in credit allocation and bank risk-taking, and results in differences in the expected marginal productivity of working capital across sectors.

$$R_i\pi_i = R_iq_i + P_iBL2 + (P_DBL2 + PR_D)\,\Omega \quad (20)$$

$$R_D = R_{FC} \quad (21)$$

$$\Omega = \frac{1 - BL1 * [d(1 - w)/dL_i]}{(1 - w) + BL1\,[d(1 - w)/dD]} \quad (22)$$

In theory, the optimal credit allocation is obtained by imposing an insurance premium adjusted for the risk of the loan portfolio. A fair insurance premium on bank liabilities can eliminate the distortions in credit allocation and bank risk-taking. The fair insurance premium (w*, in equation (23)) is equal to the expected value of the loss, which is equal to the optimal bankruptcy penalty, times its probability of occurrence. As a result, under fair insurance the expected marginal productivity of capital would be equal in all sectors, ensuring an optimal credit allocation[32].

$$w^* = \frac{(1 - P)\,[R_D * BL1 - \Sigma q_iR_iL_i/(1 - P)]}{R_D\,BL_1} = \frac{(1 - P)Z^*}{R_D\,BL_1} \quad (23)$$

$$R_i\pi_i = R_D = R_{FC} \quad (24)$$

V. Concluding Remarks

After the crisis in the 1930s, in most countries, including developing countries, an implicit safety net has in practice been offered by the governments to the holders of bank liabilities. Even in the absence of explicit deposit insurance schemes, economic agents take this safety net into account. However, this safety net and the inadequacy of corrective policies have contributed to the distortions and inefficiencies of the financial system. Under these conditions, structural reforms of the financial system can significantly increase the efficiency of the system in performing inter-temporal transactions and risk-sharing. However, any structural reform of the financial system consisting only of the simple elimination of market repression mechanisms would not eliminate all sources of distortions and may well increase the fragility of the financial system. The structural reforms of the financial system should emphasize the institution of a regulatory system that could compensate for these externalities.

In this paper only the excessive risk-taking derived from deposit insurance schemes has been formalized and analyzed using a simple model of financial intermediation. In order to correct the distortions and avoid the excessive risk-taking created by explicit or implicit deposit insurance schemes, a system of bank supervision needs to be developed and used to penalize the banks in direct relation to the risk of their loan portfolio. According to the model presented the optimal credit allocation under full insurance of bank liabilities can be obtained if a supervisory agency imposes an adjustable bankruptcy penalty in banking activity or charges a fair insurance premium on bank liabilities. The problems and limitations that any supervisory agency would face in the implementation of a regulatory system like the one proposed are very significant, and should be the subject of other studies. This paper has tried to point out the direction in which the regulators should aim in order to conduct the financial system to emulate a system free of externalities and distortions and as efficient and solid as possible.

Appendix: Alternative Solutions to the Model of Financial Intermediation

1. The demand for credit

The production function of each firm (A.1) is assumed concave and twice differentiable; f' and f'' represent its first and second derivative. Y_i is output, K_i is resource input, and Φ_i is a firm specific supply shock.

$$Y_i = f_i [K_i] \Phi_i \qquad (i = 1, ..., M) \qquad (A.1)$$

$$f'_i [K_i] > 0 \qquad (A.2)$$

$$f''_i [K_i] < 0 \qquad (A.3)$$

The firm specific supply shock (A. 4) takes values 0 or 1 with probability π_i and $1 - \pi_i$, respectively, and is independent across sectors. The expected value of Φ_i is represented by $[\Phi_i]^e$, and the covariance of Φ_i and Φ_j by $S[\Phi_i, \Phi_j]$.

$$\Phi_i = \left\{1, 0;\ \pi_i,\ 1 - \pi_i\right\} \qquad (A.4)$$

$$[\Phi_i]^e = \pi_i \qquad (A.5)$$

$$S[\Phi_i, \Phi_j] = 0 \qquad (i \neq j) \qquad (A.6)$$

Profits of the individual firm, FP_i in (A.7), are either equal to the excess of output ($f_i[K_i]$) over loan repayments ($R_i L_i$) or equal to zero depending on the value of Φ_i. The production process takes time and K_i is financed with bank loans (L_i); R_i is one plus the interest rate charged on loans to firm "i". The constrained maximization of FP_i yields the producer's first order condition in (A.9).

$$FP_i = \left\{f_i[K_i] - R_i L_i,\ 0;\ \pi_i,\ 1 - \pi_i\right\} \qquad (A.7)$$

$$K_i = L_i \qquad (A.8)$$

$$R_i = f'[K_i] \qquad (A.9)$$

2. Consumption and the supply of deposits

The expected utility of the representative consumer (4.1) is a function of present (C_1) and future consumption (C_2), δ is the rate of time preference. The elementary utility function (v(C)) is assumed quadratic.

$$[U]^e = (1 + \delta)\ v(C_1) + [v(C_2)]^e \qquad (A.10)$$

$$v'(C_t) > 0 \quad v''(C_t) < 0 \quad v'''(C_t) = 0 \qquad (t = 1, 2)$$

The expected utility of (C_2) in (A.11) is obtained applying a Taylor's series expansion around its expected value $[C_2]^e$. The variance of C_2 is $S^2\ [C_2]$.

$$[v(C_2)]^e = v([C_2]^e) + v''([C_2]^e)\ S^2\ [C_2] / 2 \qquad (A.11)$$

The first and second period budget constraints are presented in (A.12) and (A.13), respectively, where (W_1) is initial wealth, (I) non-interest (I) income, (D) deposits, (F) foreign assets, (R_D D) the return of deposits, and (R_F F) the return of foreign assets. R_D and R_F are equal to one plus the interest rate of deposits and foreign assets, respectively. Non-interest income (I) consists of the income obtained by the sale of resources, K_i, to the firms.

$$C_1 = W_1 + I - D - F \qquad (A.12)$$

$$C_2 = R_D D + R_F F \qquad (A.13)$$

$$I = \Sigma K_i \qquad (A.14)$$

C_1, W_1, I, D, and F are predetermined in the sense that they do not depend on the outcome of the production process. C_2 is a random variable with expected value and variance presented in (A.15) and (A.16). S_{HH} is the variance of the rate of return of asset H, and S_{HJ} the co-variance of the rates of return of assets H and J.

$$[C_2]^e = [R_D]^e D + [R_F]^e F \qquad (A.15)$$

$$S^2 [C_2] = D^2 S_{DD} + F^2 S_{FF} + 2(D F S_{DF}) \qquad (A.16)$$

The expected utility function (A.18) is obtained replacing (A.11) in (A.10). The maximization of $[U]^e$ subject to the conditions (A.12) and (A.13) yields the consumer's first order conditions in (A.18) and (A.19).

$$[U]^e = (1 + \delta)\ v(C_1) + v([C_2]^e) + v''(C_2)\ S^2[C_2] / 2 \qquad (A.17)$$

$$[R_D]^e = (1 + \delta)\ MRS + ARA * S[C_2]_D / 2 \qquad (A.18)$$

$$[R_F]^e = (1 + \delta)\ MRS + ARA * S[C_2]_F / 2 \qquad (A.19)$$

MRS is the ratio of the marginal utilities of present and expected future consumption, ARA is the degree of absolute risk aversion evaluated at the value of expected future consumption, and $S[C_2]_D$ and $S[C_2]_F$ are the marginal contributions of D and F to $S^2[C_2]$.

$$MRS = v'(C_1) / v'([C_2]^e) \qquad (A.20)$$

$$ARA = -v''([C_2]^e) / v'([C_2]^e) \qquad (A.21)$$

$$S[C_2]_D = 2\ (D S_{DD} + F S_{DF}) \qquad (A.22)$$

$$S[C_2]_F = 2\ (D S_{DF} + F S_{FF}); \qquad (A.23)$$

Given the possibility of bank failure the expected ($[R_D]^e$) and contractual return of deposits (R_D) differ as presented in (A.24). The expected rate of return of deposits conditional in the event of bank failure is $[g^C]^e$, the probability of bank failure is (1 – P). Rearranging, the value of (R_D) needed to satisfy ($[R_D]^e$) is presented in (A.25).

$$[R_D]^e = P\ R_D + (1-P)\ [g^C]^e \tag{A.24}$$

$$R_D = (1/P)\ [R_D]^e + (1-P)/P * [g^C]^e \tag{A.25}$$

3. The supply of Foreign Credit

The expected return of FC ($[R_{FC}]^e$) is given by that of some alternative foreign asset (R^F) (A.26). Because of the possibility of bank failure $[R_{FC}]^e$ differs from the contractual return demanded by the foreign creditor (R_{FC}) (A.27). (R_{FC}) in (A.28) is obtained replacing (A.26) in (A.27) and rearranging terms.

$$[R_{FC}]^e = R_F \tag{A.26}$$

$$[R_{FC}]^e = P\ R_{FC} + (1-P)\ [g^C]^e \tag{A.27}$$

$$R_{FC} = (1/P)\ (R_F - (1-P)\ [g^C]^e) \tag{A.28}$$

4. Bank intermediation

Bank liabilities in periods 1 and 2, BL_1 and BL_2, are presented in (A.29) and (A.30); bank's assets in-period 2 (G) equal the sum of loan returns (A.31).

$$BL_1 = D + FC \tag{A.29}$$

$$BL_2 = R_D\ D + R_{FC}\,FC \tag{A.30}$$

$$G = \sum_{i=1}^{M} R_i\ L_i\ \Phi_i \tag{A.31}$$

The bank operation is successful if G exceeds BL_2, the probability of this event is P (A.32). f(G) and F[BL_2] represent the density function and the distribution function of loan returns.

$$P = \text{Prob.}\ \left\{G\ O\geqslant\ BL_2\right\} = \int_{BL_2}^{G_{Max}} f(G)\ dG = 1 - F[BL_2] \tag{A.32}$$

Total expected loan returns ($[G]^e$ in A.33) is equal to the sum of expected returns of individual loans and also to the weighted average of expected returns conditional on the events of bank success $[G^N]^e$ and bank failure $[G^C]^e$ (A.33).

$$[G]^e = \sum_{i=1}^{M} R_i\ L_i\ \pi_i = P\,[G^N]^e + (1-P)\ [G^C]^e \tag{A.33}$$

The joint probability of the success of loan "i" and the failure of the bank is q_i (A.34). From Bayes' law q_i is equal to the conditional probability [$\pi_i \setminus G < BL_2$] times the probability of bank failure (1 – P). The joint probability of the success of loan "i" and successful bank operation is $\pi_i - q_i$ in (A.35).

$$q_i = \text{Prob.}\ \left\{\Phi_i = 1, G < BL_2\right\} = (1-P)\ [\pi_i \setminus G < BL_2] \tag{A.34}$$

$$\pi_i - q_i = \text{Prob.}\ \left\{\Phi_i = 1, G \geqslant BL_2\right\} = P\ [\pi_i \setminus G > BL_2] \tag{A.35}$$

Expected loan returns conditional on the events of bank failure (A.36) and bank success (A.37) are obtained using (A.34) and (A.35).

$$[G^C]^e = \sum_{i=1}^{M} R_i\ L_i\ [\pi_i \setminus G < BL_2] = \sum_{i=1}^{M} R_i\ L_i\ q_i/(1-P) \tag{A.36}$$

$$= [g^C]^e\ BL_1$$

$$[G^N]^e = \sum_{i=1}^{M} R_i\ L_i\ [\pi_i \setminus G \geqslant BL_2] = \sum_{i=1}^{M} R_i\ L_i\ (\pi_i - q_i)/P \tag{A.37}$$

Banker's profits (A.38) are equal to the excess of loan returns over bank liabilities if the bank succeeds and to zero if the bank fails. Expected bank profits (A.39) are obtained replacing (A.37) into (A.38).

$$BP = \left\{G^N - BL_2,\ 0;\quad P,\ 1-P\right\} \tag{A.38}$$

$$[BP]^e = \sum_{i=1}^{M} R_i\ L_i\ (\pi_i - q_i) - [BL_2]^e \tag{A.39}$$

$$[BL_2]^e = P\ BL_2 \tag{A.40}$$

The maximization of (A.39), assuming that the representative bank is competitive and subject to (A.43) yields the first order conditions for the general case, equations (A.41) and (A.42).

$$R_i\ (\pi_i - q_i) = \frac{d\,[BL_2]^e}{d\,L_i} + \frac{d\,[BL_2]^e}{d\,D} \tag{A.41}$$

$$\frac{d\,[BL_2]^e}{d\,D} = \frac{d\,[BL_2]^e}{d\,FC} \tag{A.42}$$

$$\sum_{i=1}^{M} L_i = BL_1 = (D + FC) \tag{A.43}$$

The partial derivatives of expected bank liabilities ($[BL_2]^e$) in (A.40) are presented in equations (A.44) through (A.46). Where P_i, P_D, and P_{FC} are the marginal effects of type "i" loans, deposits, and foreign credit on the probability of bank success.

$$\frac{d\,[BL_2]^e}{d\,L_i} = P_i\,BL_2 + P\,D\,\frac{dR_D}{d\,L_i} + P\,FC\,\frac{dR_{FC}}{d\,L_i} \qquad (A.44)$$

$$\frac{d\,[BL_2]^e}{d\,D} = P_D\,BL_2 + P\,D\,\frac{dR_D}{d\,D} + P\,FC\,\frac{dR_{FC}}{d\,D} + P\,R_D \qquad (A.45)$$

$$\frac{d\,[BL_2]^e}{d\,FC} = P_{FC}\,BL_2 + P\,D\,\frac{dR_D}{d\,FC} + P\,FC\,\frac{dR_{FC}}{d\,FC} + P\,R_{FC} \qquad (A.46)$$

5. Solution under laissez-faire

Under laissez-faire bank liabilities are not insured. The partial derivatives of R_D with respect to type "i" loans (A.47), deposits (A.48), and foreign credit (A.49) are obtained from equation (A.25). Because of competition it is assumed that actions of a particular bank do not affect $[R_D]^e$.

$$\frac{d\,R_D}{d\,L_i} = (1/P^2)\left\{P_i\,([g^C]^e - [R_D]^e) - P\,(1-P)\,\frac{d\,[g^C]^e}{d\,L_i}\right\} \qquad (A.47)$$

$$\frac{d\,R_D}{d\,D} = (1/P^2)\left\{P_D\,([g^C]^e - [R_D]^e) - P\,(1-P)\,\frac{d\,[g^C]^e}{d\,D}\right\} \qquad (A.48)$$

$$\frac{d\,R_D}{d\,FC} = (1/P^2)\left\{P_{FC}\,([g^C]^e - [R_D]^e) - P\,(1-P)\,\frac{d\,[g^C]^e}{d\,FC}\right\} \qquad (A.49)$$

The partial derivatives of R_{FC} with respect to type "i" loans (A.50), deposits (A.51), and foreign credit (A.52) are obtained using equation (A.28). It is assumed that bank decisions de not affect $[R_{FC}]^e$

$$\frac{d\,R_{FC-}}{d\,L_i} = (1/P^2)\left\{P_i\,([g^C]^e - [R_{FC}]^e) - P\,(1-P)\,\frac{d\,[g^C]^e}{d\,L_i}\right\} \qquad (A.50)$$

$$\frac{d\,R_{FC-}}{d\,D} = (1/P^2)\left\{P_D\,([g^C]^e - [R_{FC}]^e - P\,(1-P)\,\frac{d\,[g^C]^e}{d\,D}\right\} \qquad (A.51)$$

$$\frac{d\,R_{FC-}}{d\,FC} = (1/P^2)\left\{P_{FC}\,([g^C]^e - [R_{FC}]^e) - P\,(1-P)\,\frac{d\,[g^C]^e}{d\,FC}\right\} \qquad (A.52)$$

The partial derivatives of $[g^C]^e$ with respect to the decision variables presented in equations (A.53) through (A.55), are obtained using equation (A.36);

$$\frac{d\,[g^C]^e}{d\,L_i} = \frac{R_i\,q_i + [g^C]^e\,P_i\,BL_1}{(1-P)\;BL_1} \qquad (A.53)$$

$$\frac{d\,[g^C]^e}{d\,D} = \frac{[g^C]^e\;\{P_D\;BL_1 - (1-P)\}}{(1-P)\;BL_1} \qquad (A.54)$$

$$\frac{d\,[g^C]^e}{d\,FC} = \frac{[g^C]^e\;\{P_{FC}\;BL_1 - (1-P)\}}{(1-P)\;BL_1} \qquad (A.55)$$

The marginal effect of the decision variables on R_D and R_{FC} (equations A.56 through A.61) are obtained replacing the partial derivatives of $[g^C]^e$, (equations A.53 through A.55), into the partial derivatives of R_D (equations A.47 through A.49) and R_{FC} (equations A.50 through A.52).

$$\frac{d\,R_D}{d\,L_i} = (1/P^2)\left\{P\,P_i\,([g^C]^e - R_D)\right. \qquad (A.56)$$
$$\left. - (P/BL_1)\,(R_i\,q_i + P_i\,[g^C]^e\,BL_1)\right\}$$

$$\frac{d\,R_D}{d\,D} = (1/P^2)\left\{(1-P)\;[P_D + P/BL_1]\;[g^C]^e - P_D\;[R_D]^e\right\} \qquad (A.57)$$

$$\frac{d\,R_D}{d\,FC} = (1/P^2)\left\{(1-P)\;[P_{FC} + P/BL_1]\;[g^C]^e - P_{FC}\;[R_D]^e\right\} \qquad (A.58)$$

$$\frac{d\,R_{FC}}{d\,L_i} = (1/P^2)\left\{P\,P_i\;([g^C]^e - R_{FC})\right. \qquad (A.59)$$
$$\left. - (P/BL_1)\,(R_i\,q_i + P_i\;[g^C]^e\,BL_1)\right\}$$

$$\frac{d\,R_{FC}}{d\,D} = (1/P^2)\left\{(1-P)\;[P_D + P/BL_1]\;[g^C]^e - P_D\;[R_{FC}]^e\right\} \qquad (A.60)$$

$$\frac{d\,R_{FC}}{d\,FC} = (1/P^2)\left\{(1-P)\;[P_{FC} + P/BL_1]\;[g^C]^e - P_{FC}\;[R_{FC}]^e\right\} \qquad (A.61)$$

The marginal effect of the decision variables on $[BL_2]^e$ (equations A.62 through A.64) are obtained replacing equations A.56 through A.61 into equations A.44 through A.46.

$$\frac{d\,[BL_2]^e}{d\,L_i} = -R_i\,q_i \qquad (A.62)$$

$$\frac{d\ [BL_2]^e}{d\ D} = P\ R_D + (1-P)\ [g^C]^e \tag{A.63}$$

$$\frac{d\ [BL_2]^e}{d\ FC} = P\ R_{FC} + (1-P)\ [g^C]^e \tag{A.64}$$

The first order conditions (f.o.c.) for the maximization of bank's expected profit under laissez-faire are presented in equations (A.65) and (A.66). They are obtained replacing equations (A.62) through (A.64) into the f.o.c. of bank maximization for the general case (equations A.41 and A.42).

$$R_i\ \pi_i = P\ R_D + (1-P)\ [g_C]^e = [R_D]^e \tag{A.65}$$

$$R_D = R_{FC} \tag{A.66}$$

Using equations A.65 and A.9:

$$f'[K_i]\ \pi_i = [R_D]^e \qquad (i = 1, 2, ..., M) \tag{A.67}$$

6. Solution under full insurance to bank liabilities

Under full insurance of bank liabilities if the bank fails a government transfer would cover bank liabilities, thus expected and contractual returns of bank liabilities are equal.

$$R_D = [R_D]^e \tag{A.68}$$

$$R_{FC} = [R_{FC}]^e \tag{A.69}$$

Using equations A.68 and A.69 in the partial derivatives of bank liabilities in the general case, equations A.44 through A.46.

$$\frac{d\ [BL_2]^e}{d\ L_i} = P_i\ BL_2 \tag{A.70}$$

$$\frac{d\ [BL_2]^e}{d\ D} = P_D\ BL_2 + P\ R_D \tag{A.71}$$

$$\frac{d\ [BL_2]^e}{d\ FC} = P_{FC}\ BL_2 + P\ R_{FC} \tag{A.72}$$

The banker's f.o.c. under full insurance of liabilities (equations A.73 and A.74) are obtained replacing equations A.70 through A.72 into the f.o.c. for the general case (equations A.41 and A.42).

$$R_i\ \pi_i = R_i\ q_i + (P_i + P_D)\ BL_2 + P\ R_D \tag{A.73}$$

$$P_D\ BL_2 + P\ R_D = P_{FC}\ BL_2 + P\ R_{FC} \tag{A.74}$$

Using (A.32) to obtain the marginal effects of D and FC on P the probability of bank success:

$$P_D = -f[BL_2]\ R_D < 0 \tag{A.75}$$

$$P_{FC} = -f[BL_2]\ R_{FC} < 0 \tag{A.76}$$

Replacing A.75 and A.76 into A.74 it can be shown that the second f.o.c. implies the equality of R_D and R_{FC}.

$$R_D = R_{FC} \tag{A.77}$$

The insurance on bank liabilities creates distortions in credit allocation that can be represented by the differences between the expected marginal productivity of capital in each sector and the expected return of deposits. Using equations A.9 and A.73:

$$\pi_i\ f'i[K_i] - [R_D]^e = R_i\ q_i + (P_i + P_D)\ BL_2 - (1-P)\ R_D \tag{A.78}$$

7. Solution with bankruptcy penalty

Under bankruptcy penalty the banker is forced to pay a penalty Z if the bank fails, thus Z must be included in $[BL_2]^e$. The marginal effects of the decision variables on $[BL_2]^e$ are presented in equations A.80 through A. 82.

$$[BL_2]^e = P\ BL_2 + (1-P)\ Z \tag{A.79}$$

$$\frac{d\ [BL_2]^e}{dL_i} = P_i\ (BL_2 - Z) + (1-P)\ \frac{dZ}{dL_i} \tag{A.80}$$

$$\frac{d\ [BL_2]^e}{dD} = P_D\ (BL_2 - Z) + (1-P)\ \frac{dZ}{dD} + PR_D \tag{A.81}$$

$$\frac{d\ [BL_2]^e}{dFC} = P_{FC}\ (BL_2 - Z) + (1-P)\ \frac{dZ}{dFC} + P\ R_{FC} \tag{A.82}$$

The f.o.c. of banker's maximization under bankruptcy penalty (equations A.83 and A.84) are obtained replacing equations (A.80) through (A.82) into the f.o.c. of the general case.

$$R_i\ \pi_i = R_i\ q_i + (P_i + P_D)\ (BL_2 - Z) + P\ R_D + (1-P)\ \left(\frac{dZ}{dL_i} + \frac{dZ}{dD}\right) \tag{A.83}$$

$$P_D(BL_2 - Z) + PR_D + (1-P)\ \frac{dZ}{dD} = P_{FC}(BL_2 - Z) + P\ R_{FC} + (1-P)\ \frac{dZ}{dFC} \tag{A.84}$$

The optimal bankruptcy penalty (Z*) in (A.85) is equal to the expected short fall of loan return to bank liabilities conditional on the event of bankruptcy. Z* changes with the decision variables (equations (A.86) through (A.88)).

$$Z^* = BL_2 - \sum q_i R_i L_i/(1-P) \tag{A.85}$$

$$\frac{dZ^*}{dL_i} = q_i R_i/(1-P) - P_i \sum_{i=1}^{M} q_i R_i L_i/(1-P)^2 \tag{A.86}$$

$$\frac{dZ^*}{dD} = R_D - P_D \sum_{i=1}^{M} q_i R_i L_i/(1-P)^2 \tag{A.87}$$

$$\frac{dZ^*}{dFC} = R_{FC} - P_{FC} \sum_{i=1}^{M} q_i R_i L_i/(1-P)^2 \tag{A.88}$$

The banker's f.o.c. under Z* (equations (A.89) and (A.90)) are obtained replacing equations (A.86) through (A.88) into the f.o.c. for a general Z (equations A.83 and A.84).

$$R_i \pi_i = R_D \tag{A.89}$$

$$R_D = R_{FC} \tag{A.90}$$

8. Solution with insurance premium

The banker must pay during the first period an insurance premium (W) for each unit of BL_1. Thus, the banker's constraint becomes equation (A.93). The f.o.c. are presented in (A.92) and (A.93).

$$R_i (\pi_i - q_i) - P_i BL_2 = (P_D BL_2 + P R_D) \Omega \tag{A.91}$$

$$P_D BL_2 + P R_D = (P_{FC} BL_2 + P R_{FC}) \epsilon \tag{A.92}$$

$$\Sigma L_i = (1-w) BL_1 \tag{A.93}$$

The variables Ω and ϵ result from the imposition of the premium w.

$$\Omega = \frac{1 - BL_1 \left\{d(1-w)/dL_i\right\}}{(1-w) + D \left\{d(1-w)/dD\right\} + \left\{d(1-w)/dFC\right\}} \tag{A.94}$$

$$\epsilon = \frac{(1-w) + BL_1 \left\{d(1-w)/dD\right\}}{(1-w) + BL_1 \left\{d(1-w)/dFC\right\}} \tag{A.95}$$

Replacing equation A.92, into (A.94), (A.95) and (A.30) and imposing the equality of the rate of return of deposits and foreign credit ($R_D = R_{FC}$):

$$\Omega = \frac{1 - BL_1 \quad [d(1-w)/dL_i]}{(1-w) + BL_1 \ [d(1-w)/dD]} \tag{A.96}$$

$$\epsilon = 1 \tag{A.97}$$

$$BL_1 = BL_2 \ R_D \tag{A.98}$$

The optimal insurance premium (w*) is a "fair" insurance premium on bank liabilities (A.99).

$$w^* = \frac{(1-P) \left\{R_D BL_1 - \Sigma q_i R_i L_i/(1-P)\right\}}{R_D BL_1} \tag{A.99}$$

$$(1-w^*) = \frac{P R_D BL_1 + \Sigma q_i R_i L_i}{R_D \quad BL_1} \tag{A.100}$$

w* changes with changes in the decision variables L_i, D, and FC; differentiating (A.100):

$$\frac{d(1-w^*)}{dL_i} = \frac{R_D BL_1 (P_i R_D BL_1 + q_i R_i)}{(R_D BL_1)^2} \tag{A.101}$$

$$\frac{d(1-w^*)}{dD} = \frac{R_D BL_1 (P_D R_D BL_1 + P R_D) - (PR_D BL_1 + \Sigma q_i R_i L_i)}{(R_D BL_1)^2} \tag{A.102}$$

$$\frac{d(1-w^*)}{dFC} = \frac{R_D BL_1 (P_{FC} R_D BL_1 + P R_D) - (R_D (PR_D BL_1 + \Sigma q_i R_i L_i)}{(R_D BL_1)^2} \tag{A.103}$$

Replacing (A.101) and (A.102) into (A.96):

$$\Omega = \Omega^* = \frac{R_D - R_i q_i - P_i BL_2}{P_D BL_2 + PR_D} \tag{A.104}$$

The banker's f.o.c. under an optimal insurance premium (equations A.104 through A.106) are obtained replacing equation A.104 and A.97 into the f.o.c. for a general w (equations A.91 through A.93).

$$R_i \pi_i = R_D \tag{A.105}$$

$$R_D = R_{FC} \tag{A.106}$$

$$\Sigma L_i = P BL_1 + \Sigma q_i R_i L_i/R_D \tag{A.107}$$

Appendix: List of variables

ARA	:	Absolute risk aversion evaluated at the value of expected consumption.
BL_t	:	Bank liabilities in period t (t = 1, 2); $[BL_2]^e$ expected value in period 2.
BP	:	Bank profits, $[BP]^e$ expected value.
C_t	:	Consumption (t = 1, 2); $[C_t]^e$ expected value and S^2 $[C_t]$ variance.
D	:	Deposits.
F	:	Foreign assets.
FC	:	Foreign credit obtained by the domestic bank.
FP_i	:	Profits of the individual firm.
f(G)	:	Density function of loan returns. F[G] distribution function.
f_i	:	Production function of firm i. f' and f" represent its first and second derivatives.
G	:	Total loan returns, $[G]^e$ expected value.
$[G^C]^e$	:	Expected loan returns conditional on bank failure.
$[g^C]^e$	:	Expected rate of return of deposits conditional on bank failure.
$[G^N]^e$	:	Expected loan returns conditional on bank success.
I	:	Non-interest income.
K_i	:	Resource input, working capital.
L_i	:	Loans to firm "i".
MRS	:	Ratio of the marginal utilities of present and expected future consumption.
P	:	Probability of bank success.
P_D	:	Marginal effect of deposits on the probability of bank success.
P_{FC}	:	Marginal effect of foreign credit on the probability of bank success.
P_i	:	Marginal effect of type "i" loans on the probability of bank success.
q_i	:	Joint probability of the success of loan "i" and the failure of the bank.
R_D	:	One plus the contractual rate of return of deposits, $[R_D]^e$ expected value.
R_F	:	One plus the contractual rate of return of foreign assets, $[R_F]^e$ expected value.
R_{FC}	:	Contractual rate of interest paid on foreign credit, $([R_{FC}]^e)$ expected value.
R_i	:	One plus the interest rate charged on loans to firm "i".
$S[C_2]_D$ and $S[C_2]_F$	:	Marginal contributions of D and F to the variance of future consumption.
S_{HH}	:	Variance of the rate of return of asset H.
S_{HJ}	:	Co-variance of the rates of return of assets H and J.
$[U]^e$	:	Expected utility (4.1).
$v(C_t)$	:	Elementary utility function. $v'(C_t)$, $v''(C_t)$ and $v'''(C_t)$ are first, second and third derivatives with respect to C_t.
w	:	Insurance premium for each unit of bank liabilities.
w*	:	Optimal insurance premium.
w_1	:	Initial wealth.
Y_i	:	Output of firm i (i = 1, 2, ..., M).

Z	:	Bankruptcy penalty to be paid by the banker.
Z*	:	Optimal bankruptcy penalty.
δ	:	The rate of time preference.
Φ_i	:	Firm specific supply shock with expected value $[\Phi_i]^e$, variance $S^2[\Phi_i]$ and co-variance with Φ_j $S[\Phi_i, \Phi_j]$.
π_i	:	Probability of success of the production process of firm "i".

Footnotes

1 Historical descriptions of financial crises can be found in Kindleberger (1978), and Kindleberger and Laffargue (1982). Theoretical interpretations of some aspects of financial crises can be found in Bernanke (1983), Flood and Garber (1981). Diamond and Dybvig (1983) and Minsky (1982). A survey on the subject is presented in LeFort and Vial (1987).

2 Financial crises in developing countries are analyzed in Diaz Alejandro (1985) and Massad and Zahler (1988).

3 Consider for example the cases of the Southern Cone Countries during the early 1980s when several banks technically failed and were bailed out by the corresponding Central Bank. For details on the Argentinean financial crisis, see Balino (1987) and Fernandez (1983). For the Chilean case, see, for example, Barandiaran (1983), and Velasco (1988).

4 According to the real business cycle theory, King and Plosser (1984), recessions and financial crises jointly result from negative productivity shocks.

5 The monetarist explanation of financial crisis popularized by Friedman and Schwartz (1971) is consistent with this paradigm.

6 See Cavallo (1981), Van Wijnbergen (1983), Buffie (1984) and Blinder and Stiglitz (1983).

7 For an interpretation of economic depressions based on intermediation costs, see Bernanke (1983). For a theoretical analysis of intermediation costs, see Bernanke and Getler (1985).

8 For example the macroeconomic policy inconsistencies affecting the SCCs in the early 1980s resulted in wide swings in the relative price of traded and non-traded goods and generalized bank failures; see Corbo de Melo and Tybout (1986), Edwards (1986), Edwards (1986), and Khan and Zahler (1985).

9 Minisky (1982) presents the financing of units in a market economy evolving, over a cycle, from low risk and liquid financial position (hedge finance) to a risky and fragile position (speculative finance) and finally to an unsustainable financial position (Ponzi finance) that will ultimately collapse into a crisis.

10 A formal analysis of rational speculative bubbles can be found in Blanchard and Watson (1982) and Flood and Garber (1980); the rationality of bank runs is presented in Diamond and Dybvig (1983) and Flood and Garber (1981); finally, Solow (1982) and Doley and Mathieson (1987) discuss the distortions created by deposit insurance schemes.

11 Kindleberger (1978) and Solow (1982) provide examples of government intervention in such cases. Díaz Alejandro (1985) discusses government banking of financial institutions in developing countries.

12 Solow (1982) discusses the moral hazard problem in financial systems where a lender of last resort stands ready to bail out banks in trouble. Zahler and Valdivia (1987) discusses the asymmetries of the risk of financial sector liabilities and assets in developing countries.

13 See Barandiaran (1987) for a discussion on this subject.

14 See Diamond (1984), and Baltensperger (1980).

15 See Diaz-Alejandro (1985).

16 Non-interest income is equal to payments to the providers of inputs. It is assumed that payments to the providers of inputs are executed in the first period and before the results of the production process are known.

17 The expected value of variable X is represented by $[X]^e$, its variance by $S^2[X]$, or S_{XX} and the co-variance of variables X and Z by S_{XZ}. $[R_D]^e$ is the expected rate of return of local deposits and S_{DF} is the co-variance of the returns of local and foreign deposits.

18 The ARA, defined as $ARA = -v''([C2]^e)/v'([C2]^e)$, is the Pratt (1978) degree of absolute risk aversion evaluated at expected consumption level, $v([C2]^e)$ is the elementary utility function evaluated at expected consumption for the second period, $v'[C2]^e$ is the marginal utility, and $v''[C2]^e$ the second derivative.

19 Given by MRS = $v'(C_1)/v'(C^e_2)$, where v'(C1) and $v'([C2]^e)$ represent marginal utility evaluated at the levels of first period consumption and of expected second-period consumption.

20 See the Appendix for details on the derivation.

21 The expected rate of return of deposits conditional on bank failure is equal to the expected return of bank loans conditional on bank failure ($[G^c]^e$) divided by total bank liabilities in the first period (BL1), i.e., $[g^c]^e = [G^c]^e/BL_1$.

22 The supply of foreign credit is upward slopping and backward bending, as in Aizenman (1987), because the probability of bank failure is directly linked to the level of outstanding foreign credit.

23 BL_2 represent, bank liabilities in the second period: $BL_2 = D\,R_D + FC\,R_{FC}$.

24 Expected loan repayments over all possible events ($[G]^e$) can be presented as the weighted average of expected loan repayments conditional on the event of failure ($[G^C]^e$) and no-failure $[G^N]^e$). q_i is the joint probability of bank failure and success of sector "i" production process.

$$[G]^e = \sum_{i=1}^{M} R_i\, L_i\, \pi_i = P\,[G^N]^e + (1-P)\,[G^C]^e$$

Where:

$$[G^C]^e = \sum_{i=1}^{M} R_i\, L_i\, [\pi_i \setminus G < BL_2] = \sum_{i=1}^{M} R_i\, L_i\, q_i/(1-P)$$

$$[G^N]_e = \sum_{i=1}^{M} R_i\, L_i\, [\pi_i \setminus G \geqslant BL_2] = \sum_{i=1}^{M} R_i\, L_i\, (\pi_i - q_i)/P$$

$$q_i = \text{Prob}\,\{\Phi_i = 1,\ G < BL_2\} = (1-P)\,[\pi_i \setminus G < BL_2]$$

25 Here f(BP) represents the density function and F(BP) the probability distribution function of bank profits.

26 In this system an increase in the rate of return of deposits (R_D) can, up to a certain point, compensate for higher risk. Above a critical R_D level, the supply of deposits is backward bending and deposits fall as R_D increases. The supply is backward bending and because an increase in (R_D) also leads to a reduction in P, the probability of no-failure, and this second effect becomes dominant for lower levels of P.

27 These first order conditions imply: $f'[K_i]\,\pi_i = [R_D]^e$ (i = 1, 2, ..., M).

28 In this model, when foreign credit is fully insured the expected return is equal to the contractual return: $R_D = [R_D]^e$; $R_{FC} = [R_{FC}]^e$.

29 This type of reasoning has been used to explain the high interest rates in the Southern Cone countries during the late 1970's early 1980's. See Zahler and Valdivia (1987).

30 A bankruptcy penalty could also take the form of non-pecuniary costs to be born by the banker in the event of bank failure. These include the loss of reputation and legal actions against the banker.

31 The value of Ω in equation (22) depends on the marginal response of the premium to changes in the level of deposits and in the composition of the loan portfolio. If the premium is constant then: $\Omega = 1/(1-w)$.

32 See equation (20); details of the derivation are presented in the Appendix.

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DYNAMICS OF INVESTMENT AND GROWTH IN DEVELOPING COUNTRIES DURING THE 1980s

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Abstract:

Since the outbreak of the debt crisis in 1982 growth and investment in developing countries have been persistently low by historical standards. Most of the adjustment processes undertaken during the 1980s included strong devaluations and fiscal adjustment relying heavily on lower public investment. The assessment of the consistency of these policies with expected increases in private investment and growth has been based up to now mainly on static cross-country models that show contradictory results, specially with regard to the role of foreign debt, the real exchange rate, and public investment.
This paper discusses why static approaches are inappropriate for an essentially dynamic problem and proposes the estimation of a VAR-panel data model which may help clarify the relations between private investment and growth. The simulations of growth and investment responses to changes in the real exchange rate and the level of public investment show that dynamic responses through lagged effects differ substantially from what available static models suggest.

I. Introduction

Since the outbreak of the debt crisis in 1982, and its sequel of low growth and low investment in developing countries, there has been a renewed interest in what determines investment –specifically, private investment– and to what extent output growth depends on high rates of private and/or public investment. The question, of course, is crucial not

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