AN EMPIRICAL EXAMINATION OF THE ROLE OF FINANCIAL CONGLOMERATES IN THE BANKING CRISIS OF A RECENTLY LIBERALIZED DEVELOPING COUNTRY: THE CASE OF JAMAICA

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ABSTRACT

In the final three decades of the 20th century many developing economies liberalized their financial systems, without strengthening their weak regulatory structure, and experienced periods of financial distress. One such country was Jamaica. I estimate the determinants of the 1996/97 Jamaican banking crisis using survival analysis and conditional "fixed effects" logit models. Estimation is based on the Gonzalez-Hermosillo (1996) theoretical framework, which I extend to include the role of financial conglomerates, and the business cycle in precipitating bank distress.

In this paper, I examine the role of financial conglomerates in the Jamaican regulatory authorities' bank intervention decision. The exploration of the explicit role of financial conglomerates in influencing the bank 'intervention rule' is absent from the bank distress literature. Expectations that regulators would consider financial conglomerates "too big to fail" out of fear of inducing a systemic crisis, coupled with the low regulatory requirements in the non-bank financial sector, constituted an implicit loan guarantee. This encouraged an expansion of unsecured credit by commercial banks to their non-performing affiliate insurance companies, increasing the banks' exposure to financial contagion. Regulators subsequently closed these insolvent insurance companies; resulting in a spillover of debt obligations to affiliate commercial banks to the point where the present value of their liabilities was judged by regulators to exceed the recoverable value of assets. Overall econometric evidence confirms that the decision to intervene, based on the 'official' insolvency of the bank, was inclusive of information on the insolvency of other companies that were owned by the same conglomerate.

The large banks that failed were affiliated with extensive financial conglomerates that included at least one insurance company. When the role of financial conglomerates are not explicitly taken into account, I find evidence inconsistent with the practice of "too big to fail" policies of regulatory authorities in their relationship with large banks. This is evident in terms of a significant negative coefficient on the 'asset size' variable of the bank 'survival time until intervention' model. The opposite effect is typical of bank intervention models found in the literature. This effect disappears when the role of financial conglomerates is explicitly taken into account in estimation. However, the bank 'survival time until insolvency' model confirmed prior expectations that large banks were able exploit their inherent advantages to defer their own insolvency. Moreover, results from the estimation of "early warning" models of bank distress provide empirical evidence that larger banks experienced a lower probability of bank fragility. Further empirical support from auxiliary regressions reveal that larger domestic banks were better 'performers' and less risky, in terms of financial ratios. The study contains general implications that point to the need for strict monitoring of bank-affiliated financial conglomerates by regulators.

[1] I wish to thank the Central Bank of Jamaica for providing the data used in this paper. I benefited greatly from many helpful suggestions and discussions with Barry Ickes. I am also grateful to David Abler, Eric Bond, Ed Coulson and Neil Wallace for very helpful comments and discussions.

1. Introduction.

In the final three decades of the 20th century many developing economies liberalized their financial systems, without strengthening their weak regulatory structure, and experienced periods of financial distress. One such country was Jamaica.

During the 1986 to 1991 period, the Jamaican government undertook a program of financial liberalization. The financial reform and liberalization process had far reaching implications for the development of the Jamaican financial structure. Not only was a more practical financial system created but also the process was, in large part, responsible for the emergence and increasingly important role of financial groups in the late 1980s and early 1990s. A key phenomenon of the Jamaican financial liberalization process was the dramatic expansion in the number of bank-affiliated financial conglomerates. These groups typically included more than one type of deposit-taking institution as well as an insurance company, and offered a wide range of financial and non-financial services. In this paper, I examine the role of financial conglomerates in the Jamaican regulatory authorities' bank intervention decision.[2] The exploration of the explicit role of financial conglomerates in influencing the regulator's bank 'intervention rule' is absent from the bank distress literature.

Prior to the crisis, the banking system was the most heavily regulated financial sub-sector in the form of higher reserve, tax and capital requirements, and stricter supervision compared to all non-bank financial institutions. The existence of arbitrage opportunities arising from regulatory loopholes that widened following financial liberalization, forced commercial banks to circumvent their tighter restrictions by joining financial conglomerates. The profitable reciprocal relationship that developed among the financial institutions controlled by the same conglomerate resulted in a dramatic expansion in the asset size of both banks[3] and their affiliate companies. Non-bank financial institutions, particularly insurance companies, remained *de facto* unregulated, leading to severe moral hazard problems. These institutions engaged heavily in risky activities. Over-investment in real estate by bank-affiliated insurance companies resulted in an asset price bubble. The subsequent bursting of the bubble significantly deteriorated the asset side of their balance sheets.

Expectations that regulators would consider financial conglomerates "too big to fail" out of fear of inducing a systemic crisis, coupled with the low regulatory requirements in the non-bank financial sector, constituted an implicit loan guarantee. This encouraged an expansion of unsecured credit by commercial banks to their non-performing affiliate insurance companies increasing the banks' exposure to financial contagion. Regulators subsequently closed these insolvent insurance companies; resulting in a

[2] Intervention, in this case, encompasses bank closure and/or takeovers undertaken by a government-appointed institution.

[3] The average annual asset growth rate for commercial banks over the 1986 to 1991 period was 28 percent. This increased to 52 percent over the 1991 to 1994 period.

spillover of debt obligations to affiliate commercial banks to the point the present value of their liabilities was judged by regulators to exceed the recoverable value of assets.

However, examples of "too big to fail" policies in the bank distress literature have been limited mainly to the role of large banks in the regulator's bank intervention decision. That is, that "too-big-to-fail" policies enjoyed by large banks, result in a moral hazard problem. Consistent with this story, overconfidence in terms of the expected survival length of large banks develops, that deter depositors from withdrawing funds, and creditors from recalling loans, even when the financial conditions of these banks are weak. This has implications for the choice of econometric methodology used to uncover the determinants of the bank intervention decision.

In this paper, I construct a panel data set containing: key financial ratios, that provide idiosyncratic information on the fundamentals of Jamaican commercial banks, garnered from individual bank balance sheets and profit and loss statements provided by the Central Bank of Jamaica; as well as aggregate data that reveal the macroeconomic environment over the sample period. I estimate the determinants of the 1996/97 Jamaican banking crisis using survival analysis and conditional "fixed effects" logit models. The methodology used allows for the distinction between the determinants of the probability of bank intervention and bank 'survival time until intervention'; and the probability of bank 'book value' insolvency, and the bank 'survival time until book value insolvency'. The distinction in inference of these bank distress models is important in terms of uncovering the underlying bank 'intervention rule', as well as the repercussions for the financial structure arising from bank intervention. The estimation strategy is based on the Gonzalez-Hermosillo (1996) theoretical framework for assessing banking system distress, which I argue is ideal for use in the case of banking distress following financial liberalization. I extend the theoretical framework to include the role of financial conglomerates, along with the business cycle, in precipitating bank distress.

It is interesting to determine whether the factors that led to bank intervention had a similar impact on banking sector fragility. Thus, I estimate the determinants of bank fragility, as defined by the ratio of non-performing loans to total loans of individual banks exceeding 10 percent (fragility), and 20 percent (significant fragility) threshold values. Additionally, I estimate the determinants of a more general measure of bank fragility, in terms of the sum of capital plus provisions for loan losses minus nonperforming loans, normalized by total assets, declining below a zero threshold level. These new types of state variables also serve as ex-ante indicators of bank distress. Finally, I construct ex-post and ex-ante indices of overall banking system distress using the coefficients estimated in the bank distress and fragility models.

Examples in the literature, collectively provide further incentives of regulators to defer the intervention of large banks, such as, the relative ease of larger banks to raise new capital, alleviate

illiquidity, and diversify risk. In light of this, the estimates of the bank 'survival time until insolvency' model confirmed prior expectations that large banks were able exploit their inherent advantages to defer their own insolvency. Moreover, the results from auxiliary regressions reveal that larger banks were better 'performers' and less risky, in terms of financial ratios. This supports the results from the fragility models that provide evidence that large banks experienced a lower probability of fragility compared to smaller banks.

However, econometric evidence from the bank intervention models confirms that the decision to intervene, based on the 'official' insolvency of the bank, was inclusive of information on the insolvency of other companies that were owned by the same conglomerate. [4] The large banks that failed were affiliated with extensive financial conglomerates that included at least one insurance company. Consequently, I find evidence inconsistent with the practice of "too big to fail" policies of regulatory authorities in their relationship with large banks, in terms of a significant negative coefficient on the "asset size" variable of both the bank 'survival time until intervention' and probability of bank intervention models when the role of financial conglomerates is not taken into account. The opposite effect is typical of bank intervention models found in the literature. This effect disappears when the role of financial conglomerates is explicitly taken into account in estimation. In this case, I find evidence that only large banks that are affiliated with failed insurance companies have a shorter survival time until intervention. The study contains general implications that point to the need for strict monitoring of bank-affiliated financial conglomerates by regulators.

The rest of the paper is organized as follows. Section 2 gives a brief synopsis of the recent Jamaican financial crisis. Section 3 provides a brief survey and the current issues of the bank distress empirical literature. Section 4 presents the 'bank distress' model, and the empirical methodology is described in section 5. Section 6 discusses the data and expected results. The empirical results are presented in section 7, followed by a brief description of the methodology used to construct the banking system fragility indices in section 8. Section 9 provides some concluding remarks.

[4] The first example of this occurred in the case of a merchant bank at the beginning of the crisis period. Privy Council Appeal (PCA) No. 52 of 1997 (1998) revealed that the Jamaican authorities had (correctly) closed a solvent merchant bank given the insolvencies of a commercial bank and building society that existed under the umbrella of the same financial conglomerate. This document further disclosed that Jamaican authorities were justified in intervening speedily and without advance warning so as to reduce the risk of a bank run which would destroy any process of reconstruction. Additionally, delaying the closure of all the organizations within the conglomerate, may have increased the "risk that directors or other insiders, who have been responsible for unsound practices, may destroy incriminating records" (PCA No. 52 of 1997, Judgment delivered by Lord Steyn, 1998).

2. The Jamaican Financial Crisis.

In an effort to stimulate market-driven growth and development, the Jamaican government undertook a program of economic reform and stabilization during the 1986 to 1991 period.[5] Prior to this, the financial sector and the capital account in Jamaica were heavily regulated. These regulations were motivated largely by deteriorating foreign exchange reserves and persistent balance of payments and inflationary pressures. Credit ceilings and other selective credit controls were implemented on the banking system, in an attempt to restrict an expanding money supply, which exacerbated these problems. At the same time, very strict capital account controls were maintained for the purpose of curbing the unsustainable capital outflows as well insulating the domestic financial sector from its destabilizing effect. However, these restrictions proved ineffective as the pressure on inflation and the capital account intensified. In 1985, the central bank embarked on program of financial sector deregulation with the broad objective of economic growth via an environment of low inflation and exchange rate stability. Consistent with this policy stance, the "Financial Sector Reform Program" culminated with the elimination of foreign exchange controls in 1991.

The macro-environment immediately following financial sector deregulation spurred an expansion in the financial sector, magnified by the existence of regulatory loopholes, leading to a boom in asset prices and a shift in the composition of loan portfolios to more risky ventures. During this period, controls on capital inflows and outflows were removed and the foreign exchange rate was freed. Cushioned from exposure to risk by implicit deposit insurance from the Jamaican government and protection by the IMF in its role as 'international lender of the last resort', high domestic interest rates attracted foreign exchange inflows into the nation's banks. Another incentive for capital inflows was the long-preserved policy objective of the Jamaican government to maintain relative exchange rate stability in order to encourage foreign investment.

However, as is the story of many developing countries, financial liberalization occurred without providing an adequate regulatory and supervisory framework. This exacerbated the usual problems of adverse selection and moral hazard that are associated with financial markets. In particular, this encouraged excessive risk-taking by domestically controlled financial institutions, lacking the appropriately trained credit officers and risk-management systems, fuelled by a dramatic increase in lending and deposits.

The banking system is the most heavily regulated financial sub-sector in the form of higher reserve, tax and capital requirements, and stricter supervision compared to the fast growing near-banks and non-bank financial institutions. However, banks were able to circumvent their restrictions because of the absence of Jamaican laws preventing the formation of financial conglomerates, which usually

included at least one type of non-bank. Financial conglomerates were specifically designed to exploit opportunities for avoiding limitations in the operations of their individual components. These opportunities for regulatory arbitrage included mainly different tax, reserve and supervisory requirements according to the type of financial institution. This was particularly evident in the case of the poorly regulated insurance companies. Especially during the periods of high inflation that began to develop during the liberalization period, these companies used 'deposit-like' short-term liabilities to fund long-term assets in real estate related activities, such as hotel development. Insurance companies also competed heavily with merchant banks by entering the inflation-fed lease financing market.

Merchant banks experienced the most rapid growth within the sector over the liberalization period, as a result of its minimal requirements for entry in terms of capital, credit and investments. Furthermore, the reciprocal relationship that developed between commercial banks and merchant banks fuelled the growth in both institutions. Commercial banks indirectly increased their longer-term deposit base by channeling their deposits to subsidiary merchant banks, which had lower reserve requirements. Also, commercial banks concentrated on their comparative advantage in obtaining checking accounts and low-interest savings accounts while merchant banks granted term loans using shorter-term funds sourced from commercial banks. Moreover merchant banks were involved heavily in the booming lease financing market until facing intense competition from the life insurance industry. However, they maintained their vulnerability to a deflation in assets prices by engaging in consortium financing for hotel developments.[6]

Furthermore, an increase in reserve requirements for near-banks in 1990 and 1991 precipitated a dramatic rise in the number of building societies, at the expense of other financial institutions. Among the advantages of this type of institution included the absence of reserve, and withholding tax requirements, as well as lower capital, corporate tax and lending requirements (relative to commercial and merchant banks). This was a direct consequence of the fact that the activities of building societies were not subject to the supervision of an independent agency prior to 1994. Instead the relatively weak prudential standards were dictated by the Building Societies Association, which was controlled by the building societies themselves.

Financial sector liberalization, coupled with the exchange rate deregulation, allowed a massive speculative attack resulting in a substantial depreciation of the Jamaican dollar in the early 1990s. Further increases to the already high domestic interest rates could do little to curb the continued movement of the exchange rate towards reflecting the economy's fundamentals. Instead, the high interest rate environment had a significant negative impact on the financial sector by accentuating the maturity mismatch between assets and liabilities experienced particularly by banks and insurance companies. During this high interest

[5] Hereafter referred to as the liberalization period.
[6] See Chen-Young (1998).

rate period, banks engaged further in 'connected party' lending to insurance companies to finance interest payments on short-term deposits, increasing the banks' exposure to financial contagion (see figure 1). This exerted additional pressure on the deteriorating bank balance sheets by increasing the riskiness of their loan portfolios.

As a consequence of the increase in capital inflows immediately following exchange rate deregulation, foreign currency denominated assets grew substantially, which consisted largely of bank loans for hotel development and manufacturing. However, the construction and manufacturing sectors recorded overall negative growth between 1990 and 1997. An economic downturn between 1990 and 1995, coupled with sudden contraction in inflation orchestrated by the monetary authorities in the mid-1990s, re-enforced an asset price 'bust' and initiated the collapse of the financial system. In light of this, although it is generally recognized that the underlying cause of the crises was microeconomic, the macro-environment certainly exacerbated the internal troubles of many of financial institutions. Especially following financial liberalization, the macro environment dictated the profit opportunities available to the financial sector and significantly transformed the way the nation's savings were intermediated.

In January 1997, the Government of Jamaica established the Financial sector Adjustment Company (FINSAC) to resolve the serious problems faced by the financial sector. After its institution FINSAC began a three-phased agenda to address the problems, which included: a recapitalization of illiquid or insolvent institutions, along with the acquisition of ownership; the rationalization and restructuring of the failed institutions; and finally, the divestment of FINSAC's acquired assets.[7] The primary reason for bank intervention was to reduce the risk of financial contagion of banks by insurance companies. Thus the failed insurance companies were required to divest to FINSAC their ownership in commercial banks. Further, the debt obligations of insurance companies were purchased by FINSAC. The failure of the first bank-affiliated financial conglomerate occurred in July 1996. The initial announcement by the government was a 90 percent limit on depositor payouts on accounts not exceeding J$100,000 (US$2,500), and zero otherwise. This led to deterioration in confidence of the health the banking sector. Intervention was a costly activity. As of April 1998, the monetary cost of bank invention to FINSAC was almost 25 percent of GDP.[8] The question that remains following the collapse of the domestic financial sector, as in the case of many banking crises around the world, is whether or not the use of the particular regulator's bank 'intervention rule' was justified. Specifically, controversy usually centers on whether or not regulators employed "too big to fail" policies in their intervention decision.

[7] See Ministry Paper No. 13/98.
[8] See IMF (1999).

3. Literature Survey and Current Issues.

Banks play a key role in monetary policy, the facilitation of credit to productive activities, and as the repository of the nations savings, among other things. In this light, banks are essential for a well-functioning economy. Thus, fragility in the banking system would undoubtedly serve to undermine public confidence in other financial sectors. A wealth of evidence exists that show a strong positive relationship between financial development and future economic growth.[9] However, the occurrence of banking crises exacerbates this relationship, deteriorating the ability of the financial system to effectively channel funds to economic agents with the most promising investment opportunities.[10] Specifically, a failing financial system will lead to a higher cost of funds and restrictions in its supply, thereby retarding economic growth.

The increased frequency of banking crises worldwide, especially within the last two decades, has resulted in a dramatic rise in the number of proposals by researchers and regulators alike, to measure the riskiness of the banking sector, as well as the soundness of individual banks. Given the abrupt nature in which bank contagion manifests itself, as evidenced in the severe banking crises of the 1980s and 1990s, regulators find it increasingly necessary to forecast potential bank crises with a reasonable degree of accuracy within an acceptable lead time. In this regard, traditional on-site examination techniques, which were mainly relied upon before the current wave of banking crises, proved impractical. Although on-site bank examinations remain the principal tool of investigation, the use of "early warning/failure"[11] models has grown in popularity because of their ability to provide statistical measures of bank distress in a relatively cheap and accurate way. More importantly, these statistical techniques allow for a more formal methodology to predict potential bank distress and within a suitable length of time.[12] Specifically, the financial records of individual banks, namely their balance sheet and income statements, are used to explore the factors that contribute to the probability of future bank distress.

While the use of early warning/failure models became commonplace, the choice of statistical technique utilized by researchers differed. Earlier researchers used both multiple discriminant analysis (MDA) models[13] and standard logit/probit --qualitative response (QR) [14]-- models. However, the use of MDA models for explaining bank distress eventually lost ground to QR models, given the latter's

[9] For a discussion of this, see King and Levine (1993).
[10] See Mishkin (1991a,b; 1999).
[11] Note that failure is defined here to reflect regulatory intervention of a bank.
[12] Early warning/failure models are also used to predict the unsoundness of other types of financial institutions.
[13] See, for example, Sinkey (1975) and Altman (1977).
[14] The following studies are examples of both the early and more recent QR literature: Martin (1977), Avery and Hanweck (1984), Barth, Brumbaugh, Sauerhaft, and Wang (1985), Benston (1985), Thompson (1992), Demirguc-Kunt and Detragiache (1997), Gajewski (1988), Hardy and Pazarbasioglu (1998), Demirguc-Kunt and Detragiache (1999), and Gonzalez-Hermosillo (1999).

superior statistical properties and intuitive appeal.[15] The important advantage of QR models over MDA models is that it reflects a causal relationship between bank soundness and bank characteristics by explicitly conditioning the dependent variable on the explanatory variables; whereas MDA models specifies a joint distribution between these two types of variables.

However, the use of standard logit/probit "early warning/failure" models is not beyond repeal. Although this type of model provides estimates of the probability of failure within a specified period of time, it neglects important information on the length of time a particular bank has survived. Thus, the subsequent use of survival analysis or duration models has been extensive, particularly during the 1980s and 1990s, once it was discovered that these types of models could produce estimates of the probability that a particular bank, depending on its financial condition and/or environment, would survive or fail longer than a specified time interval, given the length of time that it had already survived. In other words, whereas QR models determine the unconditional probability of bank distress, duration models focuses on the conditional probability of bank distress.[16] This additional feature of duration models has been exploited by researchers to generate of a survival profile for individual banks.[17] However, a shared feature of duration models and QR though, is their ability to generate an indicator of the degree of fragility of the banking sector as a whole.[18]

Bank balance sheet and income data provide a wealth of information for regulators to construct a wide variety of financial ratios that may be used to determine the financial condition of individual banks. This information can be included in early warning/failure models to identify the specific factors that cause bank distress. Many of the early warning/failure literature found to date, have focused exclusively on the soundness of U.S. banks.[19] In particular, U.S. regulatory agencies have concentrated on five general categories for examining bank distress, in an effort to undertake a uniform approach to bank examination. These categories cover the individual bank's capital adequacy, asset quality, management, earnings, and liquidity (or CAMEL).[20]As a result most early warning/failure studies (including all of the studies on U.S. institutions) that use bank level data have selected their explanatory variables to proxy the areas of the CAMEL rating system. The typical approach is to begin with a large number of financial ratios and then

[15] See Demirguc-Kunt (1989) for a discussion on the relative strengths and weaknesses of MDA and QR models.
[16] See the following for examples of the application of duration models of bank distress: Lane, Looney and Wansley (1986), Whalen (1991), Weelock and Wilson (1994), Cole and Gunther (1995), Gonzales-Hermosillo (1996), Gonzales-Hermosillo, Pazarbasioglu, and Billings (1997), and Gonzales-Hermosillo (1999).
[17] See, for example, Lane, Looney and Wansley (1986) and Whalen (1991).
[18] See, for example, Gonzales-Hermisillo, Pazarbasioglu, and Billings (1997).
[19] See, for example, Sinkey (1975), Altman (1977), Martin (1977), Avery and Hanweck (1984), Barth et al (1985), Benston (1985) Lane, Looney and Wansley (1986), Gajewski (1988), Whalen (1991), Thompson (1992), Wheelock and Wilson (1994), Cole and Gunther (1995).
[20] The categories are commonly identified in the literature by the acronym CAMEL.

use a stepwise procedure to obtain the optimal subset of variables, within the confines of the particular data set.

The role of macroeconomic determinants of bank distress/failure, however, has only recently received serious attention in the "early warning/failure" literature.[21] A possible explanation for this, apart from the difficulty of obtaining bank-specific data, is that prior to the 1980s, most bank failures were due to idiosyncratic financial weaknesses and, also, were not considered contagious. Moreover, many of the early cases of bank failures occurred during favorable economic climates. At the other end of the spectrum, the recent literature that focuses entirely on the macroeconomic determinants, have failed to explain why only a subset of the banking sector would fail even though all banks are hit by the same adverse macroeconomic shock.[22] Nevertheless, these studies that focus on the macroeconomic causes of bank fragility have generally found strong evidence that supports a negative relationship between bank soundness and a deteriorating macroeconomic environment. It is important to add though, that these studies have been primarily concerned with explaining bank failure during episodes of crises.

The optimal approach to investigating bank soundness would seem to require the use of both microeconomic and macroeconomic explanatory variables.[23] However, the relatively few studies that have followed this approach have, on the most part, done so in an adhoc manner. That is, they have utilized individual bank financial ratios (mainly consistent with the CAMEL rating system) along with macroeconomic factors without any formal connection between these two classes of variables. In response, Gonzalez-Hermosillo (1996) introduced a simple model of bank failure that reflects both microeconomic and macroeconomic factors in the context of market, credit and liquidity risks.[24] In addition to providing a formal link between the theoretical and empirical components of early warning/failure models that included both microeconomic and macroeconomic variables, the application of the model offers the advantage of being broadly comparable over different episodes of bank distress.

Additionally, determinants of bank distress are not limited to microeconomic and macroeconomic determinants. Bank fragility and/or bank failure are also affected by various structural factors. For example, the following factors were found in the literature to impact bank distress: the vulnerability of the banking sector to capital outflows[25]; moral hazard created by the existence of explicit or implicit deposit

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[21] Examples of studies that focus on the macroeconomic determinants of bank fragility include: Kaminsky and Reinhart (1996), Demirguc-Kunt and Detriache (1997and 1998), and Hardy and Pazarbasioglu (1998) Demirguc-Kunt and Detriache (1999).

[22] This point is made in Gonzales-Hermosillo (1999).

[23] Studies that undertake this approach include: Gonzales-Hermosillo (1996), Gonzales-Hermosillo et al (1997), Petri (1998), and Gonzales-Hermosillo (1999). Gonzalez-Hermosillo et al (1997) provide evidence that favor the inclusion of both bank specific and macroeconomic variables.

[24] This model is again applied in Gonzales-Hermosillo (1999).

[25] See, Demirguc-Kunt and Detriache (1997). According to Calvo (1996), this factor may be measured by the ratio of M2 to foreign exchange reserves.

insurance[26]and lower franchise values associated with financial liberalization[27]; other measures of financial liberalization, such as, a rising share of private sector credit and high real interest rates[28]; weak law enforcement[29]; and holding company affiliation[30].

Most of the "early warning/failure" literature has failed to distinguish between economic insolvency and bank closure when conducting an empirical analysis of bank distress.[31] While bank closure is considered to reflect official recognition of its economic insolvency, insolvency is not a sufficient condition for bank closure. This is due to existence of various other incentives faced by bank regulators, outside of the realm of bank performance financial ratios.[32] Nevertheless, most studies have underplayed these incentives by modeling the closure decision as a measure of economic insolvency.[33] However, it is critically important to distinguish between studies that model the regulatory screening process (early warning models) versus studies that model the regulatory closure decision process (bank failure models). Studies that employ the same financial ratios to model separately the regulatory screening and the closure decision processes, typically find that the influence of these ratios vary across the models.

A parallel issue, to the one above, concerns the use of empirical methodology to distinguish between the factors influencing the probability of failure versus the timing to failure, and the implications of their differences. Importantly, some studies have modified the standard duration model given its implicit assumption that each bank will ultimately fail, by allowing the probability of failure to be less than one.[34] The intuition here is that the assumption allows for potential model misspecification if the data set contains both sound banks, which are unlikely to fail, along with unsound banks that have failed, or are likely to eventually fail. Furthermore, the probability of bank failure is estimated and then substituted in the survivor function, using the same financial ratios for both specifications, and the differences in the sign and significance of these ratios between the two models are analyzed. However, the potential for misspecification is minimal if a large percentage of banks fail (such as in the case of a severe crisis). Other studies have had success in just estimating a 'standard' duration model, along with a logit model of

[26] Wheelock and Wilson (1994), and Demirguc-Kunt and Detragiache (1997 and 1998).
[27] Demirguc-Kunt and Detragiache (1998).
[28] Demirguc-Kunt and Detriache (1997).
[29] Demirguc-Kunt and Detriache (1997 and 1998).
[30] Gajewski (1988) and Cole and Gunther (1995).
[31] Exceptions include, Gajewski (1988), Demirguc-Kunt (1989 and 1991), and Thompson (1992).
[32] See Kane (1986 and 1989) and Thompson (1992) for a further discussion of these incentives. Thompson (1992) offers empirical evidence against the one-equation bank failure model that fails to distinguish between economic insolvency and closure, when compared to his two-equation model that explicitly makes this distinction.
[33] These incentives are mainly influenced by political, informational and administrative factors. Furthermore, there has been no consensus in the literature as to how to measure these incentives. Also, most of these incentives disappear during a banking crisis.
[34] See, for example, Cole and Gunther (1995) and Gonzalez-Hermosillo et al (1997) for a detailed explanation of this modification.

bank failure, to determine the differences in the factors that impact the likelihood of failure versus the time to failure.

This separation of inference in terms of the 'probability of failure' and 'time to failure', for both 'early warning' models and 'bank failure' models, provide important implications for regulatory decision-making. Apart from determining the factors that influence the likelihood of bank fragility or failure, bank regulators can further identify (possibly separate) factors that allow adequate time for counteractive measures for both types of models.[35] That is, a wealth of information lies in the estimation of these four models, even if the same explanatory variables are used for each specification.

4. Model of Bank Distress.[36]

The model of bank distress used in this study is proposed in Gonzalez-Hermosillo (1996). The basic two-period balance sheet framework represents a formal attempt to integrate the bank-specific and macroeconomic approaches in explaining bank distress. Bank distress fundamentally encompasses liquidity risk, market risk and credit risk. An important advantage of this model, over the traditional CAMEL models of categorizing risk, is that macroeconomic variables (as well as other off-balance sheet items) may also serve as proxies of these three sources of risk. That is, this framework allows for the utilization of the additional information on risk provided by macroeconomic data. This is especially useful when the balance sheet data is limited, such as in the case of the unavailability of information on loans to specific high-risk sectors that are affected by the business cycle.[37] Specifically, the probability of an individual bank becoming unsound at the end of period t is given by the following function:

$$(1) \qquad \Phi_i = \Pr ob(v_i < 0) = \Phi[p_i, q_i, \pi_i],$$

where p_i represents the net present value of the return on bank assets flows realized at the end of period t, q_i denotes the net present value of bank deposit flows realized at the end of period t, and π_i indicates a measure of the level of the capital stock. Economic insolvency is defined here as: $(\pi_i + p_i - q_i) = v_i < 0$.[38]

Equation (1) is generalized to reflect the fundamental sources of risk. Assuming a zero rate of retrieval on non-performing loans, the expected return on assets at the beginning of the period can be

[35] Cole and Gunther (1995), Gonzalez-Hermosillo et al (1997) and Gonzalez-Hermosillo (1999) provide evidence that supports the fact that the determinants of the likelihood of bank failure can differ significantly from the determinants of the time to failure.

[36] The following exposition of the Gonzalez-Hermosillo (1996) model follows closely that of Gonzalez-Hermosillo (1999). In this section, I argue that this framework is especially suitable in the context of banking crises that follow financial liberalization.

[37] As is the case in this study.

[38] These normalized variables represent market (or economic) values.

expressed as a function of market risk, $\alpha^*_i(\Lambda,\Phi_Y)r$ [39], and default (or credit) risk, $\eta_i(\Lambda,r)$ of bank $i's$ portfolio:

$$(2) \qquad p_i = p[\alpha_i^*(\Lambda,\Phi_Y)r, \eta_i(\Lambda,r)], \qquad 0 \le \alpha_i^* \le 1,$$

where r is the realized (exogenous) market return; and $\alpha^*_i(\Lambda,\Phi_Y)$ is the bank's asset portfolio chosen by bank management expressed as a function of the vector of macroeconomic variables, Λ, and the fragility of the overall banking sector, Φ_Y.

The individual bank's deposit flows over a particular period is expressed as:

$$(3) \qquad q_i = q[\delta, (\Phi_i \mid \tau^*(\tau_{\max}, \Phi_Y), \Psi_t)],$$

$$\text{such that } \partial q_i / \partial \Phi_i \mid \Psi_t \to 0 \text{ if } \tau^* \to 1, \forall\, 0 \le \tau^* \le 1,$$

where δ indicates the depositor's exogenous transactions demand, and $(\Phi_i \mid \cdot)$ represents the expected probability that bank i will fail given the anticipated effective level of deposit guarantees, τ^*, and given the information set available at time t, Ψ_t. If an explicit (implicit)[40] deposit insurance scheme exists, $\tau_{\max}$, represents the (expected) maximum level of deposits covered by the deposit insurance program (government).[41] Furthermore, a higher level of overall fragility of the banking sector, Φ_Y, would result in depositors expecting a lower percentage of deposit coverage.

Important implications of the model.

High values of the ratios that measure $\alpha^*_i(\cdot)r$ and $\eta_i(\Lambda,r)$ would be expected to result in a low return on assets for a particular bank during an economic downturn. It is worthy to note, therefore, that following financial liberalization of a developing, market economy, $\alpha^*_i(\cdot)r$ and $\eta_i(\Lambda,r)$ are typically very high.[42] In particular, financial deregulation increases the pool of welfare enhancing projects by allowing the financing of socially desirable high-risk projects, which offer a higher return than previously possible, thereby increasing $\alpha^*_i(\cdot)r$. The resulting surge in risky lending produces inflated asset prices. Thus, when legal restrictions on the financial system are removed, financial intermediaries typically undertake more risky projects, instead of hedging the market risk. Furthermore, it has become

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[39] Note that $\alpha_i^*(\Lambda,\Phi_Y)r \ge 0$. High values of α^* are associated with a high market and liquidity risks.

[40] Note that explicit deposit insurance may be preferable to implicit insurance given the public belief that the deposits of large banks will be completely insured.

[41] This may also represent the expected extent of the IMF's role as the 'international lender of last resort', depending on the level of foreign deposits. Also, in the case of implicit deposit insurance, $\tau_{\max}$ is constrained by factors such as the extent of inflation created by monetizing the deposit liabilities of unsound banks and the state of the country's internal and external accounts.

[42] This outcome adds additional support to the usefulness of macroeconomic variables to proxy for market risk when bank-specific information on market risk is unavailable.

increasingly common in recent decades for financial deregulation to be accompanied by capital account liberalization. This introduces an additional source of risk for the newly market-oriented financial system, as banks are now able to source foreign exchange in international markets to fund domestic borrowers. Massive capital inflows also contribute to the lending-induced asset price bubbles.

Hence, unless financial liberalization is accompanied by an important increase in prudential supervision it may have dire consequences for the health of the financial system. Higher profit opportunities increase entry and competition in the financial system. Financial institutions, especially those in developing economies, may lack the required skilled and experienced staff in managing the emergence of high-risk ventures. The increased risk arises, not only from their existing customers, but also from a greatly expanded new clientele on which limited information is available, reducing the banks' capacity to evaluate these ventures.[43] Additionally, given the potentially high market return, banks themselves have greater incentives to increase their own risky investments in the market, rather than sticking to their traditional role of financial intermediaries. Consequently, a significant decline in the quality of banks' loan portfolio, which follows an inevitable collapse of an asset price bubble, results in a sharp increase in the ratio of non-performing loans as a percentage of total loans. Then, the typically high interest rates and the downturn in the economy that follows a poorly planned financial liberalization process, results in a high risk of defaulted loans, $\eta_i(\cdot)$. Hence, banks with a high α_i^* experience a sharp decline in the net present value of net asset income flows.

Furthermore, this framework has important implications for the role of large banks and financial conglomerates in precipitating a banking crisis. In much the same way that explicit deposit insurance creates a moral hazard problem for bank depositors,[44] the presence of large banks and bank-affiliated financial conglomerates may result in the same effect through their role as a form of *implicit loan and deposit insurance*.[45]

In the case of implicit loan insurance, non-bank financial institutions typically have lower regulatory requirements than banks. Banks' profitability can increase through their affiliation with more risky financial institutions, which attract a higher market return. Banks expect greater regulatory forbearance to be enjoyed by these institutions, given their relatively loose regulatory environment, and thus extend unsecured loans to these companies. However, the typical "connected party" loans associated with financial conglomerates may compromise the economic solvency of banks in the event of an adverse shock.

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[43] See, for example, Gavin and Hausman (1998).
[44] See Merton (1977) and Kareken and Wallace (1978).
[45] Note that explicit deposit insurance may be preferable to implicit insurance given the public belief, in the latter case, that the deposits of large banks will be completely insured.

The case of implicit deposit insurance is as follows. Examples have been given in the literature that show the incentives of regulators to defer the closure of large banks, such as, the relative ease of larger banks to raise new capital,[46] alleviate illiquidity,[47]and diversify risk.[48] Regulators fear that the failure of these large institutions may result in systemic crisis. These advantages of large banks, and similarly, bank-affiliated financial conglomerates, diminish the monitoring incentives of large bank depositors. Overconfidence in terms of the expected likelihood of failure, as well as the length of survival, of large institutions develops, that deter depositors from withdrawing funds, even when the financial conditions of these institutions are weak. Therefore, given "too-big-to-fail" policies of bank regulators toward large banks, increases in the size of banks, which typically occur following financial liberalization and with the formation of financial conglomerates, are expected to increase τ^*. Hence, demand deposits are ineffective in their role as a 'banker-discipline-device', in terms of giving depositors the option to withdraw their funds and thus force bank liquidation. In other words, the public expects the presence of large banks and bank-affiliated financial conglomerates to decrease the likelihood of banking crises.

Extension of the theoretical framework.

The two important drawbacks of the Gonzalez-Hermosillo (1996) model that I allude to above, are that it focuses exclusively on the banking sector, and the role of the business cycle is absent. In this section, I extend the basic theoretical framework to include the role of financial conglomerates, and the business cycle in precipitating bank distress.

Let the size (as influenced by the existence of profitable opportunities) of the financial conglomerate affiliated with bank i be expressed as:

$$(4) \qquad \Theta_i = \Theta[\omega(\Lambda_t)], \quad 0 \le \Theta_i \le 1, \quad 0 \le \Lambda_t \le 1.$$

where ω represents the typically strict exogenous level of regulations on banks relative to non-bank financial institutions, and $\Lambda_t \in [0,1]$ now represents a vector of macroeconomic variables that reflect the current stage of the business cycle. Specifically, $\Lambda_t \in [0, \xi_1]$ corresponds to an economic downturn associated, for example, with the bursting of an asset price bubble, and $\Lambda_t \in [\xi_2, 1]$ corresponds to an economic boom consistent, for example, with the peaking of an asset price bubble, where $0 \le \xi_1 \le \xi_2 \le 1$, and ξ represents some threshold stage.

Given the expansion in profitable opportunities following financial liberalization, it is expected that ω becomes more binding. That is, if the non-bank financial sector remains unregulated, then the opportunities for risky profitable activities during financial liberalization will increase for these

[46] See Avery and Hanweck (1984).
[47] See Barth et al (1985) and Gonzalez-Hermosillo et al (1997).
[48] Gonzalez-Hermosillo et al (1997).

institutions, relative to the banking sector. Thus, banks are forced to circumvent their restrictions by joining financial conglomerates. Further, the wider the gap between the level of regulations of the bank and non-bank financial sector is the greater the potential for profitable reciprocal relationships arising from consolidation. This increases the asset size of the individual components of the financial conglomerate. However, consolidation is also profitable for reasons outside of the specific stage of the business cycle, such as efficiency or scale advantages, such that, $\partial\Theta_i/\partial\omega > 0$ for any $\Lambda_t \in [0,1]$, $\forall i$.

With the inclusion of the role of financial conglomerates, the net present value of the return on asset income flows may be expressed as:

$$(2') \qquad p_i = p[\alpha_i^*(\Lambda_t, \Phi_\gamma, \Theta_i)r, \eta_i(\Lambda_t, r, \Theta_i)], \qquad 0 \le \alpha_i^* \le 1.$$

Using the envelope theorem: $\partial p_i/\partial\omega < 0$ for $\Lambda_t \in [0,\xi_1]$, and $\partial p_i/\partial\omega > 0$ for $\Lambda_t \in [\xi_2,1]$, given that $\partial\alpha_i^*/\partial\Theta_i > 0$ and $\partial\eta_i/\partial\Theta_i > 0$, $\forall i$.[49] The last two inequalities arise from the fact that the more tightly restricted banks provide, sometimes unsecured, loans to non-bank affiliate companies. This is so that they may invest heavily in the market and share the returns, or to rescue them during an economic downturn. Importantly, banks expect longer regulatory forbearance on the part of non-bank financial institutions. That is, the size of the bank-affiliated financial conglomerate, coupled with the low regulatory requirements in the non-bank financial sector, constitutes an implicit loan guarantee. An increase in the size (or profitability) of the conglomerate affiliated with bank i, is interpreted as the bank increasing their market and default risk.

Further, by including the role of financial conglomerates, the net present value of deposit flows may be expressed as:

$$(3') \qquad q_i = q[\delta, (\Phi_i \mid \tau^*(\tau_{\max}, \Phi_\gamma, \Theta_i), \Psi_t), \Theta_i].$$

Using the envelope theorem: $\partial q_i/\partial\omega > 0$ for $\Lambda_t \in [0,\xi_1]$ and $\partial q_i/\partial\omega < 0$ for $\Lambda_t \in [\xi_2,1]$, $\forall i$.[50] In the former case, depositors redirect their funds to the 'safer', more restrictive, banks because of the low profitable opportunities available to the 'risky', 'unregulated' non-bank financial institutions that offer short-term 'deposit-like' instruments. Given $\partial p_i/\partial\omega < 0$ for $\Lambda_t \in [0,\xi_1]$ from equation (2'), this increases the risk of economic insolvency, or $\Pr ob(\pi_i + p_i - q_i) < 0$, for banks affiliated with financial conglomerates during an economic downturn. In the latter case, the 'safer' banks lose deposits to the

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[49] We know that the booms and 'busts' of the business cycle imply: $\partial p_i/\partial\alpha_i^* < 0$ for $\Lambda_t \in [0,\xi_1]$ and $\partial p_i/\partial\alpha_i^* > 0$ for $\Lambda_t \in [\xi_2,1]$, $\forall i$; also $\partial p_i/\partial\eta_i < 0$ for $\Lambda_t \in [0,\xi_1]$ and $\partial p_i/\partial\eta_i > 0$ for $\Lambda_t \in [\xi_2,1]$, $\forall i$.

[50] That is: $\partial q_i/\partial\Theta_i > 0$ for $\Lambda_t \in [0,\xi_1]$ and $\partial q_i/\partial\Theta_i < 0$ for $\Lambda_t \in [\xi_2,1]$, $\forall i$.

'risky' non-bank financial institutions due to the relative expansion in profitable opportunities available to them and the potential for higher return. Given $\partial p_i/\partial\omega > 0$ for $\Lambda_t \in [\xi_2, 1]$ from equation (2'), this decreases the risk of economic insolvency, or $\Pr ob(\pi_i + p_i - q_i) < 0$, for banks affiliated with financial conglomerates during an economic expansion.

However, $\partial\tau^*/\partial\Theta_i > 0$, arises from expectations of "too big to fail" policies. Therefore, $\partial q_i/\partial\omega \mid \Psi_t \to 0$ as $\Theta_i \to 1$. That is, demand deposits are ineffective in their role as a banker-discipline-device, when the size of the bank-affiliated financial conglomerate increases.

The expansion in profitable opportunities that generally follow financial liberalization generally result in sharp increases in the asset size of banks affiliated with financial conglomerates. The implications of this extended framework are that the lower the regulatory requirements on non-bank financial institutions relative to banks, the greater the likelihood that banks affiliated with financial conglomerates will fail during an economic downturn. Moreover, the impact of bank failure is likely to be greater on the depositors in banks affiliated with financial conglomerates, given their expectation of "too big to fail" policies and, thus, their lack of monitoring of bank activities

5. Empirical Methodology.

The extended theoretical framework presented in the previous section contains important 'testable' implications. In particular, it is necessary to separate the influence of large banks versus financial conglomerates in the bank distress and bank fragility estimations in order to determine the existence of "too big to fail" policies. That is, the role of financial conglomerates needs to be explicitly accounted for in estimation. This may have important consequences for the sign of the coefficient on the 'asset size' variable.

According to the theoretical framework, economic insolvency is defined as: $(\pi_i + p_i - q_i) = \nu_i < 0$. In terms of the estimation strategy, economic insolvency may be expressed as a function of a vector of bank characteristics, Z_{it}, including an asset size variable K_{it}, where $\mathrm{Z}_{it} = [\mathrm{K}_{it} \vdots \Omega_{it}]$.[51] Specifically, banks may expect that "too big to fail" policies, coupled with the low regulatory requirements of the non-bank financial sector, will protect them from negative externalities arising from a deterioration in the financial health of their affiliate financial conglomerate. Therefore, in the bank's view the government's intervention decision will be: if $\nu_i < \mu_i \mathrm{K}_{it} + \delta_i \Omega_{it} + \varepsilon_{it}$, then intervene; and if $\nu_i \geq \mu_i \mathrm{K}_{it} + \delta_i \Omega_{it} + \varepsilon_{it}$, then do not intervene.

[51] The relevance of including an asset size variable in the determination of economic insolvency lies partly in the inherent advantages of large banks to raise new capital, alleviate illiquidity, and diversify risk.

However, given an unanticipated policy change in regulatory requirements, arising from an adverse economic shock, the government's intervention decision becomes: if $\nu_i < \gamma_i \mathrm{M}_{it} + \beta_i \mathrm{K}_{it} + \sigma_i \Omega_{it} + \rho_i \mathrm{N}_{it} + u_{it}$, then intervene; if $\nu_i \geq \gamma_i \mathrm{M}_{it} + \beta_i \mathrm{K}_{it} + \sigma_i \Omega_{it} + \rho_i \mathrm{N}_{it} + u_{it}$, do not intervene. $\mathrm{X}_{it} = [\mathrm{M}_{it} : \mathrm{N}_{it}]$ represents the characteristics of the financial conglomerate affiliated with bank i at time t, where M_{it} represents the asset size of the financial conglomerate.

Assuming that: $\mathrm{K}_{it} \propto \mathrm{M}_{it}$, if the government's decision is specified excluding the role of financial conglomerates, following the policy change, then $\mu_i = (\gamma_i + \beta_i)$.[52] In this case, both γ_i and β_i are unidentified. The intuition here is that a positive coefficient on the 'asset size' variable in the bank intervention equation may not reflect "too big to fail" policies directed towards large banks *per se*, but rather banks that are affiliated with financial conglomerates, and vice versa. Therefore, the role of financial conglomerates must be explicitly accounted for in estimation.

Survival time models have long been used to examine phenomena such as the survival time of electrical and mechanical components by engineers and heart transplant and cancer patients in the biomedical sciences.[53] Since its inception in the social sciences, survival analysis has been used extensively by economists to analyze labor supply data. However, in recent years, duration analysis has gained popularity in the prediction of commercial bank failure during periods of banking crises. The characteristic of commercial bank failure data that makes it well suited for this type of analysis is the likelihood of censoring in the data. For the uncensored data in the particular sample, information on the survival time of the duration provides additional information to include in the estimation, along with information on the end of the bank duration.

The dependent variable in the 'time-varying' survival time model is $T_i, i = 1,...,n$, which represents the time until the failure of the i^{th} bank in the sample of n banks. Assume that T is a random variable with continuous probability distribution, $f(t;x)$, where t is a realization of T. Then, the cumulative probability distribution function is

$$(5) \qquad F(t;x) = \int_0 f[(\upsilon), x(t), \beta] d\upsilon = \Pr ob(T < t),$$

where β is a vector of coefficients corresponding to the variable matrix, $x(t)$.[54]

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[52] Note that σ_i and ρ_i may be not be identified if some of the bank characteristics of the bank and the conglomerate are also be correlated.

[53] See, for example, Crowley and Hu (1977).

[54] As evidenced in this study, it is implausible to assume that the values of the explanatory variables are constant over the duration of the observation. In practice, it is likely to be the case that the explanatory variables are a function of time, i.e., $x(t)$.. For further discussion, see Lancaster (1990).

The survivor function, which gives the probability that the bank survives longer than t periods, can be expressed as

$$(6) \qquad S(t;x) = 1 - F(t;x) = \Pr ob(T \geq t).$$

A key question in this study is: given that an individual bank has survived until time t, what is the probability that it will fail in the next period, i.e., within the next three months when using quarterly data? Mathematically, the function used to characterize this particular question is the hazard function or the hazard rate, defined as

$$(7) \qquad \lambda(t;x) = \lim_{dt \to 0} \frac{\Pr ob(t \leq T < t = dt \mid T > t, x)}{dt}$$

$$= \lim_{dt \to 0} \frac{F(t+dt;x) - F(t;x)}{dS(t;x)/dt}$$

$$= \frac{f(t;x)}{S(t;x)},$$

given that $f(t;x) = -S'(t;x) = -dS(t;x)/dt$, it follows that

$$(8) \qquad \lambda(t;x) = -\frac{d \ln S(t;x)}{dt}.$$

The integrated hazard is then

$$(9) \qquad \Lambda(t;x) = \int_0 \lambda[(\upsilon), x(t), \beta] d\upsilon.$$

For practical purposes, the density function of T may be obtained by directly modeling the hazard function instead of the survival function, and then integrating backwards. It is possible to specify a variety of hazard models, according to the assumption made about the distribution of T. The proportional hazard model, developed by Cox (1972), is expressed as

$$(10) \qquad \lambda(t;x) = \lambda_0(t;x) e^{x(t)'\beta},$$

where x is a $K \times 1$ vector of variables of covariates that determine the survival (or failure) time for the banks in the sample. The corresponding survivor function is expressed as

$$(11) \qquad S(t;x) = \exp[-\int_0 \lambda_0[(\upsilon), x(t), \beta] e^{x(t)'\beta} d\upsilon].^{55}$$

The conditional "fixed effects" logit model, developed by Chamberlain (1980), is used to determine the probability of bank fragility in this study. Consider the following model

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[55] The Weibull distribution is used in estimation. In this case, the baseline hazard is specified as: $\lambda_0(t;x) = pt^{p-1}$, where $p > 0$ is obtained from the estimation. The hazard function is increasing in duration if $p > 1$, and decreasing if $p < 1$. The case of $p = 1$ corresponds to the exponential distribution.

$$(12) \qquad prob(y_{it}=1) = F(\beta' x_{it} + \alpha_i), i = 1,...,N; t = 1,...,T)$$

where each of the N banks contains T observations; y_{it} is the dependent variable that equals one in the case of bank distress, and zero otherwise; α_i is a parameter that may vary over banks but remains constant over time; and $F(\,)$ is the cumulative logistic distribution function. The corresponding unconditional log-likelihood function is

$$(13) \qquad L = \sum_{i=1,t=1}^{N,T} \{y_{it} \ln F(\beta' x_{it} + \alpha_i) + (1 - y_{it}) \ln[1 - F(\beta' x_{it} + \alpha_i)]\}$$

where $\sum_{t=1}^{T} y_{it}$ equals the number of periods in which bank i was fragile as defined by the dependent variable.

In contrast to the linear model, the α_i's cannot be estimated. Furthermore, even if these parameters could be estimated, the sample would require a large enough T given the asymptotic consistency property of ML estimators. To account for the heterogeneity, Chamberlain (1980) posits that a consistent estimator of β may be obtained by maximizing the following conditional likelihood function (assuming independence across observations)

$$(14) \qquad L^{cond.} = \sum_{i=1}^{N} \ln[\exp(\beta' \sum_{t=1}^{T} x_{it} y_{it}) \Big/ \sum_{q \in \Omega_i} \exp(\beta' \sum_{t=1}^{T} x_{it} q_t)]$$

where $\Omega_i = \{q = (q_1,...,q_T) \mid q_t = 0 \text{ or } 1 \text{ and } \sum_{t=1}^{T} q_t = \sum_{t=1}^{T} y_{it}\}$. Only $T-1$ alternative sets of Ω_i (excluding sets where $\sum_{t=1}^{T} y_{it} = 0 \text{ or } T$) contribute to the conditional likelihood. In the case of f periods of bank distress during the sample period ending at T, each alternative set has $\binom{T}{f}$ elements. The conditional likelihood function does not depend on the incidental parameters, i.e., the α_i's.

6. Data and Expected Results.

The data used in this study comprises the commercial bank balance sheet and income statements, and specific macroeconomic variables, collected by the Jamaican central bank. The bank-specific sample includes 9 banks (6 domestic and 3 foreign-controlled), which, in fact, represents the entire population of banks during that operated for at least part of the crisis period. Half of the intervened domestic banks

were affiliated with failed insurance companies.[56] The data is recorded on a quarterly basis and covers a nine-year time span, ranging from the first quarter of 1989 to the first quarter of 1998, and thus includes the 1996 to 1998 crisis period. Thus covering the last two years of the financial liberalization period, and the first 6 years of the post-liberalization period. Five of the banks in the data set are right-censored and all, but one, of the banks are left-censored.[57] Also, following the crisis period, none of the failed banks were reinstated in the banking sector. Additionally, although all, but one, of the interventions occurred before the last quarter of the sample period, the subsequent forced mergers[58] and involuntary closures were all completed after the sample period.

The use of both macroeconomic and bank-specific variables as explanatory variables holds certain advantages. Whereas macroeconomic data capture the impact of current economic conditions on the financial soundness of a particular bank, the bank-specific data uncovers the idiosyncratic factors that cause bank distress. This approach ensures that the market, liquidity and credit risks[59] are adequately represented by the explanatory variables. The inclusion of 'return on assets' and macroeconomic data as explanatory variables is particularly useful in this case, given the unavailability of important bank-specific information on credit to the individual sub-sectors of the Jamaican economy.

One important disadvantage of using bank-specific data is that some variables may themselves be endogenous.[60]That is, the bank-specific and macroeconomic factors that lead to bank distress may be the same factors that negatively influence a particular bank-specific variable. The most obvious candidate is non-performing loans, which is commonly used in studies to explain bank distress. However, it is likely that some of the other explanatory variables utilized in these studies may also determine value of non-performing loans as a proportion of total loans. Therefore, I also use the ratio of non-performing loans to total loans as a measure of bank fragility, and examine how the probability of this ratio exceeding a particular critical threshold is influenced by other bank-specific and macroeconomic variables.

In addition to the non-performing loans ratio, the ratio of capital to assets is often considered to be an endogenous variable in models of bank distress. Specifically, a bank becomes insolvent when its 'book value' net worth is negative. However, the 'capital to assets' ratio typically declines significantly before the bank becomes 'book value' insolvent. Thus, to account for possible 'endogeneity' problems I also estimate the 'book value' insolvency model excluding the 'capital to assets' ratio.

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[56] One of the banks was intervened a few months after the period covered by the data set.
[57] Consistent with the terminology of bank duration studies, observations are right and left censored if they began operations before the start of the sample period and continued operations at the end of the sample period, respectively. Otherwise, they are right and left 'uncensored', respectively. The only bank that was closed before the end of the sample period was not included in the sample because of its exclusion from the data set by the source.
[58] One of the banks, during the sample period, had merged with another bank outside of the sample. However, this was a 'competitive' merger and hence, does not indicate fragility.
[59] As introduced formally in Gonzalez-Hermosillo (1996).
[60] See Gonzalez-Hermosillo (1999) for this argument.

Furthermore, a more general measure of bank fragility can be constructed which simultaneously takes into account the endogenous nature of the non-performing loans ratio and the capital to assets ratio. This general measure, labelled the 'coverage ratio', refers to the sum of capital plus provisions for loan losses minus non-performing loans ratio, normalized by total assets. This ratio holds important advantages over the more specific measures of bank fragility. For example, banks with higher levels of capital or loan loss reserves would be in a more secure financial position, even if they have the same high level of non-performing loans as other banks. Also, banks may have low levels of non-performing loans but, at the same time, have inadequate capital or loan loss reserves. Here, greater bank fragility may be measured in terms of the coverage ratio declining below some minimum threshold value. This variable may better capture the fragility of domestic banks in that only the indigenous banks recorded periods of negative 'coverage ratios'.

Bank outcome variable.

I utilize four types of outcome variables in this study. In the first specification, the bank distress variable equals one, if the bank is intervened by the government (including the quarter before intervention) and zero, otherwise. The intervention dates were obtained from documents published by FINSAC.

As is the case with all of the government –failed banks in the data set, after the bank is failed it may continue its operations before a final resolution is reached. If bank data, following government intervention, were used in the estimation of a bank insolvency model, then subsequent government actions, such as capital injections, would be reflected in its estimated coefficients as the government attempts to minimize losses to depositors. Therefore, the bank insolvency models are run using a subset of the data, excluding the period following intervention (if an intervention was made). Here, instead, the specification of the bank distress variable equals one, if the bank is 'book value' insolvent (before the specific bank intervention date) and zero, otherwise. This model is also estimated, with the "capital" ratio excluded, given the endogenous nature of this variable.[61]

The third type of outcome variable defines the bank fragility variable to equal one if the ratio of non-performing loans to total assets (the non-performing loan ratio) exceeds 10 percent.[62] Additionally, the frequency and range of the non-performing loan ratio in the data allow for the specification of a higher threshold. Specifically, the bank fragility variable is then set to equal one, if the ratio exceeds 20 percent

[61] However, troubled institutions are like to engage in various exogenous activities to influence this ratio in order to defer insolvency. This is expected to minimize the endogeneity problems associated with the inclusion of this variable.

[62] The 10 percent threshold is commonly used in identifying banking crises in the literature. For an example see Gonzales-Hermosillo, Pazarbasioglu and Billings (1997).

and zero, otherwise. Using different thresholds uncovers the variables that are more (or less) important in determining higher levels of fragility as defined by the outcome variable.

The final specification defines the bank fragility variable to equal one if the 'coverage ratio' declines below zero percent and zero, otherwise.

Explanatory variables.

The panel data set used in this study consists of two categories of explanatory variables: bank-specific (financial ratios) and macroeconomic.[63] Table 1 provides the definition of the explanatory variables, along with their expected sign in each of the bank failure specifications.[64] Table 2 contains the sample means of the bank-specific explanatory variables. The first two columns present the means of the failed and non-failed banks, respectively, over the entire period. The third and fourth columns displays the means for the failed and nonfailed banks prior to the crisis and the last two columns give these means during the crisis period, respectively.

I expect that large banks may be less likely to fail, given the expected relative advantages of large banks, such as, in raising new capital, alleviating illiquidity, and diversifying risk. Also, I expect that these advantages will serve to extend the survival time of large banks. However, the log of bank assets, which represents the size of the bank, is larger, on average, for failed banks than for nonfailed banks throughout the sample period.

The average capital adequacy ratio is much higher for nonfailed banks compared to failed banks. The means of both ratios experienced a significant decline over the sample period, with the failed banks' mean ratio recording negative values, given episodes of negative capital values during the crisis period. Because this ratio measures the extent to which the bank can absorb adverse shocks, I expect it to be negatively related to the likelihood of failure and positively related to survival time.

The loans to capital mean ratio for failed banks showed an even more dramatic decline from 29.75 prior to the financial crisis to 4.16 during the crisis. The mean ratio for nonfailed banks moved from a much smaller value of 4.30 prior to the crisis, and registered a marginal decline to 4.05 in the crisis period. This indicates that failed banks exhibited extremely high financial leverage, on average, before the onset of the crisis. I expect that the loans to capital ratio is positively related to the likelihood of failure and negatively related to survival time.

The mean deposits to loans ratios, measuring the liquidity risk of domestic deposit runs, recorded a slight decline for failed banks but increased for nonfailed banks from the period prior to financial crisis to the crisis period. This may be indicative of a transfer of funds from increasingly fragile banks to more

[63] The current levels of the macroeconomic variables are used in estimation, avoiding the common practice of experimenting 'adhoc' with lags of these variables. Note that structural variables are also included in estimation.
[64] My expectations here, especially in the case of the macroeconomic variables, are formed ex post (i.e., after the occurrence of the banking crisis).

healthy banks as information becomes available to the public on the state of banks. This ratio is higher for nonfailed banks throughout the sample period. I expect the deposits to loans ratio to be negatively related to the likelihood of failure and positively related to survival time.

However, the liquid funds to total assets mean ratios, the overall measure of liquidity risk, declined between these periods for both bank categories. The decrease in this ratio over time for nonfailed banks may indicate their rising franchise values. However, a lower value for this ratio for the failed banks during the crisis period reflects imprudent management practices and inflexibity, given the significant runs on two commercial banks at the beginning of the financial crisis. A high liquid funds to total assets ratio during the crisis period would send a positive signal to the public on the likelihood of the bank to honor their deposit liabilities. Thus, I expect this ratio to be negatively related to the likelihood of failure and positively related to survival time.

The mean values for the provision for loan losses to assets and the non-performing loans to total loans ratios prior to and during the crisis period indicates a rapid deterioration of loan quality for failed banks compared to nonfailed banks. Therefore an increase in these measures of credit risk is expected to increase the likelihood of failure and decrease the survival time.

In terms of market risk, the mean private sector to total loans ratios decreased for nonfailed banks, while remaining relatively stable for failed banks, while, failed banks, on average, experienced an increase in its financial institution loans to total loans ratio during the financial crisis period. These failed banks (all of them domestic) had more pressure to assist other domestic financial institutions within their financial conglomerate that were also undergoing financial difficulties. Therefore, I expect that an increase in the financial institution loans to total loans ratio will be positively related to the likelihood of failure and negatively related to survival time. Private sector loans consist of the aggregated loans to the different economic sub-sectors. Given the overall downturn in the Jamaican economy in the 1990s, the greater the increase in this private sector loans to total loans ratio is the higher the expected likelihood of failure and the longer the expected survival time.

On average, the profitability of both failed and nonfailed banks, as measured by the net income to assets, net interest income to assets, and non-interest income to assets ratios, declined over the sample period. In fact, the net income to assets ratio, the overall measure of the return on assets, recorded negative values for the failed banks during the crisis period. Nonetheless, these measures of profitability for nonfailed banks remained, on average, significantly above those for failed banks. Contributing to the values of the return on assets ratios, nonfailed banks fared better on the cost side, as they had the flexibility to decrease, on average, the ratios of fixed-asset expenses to assets and employee remuneration to assets ratios, while these ratios increased for failed banks during the crisis period. It is expected that

higher profit indicators will be positively related to the survival time and negatively related to the likelihood of failure. The opposite is expected to be true for higher cost ratios.

My expectations with regard to the signs of the macroeconomic variables are as follows. An increase in credit extended to the private sector is taken to reflect a rise in risky lending (especially following financial liberalization).[65] Thus, an increase in the 'private' variable is expected to be positively related to the likelihood of failure and negatively related to survival time. I expect decreases in the 'inflation' and 'equity' variables to be positively related to the likelihood of failure and negatively related to survival time, in so far as inflation and equity prices proxy real estate prices. A sharp decline in these variables would indicate an asset price 'bust'. An appreciation of the exchange rate is expected to increase the likelihood of failure and decrease the survival time given that commercial banks had typically held long positions in foreign exchange following the elimination of capital controls. The ratio of M2 (currency plus demand and savings deposits in commercial banks) to foreign reserves acts as a gauge of potential currency convertibility.[66] That is the extent of a bank run will depend on the actual amount of liquid monetary assets that depositors can potentially withdraw from the banking system in the event of a currency crisis. Thus this variable is expected to be positively related to the likelihood of bank failure and negatively related to bank survival time.

7. Empirical Results.

This section provides the empirical results for the different models of bank failure and fragility described in section 6. In the interest of parsimony, all the financial ratios were not included in the final model specifications because of the repetition of the information in a number of ratios that were included in original specifications of the models. For example, the 'loans', 'loan loss fund' and 'troubled assets' ratios all measure credit risk; the 'deposits' and 'liquid funds' ratios both measure liquidity risk; and finally, in terms of market risk, the similar information is contained in the 'financial loans', 'private loans', the return on assets variables (furthermore all the ratios relating to bank income and costs, contains information relating to the bank's return on assets), and the macroeconomic variables. Consistent with previous studies, I used a stepwise method of eliminating insignificant variables. However, to escape potential misspecification problems given the underlying model presented earlier, at least one of the ratios representing each of the risk categories were included in the final specifications of each model, given the absence of multicollinearity problems.[67]

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[65] See Pill and Pradhan (1995).
[66] See Calvo (1996).
[67] Note that the overall criteria for model selection resulted in the elimination of the financial ratios that measure liquidity risk.

Severe multicollinearity prevented the estimation of the specifications used to determine the likelihood of intervention or insolvency when the macroeconomic variables were included in estimation. Consequently, for comparative reasons, the results from the models used for the determination of the non-performing loan ratio exceeding the threshold values are presented with and without the inclusion of the macroeconomic variables.

The χ^2 test, which examines the null hypothesis that all the variables in the model have no influence on the measure of financial fragility, is given as: $\chi^2 = -2(\ln L_0 - \ln L_1)$, where L_0 is the log-likelihood in the constant only model, and L_1 is the log-likelihood for the fitted model. The psuedo R^2 is reported for the fixed effects logit model and is given as: $pseudo\ R^2 = 1 - L_1/L_0$. A value for this statistic greater than one indicates a perfect fit, assuming the absence of multicollinearity problems. Also, the *p(weibull)* measure indicates whether the duration dependence for the 'estimated' Weibull model is positive, constant, or negative.

Table 3-a contains the results of the determinants of the probability of one-period-ahead bank intervention, the survival time until failure, the probability of 'book value' insolvency, and the time until 'book value' insolvency, respectively. Specification (1), (3) and (3′) are (time-varying) Weibull models, whereas (2), (4) and (4′) are conditional 'fixed effects' models.

Specification (1) and (2) correspond to the bank 'survival time until intervention' model and the bank probability of intervention model, respectively. The key result from the bank intervention equations concerns the signs of the coefficients on the "asset size" variable associated with the survival and conditional logit models. Larger banks experienced a shorter time until intervention than smaller banks and a higher probability of intervention.[68] This is inconsistent with prior expectations and is opposite to what is found in the bank distress literature. That is, generally, the influence of "too big to fail" policies are cited as the reason to expect large banks to display a longer time until intervention or a lower probability of intervention. So, how can this result be explained? Well, the larger banks were all affiliated with extensive financial conglomerates, which included at least one insurance company.

Whereas commercial banks had very strict capital, reserve and tax restrictions, insurance companies were, on the most part, free of regulation and prudential supervision. Before the onset of the crisis in the banking sector, their existed serious liquidity and solvency problems in a number of the large insurance companies associated with financial conglomerates. Following financial liberalization,

[68] Note that an examination of the data set reveals that the size of a foreign bank and its affiliation with a foreign-controlled local financial conglomerate, would have a negligible influence, if any, (compared to domestic banks) on its survival time. This is because foreign banks that exhibited these characteristics over the sample period still remained very healthy. The nonintervention of these institutions indicate that other affiliated institutions were also healthy.

insurance companies offered new types of policies that allowed them to accumulate deposits under the guise of insurance premiums, which were primarily used for tax-free long-term investments in the booming real estate and securities markets. However, the subsequent asset price 'bust', in the mid 1990s, resulted in insurance companies facing serious difficulties in honoring the withdrawal demands of policy-holders. Despite the insurance companies' huge leverage, healthier affiliated commercial banks continued to concentrate lending to them. The obvious implication is that commercial banks would expect the government to exercise a greater regulatory forbearance on the part of financial conglomerates out of fear of inducing a systemic crisis in the event of their failure. Furthermore, commercial banks believed that they were implicitly insured from any negative externalities arising from the more risky practices of their affiliate companies, given the absence of regulations governing their operations.[69] In other words, the commercial banks considered their financial conglomerates "too-big-to-fail". This, in effect, constituted an implicit loan guarantee.

However, the extent of illiquidity and insolvency problems experienced by the large insurance companies and ultimately resulted in the failure of the entire conglomerate. In order to decrease the risk of contagion, these conglomerates were required by FINSAC to divest their holdings of commercial banks. These banks that were intervened at the beginning of the crisis period, on average, had higher capital to assets ratios and were more book value solvent than those that survived longer. Hence, accounting for the result that banks with higher capital to asset ratios experienced a shorter survival time until intervention as well as a higher probability of intervention.[70] Nevertheless, given the extent of the problems in their affiliate insurance companies, they were deemed economically insolvent and intervened earlier.

Specifications (3) and (4) examine the results of the determinants of the probability of bank insolvency and the survival time until insolvency for the sample period, excluding the intervention period for the particular bank. The results from specification (3) show that an increase in the "asset size" variable, increased banks' survival time until insolvency. Importantly, the positive sign on the "assets size" variable is consistent with prior expectations that larger banks were able to extend their survival

[69] In fact just prior to the crisis the troubled insurance companies approached the regulators for assistance on liquidity problems. These problems were later uncovered by regulators to be insolvency problems. The point here is that these problems would have gone unnoticed for a longer time, given the lack of regulation in the nonbank financial sector, if the perpetrators themselves had not pointed them out.

[70] Another obvious implication is that financial conglomerates would expect the government to exercise a greater regulatory forbearance on the part of insurance companies, given their low regulatory requirements. This creates an incentive for the conglomerates to 'transfer' capital, during periods of fragility, to their institutions where the practice of regulatory forbearance is least expected--commercial banks. This practice is known as "double gearing", which was apparent during the expansion in the operations of financial conglomerates in Europe in the early 1990s. Specifically, financial institutions under the umbrella of the same conglomerate optimize their capital holdings by transferring their funds among the subsidiaries of the holding company. Thus, the "consolidated" solvency of the conglomerate could be a great deal lower than the sum of capital holdings of its member institutions. (see Van den Berghe, 1995).

time until insolvency. Similar to specifications (1) and (2), it is apparent that the number of variables that determine the likelihood of bank insolvency is smaller than those that determine the survival time until insolvency. The importance of the distinction in inference between models (3) and (4) concerns the "asset size" variable. Although large banks possess inherent advantages that allow them to extend their survival time until 'book value' insolvency, bank size has no meaningful relationship with the probability of 'book value' insolvency. Overall, the model statistics for the insolvency models and those from the failure models reveal a very good fit. Additionally, the weibull specifications for both types of models indicate a positive duration dependence (greater than one), but is significant only for the intervention model.

Specifications (3′) and (4′) correspond to specifications (3) and (4), but with the exclusion of the 'capital to assets' ratio as an explanatory variable. The key difference, in terms of the survival models of bank 'book value' insolvency, is that in the latter specification, the 'asset size' variable is insignificant.

Specifications (1), (2), (3), and (4) in table 3-b, correspond to the specifications in table 3-a, but now I take account of the role of financial conglomerates in determining bank distress. I create a dummy variable labeled as 'insurance', which equals one if bank i is affiliated with an insurance company that failed and zero, otherwise. Banks that are affiliated with insurance companies in the data set represent the most extensive form of financial conglomerate. Then I interact the 'insurance' dummy with the 'liberalization' dummy, and the 'asset size' variable, such that: 'conglomerate' = 'insurance'*'liberalization'*'asset size'. This new variable is included in the estimation, in the place of the 'liberalization' dummy,[71] to potentially separate the influence of financial conglomerates from the coefficient on the 'asset size' variable. Comparing the results from these equations with the original equations indicates that evidence against "too big to fail" policies no longer exists for large banks *per se*. The results from table 3-b show that only the larger domestic banks that are affiliated with failed insurance companies following financial liberalization had a shorter survival time until intervention and a higher probability of intervention. Moreover, the results from the bank 'book value' insolvency models, taking account of the role of domestic financial conglomerates, support those from the original regressions. Also, as is the case with the original regressions, the 'asset size' of banks has no impact on 'book value' insolvency when the role of financial conglomerates is explicitly taken into account.

Table 4-a contains the determinants of bank fragility in terms of the probability of exceeding a minimum level of non-performing loans ratio, conditional on the number of periods of fragility of bank i. Specification (1) gives the results of estimating the factors that determine the non-performing ratio exceeding 10 percent of total loans (fragility) for the entire sample period. The macroeconomic variables are excluded in this specification. Specification (2) estimates the model from specification (1) but with the inclusion of the macroeconomic variables. Specification (3) and (4) corresponds to specifications (1) and

(2) respectively, but now with the dependent variable being equal to one if the non-performing loans ratio exceeds 20 percent of total loans (significant fragility) and zero otherwise. The key result from the fragility regressions concerned the sign of the coefficient on the "asset size" variable. That is larger banks were found to decrease the probability of fragility and, in particular, significant fragility.

Specification (1)-(4) in table 4-b correspond to those in table 4-a, but now with the inclusion of the 'conglomerate' dummy. The results of the four specifications are similar. Except, table 4-b contains evidence that large banks affiliated with failed insurance companies following liberalization, decrease the probability of the fragility models with the lower thresholds.

Table 4-a also contains the results from the 'coverage ratio' specifications of the outcome variable (specifications (5) and (6)). The key difference is of these specifications with the other bank fragility specifications is that the "asset size" variable is not significant. The results for these specifications are similar in table 4-b, however, it is now also observed that only large domestic banks that are affiliated with failed insurance companies following financial liberalization, have a lower probability of overall fragility (when the macroeconomic variables are not included). The model statistics reported in both table 4-a and 4-b indicate a reasonably good fit for all specifications.

Table 5 contains the results of regressions of bank financial ratios on bank asset size, measured as log(total assets of bank *i* /total banking sector assets). The dummy "liberalization" variable is included in the estimations to take account of the impact of the financial liberalization process on these relationships.[72] These are auxiliary regressions intended to support the evidence from the bank 'survival time until insolvency' and fragility models in terms of the better financial performance and less risky operations of large banks. These regressions are only run for the subset of the panel data set that contains domestic banks. The foreign-controlled banks, regardless of size, were relatively unaffected by the crisis in terms their financial ratios. This is due largely to the fact that foreign-controlled banks were subject to more the prudent standards of their foreign parent companies.

The capital to assets ratio is found to vary positively with bank size. This result may seem counterintuitive given the expectation that larger banks would be induced to have lower capital to assets ratios than smaller banks, further increasing the riskiness of their operations because of the prior expectation of a longer survival time until intervention.[73] However, when large banks are affiliated with financial conglomerates this moral hazard problem seem to be more concentrated in the hands of their affiliate companies. Further, the 'coverage ratio' is positively related to bank size, indicating that large banks were able to utilize their inherent advantages to cover their non-performing loans. The "loans" ratio

[71] Note that including both variables result in multicollinearity problems.
[72]Furthermore, as is done with the previous panel regressions, the standard errors are adjusted to take account of correlations of the error terms.

is shown to be uncorrelated with bank size. The "deposits" ratio indicates that larger banks attracted more deposits relative to capital. The "liquid assets" ratio is positively related to bank size. The "troubled assets" regression indicates that larger banks were found to have lower ratios of nonperforming loans to total loans. "Net Income" is positively related to bank size, indicating higher levels of profitability for larger banks. However, this variable is significant, only at the 20 percent level. Also, significant evidence of the relative efficiency of larger banks compared to smaller banks is found in the "fixed asset expense" ratio but not in the "salary expense" ratio. Overall, the results support previous evidence that larger banks were better 'performers' and less risky, in terms of financial ratios.

8. Banking System Fragility Indicators.

In this section, ex post and ex ante indicators of the degree of fragility of the overall banking sector are constructed using the data and empirical results from the conditional logit and survival models. This can be achieved by utilizing the following two-step procedure.[74] First, to obtain the probability of failure or the survival function of individual banks, the coefficients on the explanatory variables are multiplied by the corresponding data relating to each bank. Then, the average probabilities and average expected survival times are weighted by the assets size (relative to the total assets of the banking system) of the respective banks, in order to arrive at estimated fragility indices of the overall banking sector. Specifically, the indices associated with bank failure and insolvency are ex post measures of bank fragility, whereas, those based on the probability of the non-performing loans ratio exceeding the minimum threshold value depict ex ante measures of bank fragility. The window used for the graphical depictions of the indices covers the period March 1992 to December 1995. That is, it includes the post-liberalization period but ends just prior to the crisis period.[75]

Figure 2-a depicts the 'intervention' and 'insolvency' hazard functions[76] and their respective probability indices when the 'conglomerate' variable is excluded. The 'intervention' and 'insolvency' indices, by and large, exhibit an upward trend following financial liberalization. However, these indices begin to decline just prior to the crisis period, which may be reflect the effort of large banks to defer 'book value' insolvency. When the 'capital to assets' ratio is excluded from the estimation the insolvency hazard function does not increase noticeably over most of the post-liberalization period. The insolvency probability index remains noticeably low for most of the period and then increases significantly just prior to the crisis period. The obvious difference in the insolvency indices is that when the 'capital to assets' ratio is excluded the "asset size" variable is no longer significant. Thus evidence of the ability of large banks to defer their book value insolvency is not evident.

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[73] See Boyd and Gertler (1993) and Mishkin (1998) for a further discussion of these arguments.
[74] This procedure is introduced in Gonzalez-Hermosillo et al (1997).
[75] Including the crisis period would incorporate distortions to the indices associated with government intervention.
[76] These capture the probability that banks will exit the survival state given that they have not yet exited.

The insolvency and probability indices when the 'conglomerate' variable is included are presented in figure 2-b. These indices exhibit a flat or downward trend over the pre-crisis period. This implies that it was the large banks that were affiliated with failed conglomerates that influenced the upward movement of the indices when the role of conglomerates is not taken into account.

Figure 3-a depicts the indices representing the probabilities that ratio of non-performing loans to total loans exceed the 10 percent and 20 percent minimum thresholds, with and without the inclusion of the macroeconomic variables. The graphs for these indices, although showing an overall increase over the pre-crisis period, exhibit sharp declines over the period especially when the macroeconomic variables are included. This may also be taken as evidence of the positive impact of the asset price boom, which occurred following financial liberalization, on nonperforming loans. Figure 3-a also depicts the indices of the probability of the 'coverage ratio' declining below the zero percent threshold value. When the macroeconomic variables are excluded, the 'coverage ratio' index is fairly flat indicating the 'adequacy' of capital plus loan loss reserves in terms of 'covering' the increases in nonperforming loans prior to the crisis period. However, when the macroeconomic variables are included the index depicts a brief period of decline between 1992 and 1993, which may be interpreted as further evidence of the positive impact of the asset price boom on nonperforming loans.

The trends in the indices in figure 3-b, when the 'conglomerate' variable is included in estimation, are similar to those in figure 3-a. However, the indices of the non-performing loans exceeding 20 percent exhibited greater volatility than the corresponding ones in figure 3-a.

9. Concluding Remarks.

Banks can be both illiquid and solvent[77], or liquid and insolvent. Thus, in the event of bank distress, the government may intervene in regular bank operations either to inject liquidity or recapitalize or both. Another consideration that has not been given much attention in the literature is the case of illiquidity or insolvency of companies closely affiliated with the bank. Financial institutions that operate with banks under the umbrella of a financial conglomerate are typically subject to fewer restrictions than their deposit-taking counterparts. Therefore, their operations are, in general, more risky. However, banks are attracted to these non-bank financial companies, given the opportunities that exist to circumvent their tighter regulations. In exchange, the bank is expected to provide "connected party" loans. The lower restrictions and supervision act as an implicit loan guarantee, which encourages an expansion of loans to affiliate financial institutions and exposes the banks to the risk of financial contagion.

Because of the typical "connected party" lending associated with financial conglomerates some of the banks in the Jamaican data set, though possessing otherwise healthy fundamentals, were deemed

economically insolvent by regulators, given the extent of insolvency of affiliated institutions. Consistent with the theoretical framework, this was particularly the case of large banks. Econometric evidence confirms that they were the first to be intervened. However, larger banks were found to have a longer survival time until bank 'book value' insolvency, as well as a lower probability of fragility. Furthermore, results from auxiliary regressions reveal that they were better 'performers' and less risky, in terms of financial ratios. This has significant implications for the financial sector, which point to the need for strict supervision of financial conglomerates. Increasing regulations for the more loosely regulated financial institutions reverses the advantages of financial liberalization. One possible alternative for improving the regulatory environment is to consolidate the supervision of financial conglomerates. This will reduce the risk of financial contagion resulting from unregulated financial entities. [78]

[77] Insolvency here incorporates both 'book value' and/or economic (or market) insolvency.

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[78] See Scott (1994) for a discussion of various alternatives available for the regulation and supervision of financial conglomerates.

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Table 1.
Definitions of explanatory variables and their expected signs.

Variable	Definition	Expected Sign: Failure	Survival time
Bank-specific variables:			
Asset Size	logarithm of total assets	-	+
Capital	total capital as a percentage of total assets	-	+
Loans	ratio of total loans to total capital	+	-
Deposits	ratio of total deposits to total loans	-	+
Liquid Assets	ratio of liquid funds to total assets	-	+
Loan Loss Fund	accumulated provision for loan loss as a percentage of total assets.	+	-
Troubled Assets	nonperforming loans (≥ 6 mths) as a percentage of total loans.	+	-
Financial Loans	ratio of loans to financial institutions as a percentage of total loans.	+	-
Private Loans	ratio of private sector loans to total assets	+	-
Net Income	net income as a percentage of total assets	-	+
Interest Income	net interest income as a percentage of total assets	-	+
Non-Interest Income	non-interest income as a percentage of total assets	-	+
Fixed Asset Expense	fixed asset expenses as a percentage of total assets	+	-
Salary Expense	ratio of employee remuneration to total assets	+	-
Structural variables:			
Domestic	one for domestic banks and zero otherwise	+	-
Liberalization	one for the period following the liberalization process and zero otherwise	+	-
Macroeconomic variables:			
Private Sector	four-quarter percentage change in the total credit extended to the private sector	+	-
Inflation	four-quarter percentage change in the Consumer Price Index	-	+
Equity	the composite stock exchange index	-	+
Exchange Rate	the nominal exchange rate (relative to the US dollar)	+	-
M2/Reserves	ratio of M2 to net international reserves	+	-

Notes:
1. Capital includes: Common and Preferred Stock paid-up or Assigned Capital; Share Premium; Reserves; Retained Earnings; and Unappropriated Profits.
2. Financial Institutions include deposit-taking and other financial institutions (excluding commercial banks), such as, investment banks, development banks, insurance companies, building societies, credit unions, etc.
3. Private Sector includes all individuals, firms and non-profit institutions involved in the various economic sub-sectors.

Table 2.
Means of Bank-Specific Variables.

Variables	Entire Period		Before Financial Crisis		Financial Crisis	
	Failed	Nonfailed	Failed	Nonfailed	Failed	Nonfailed
Asset Size	6.53	6.21	6.38	6.05	6.98	6.68
Capital	4.22	11.54	5.83	12.31	-0.79	9.35
Loans	23.53	4.24	29.75	4.30	4.16	4.05
Deposits	2.01	2.09	2.05	1.90	1.91	2.63
Liquid Assets	0.35	0.40	0.39	0.42	0.25	0.35
Loan Loss Fund	7.13	2.13	3.70	1.56	17.78	3.77
Troubled Assets	13.96	5.77	9.57	5.56	27.64	6.36
Private Loans	0.32	0.45	0.32	0.48	0.31	0.37
Financial Loans	0.04	0.01	0.01	0.01	0.12	0.01
Net Income	-0.56	0.88	0.48	1.12	-3.81	0.22
Interest Income	1.59	2.11	1.68	2.28	1.32	1.66
Non-Interest Income	0.87	0.93	0.94	1.01	0.68	0.70
Fixed Asset Expense	0.31	0.26	0.29	0.25	0.38	0.26
Salary Expense	0.88	0.81	0.85	0.83	0.95	0.78

Note:
1. The financial crisis period covers the period March 1996 to March 1998.

Table 3-a.
Determinants of Bank Intervention and Book Value Insolvency.

Variables	(1)	(2)	(3)	(4)	(3')	(4')
Bank-Specific:						
Constant	10.56548*	–	4.28264**	–	8.38932*	–
	(0.94610)		(2.20563)		(1.12230)	
Asset Size	-0.54849*	12.31594*	0.53398*	-1.68231	0.11285	0.79751
	(0.10555)	(4.10018)	(0.09537)	(3.96189)	(0.08342)	(2.30455)
Capital	-0.03618*	0.14192***	0.06085*	-0.08431	–	–
	(0.00524)	(0.08576)	(0.01775)	(0.13227)		
Loans	0.01479*	-0.18516	0.00001	0.00023	-0.00018**	0.00036
	(0.00279)	(0.12156)	(0.00007)	(0.00176)	(0.00007)	(0.00176)
Troubled Assets	-0.00898*	0.21229**	-0.01414*	0.40467*	-0.01745*	0.40210*
	(0.00078)	(0.09233)	(0.00434)	(0.16215)	(0.00362)	(0.15515)
Net Income	0.02844*	-0.17612	0.12323**	-0.48737	0.05923	-0.48467
	(0.00582)	(0.33302)	(0.05580)	(0.39732)	(0.04364)	(0.33819)
Structural:						
Liberalization	0.66532**	27.3376	0.92692**	-5.31665	0.67637*	-7.19583**
	(0.35939)	(0.0000)	(0.43520)	(3.49826)	(0.24203)	(3.27211)
Domestic	-1.88018*	–	-2.88269**	–	-3.97261*	–
	(0.19928)		(1.50759)		(1.21748)	
Model Statistics:						
Model χ^2	1285.35	64.53	154.48	44.62	63.98	44.06
Prob>χ^2	0.000	0.000	0.000	0.000	0.000	0.000
Pseudo R^2	–	0.719	–	0.682	–	0.674
Log lik.	5.071	-12.579	-2.715	-10.365	-8.358	-10.649
p(Weib.)	47.540***	–	9.973	–	6.338*	–
	(25.680)		(8.148)		(2.981)	

Notes:
1. * indicates significance at the 1 percent level.
2. ** indicates significance at the 5 percent level.
3. ***indicates significance at the 10 percent level.
4. Huber-White robust standard errors are given in parentheses.
5. The 'Domestic' variable was dropped from the conditional logit specifications because of no within group variance.

Table 3-b.

Determinants of Bank Intervention and Book Value Insolvency: Accounting for the Role of Financial Conglomerates.

Variables	(1)	(2)	(3)	(4)	(3′)	(4′)
Bank-Specific:						
Constant	6.13289*	–	6.13828*	–	11.3996**	–
	(0.09070)		(1.79319)		(5.76164)	
Asset Size	0.06914	-10.28900	0.33830**	-3.69781	-0.03854	-0.42813
	(0.07022)	(9.12480)	(0.15639)	(2.47670)	(0.43876)	(1.46191)
Capital	-0.02817	0.19101***	0.06890*	-0.20138	–	–
	(0.02074)	(0.10015)	(0.02313)	(0.16755)		
Loans	-0.00161*	-0.20864***	-0.00005	0.00083	-0.00033**	0.00202
	(0.00033)	(0.12680)	(0.00009)	(0.00171)	(0.00007)	(0.00168)
Troubled Assets	-0.02112	0.22472**	0.01688	0.30310*	-0.002551	0.27725*
	(0.04762)	(0.09727)	(0.01429)	(0.11539)	(0.02441)	(0.09580)
Net Income	0.01347	-0.18616	0.17929**	-0.26816	0.14284	-0.18449
	(0.06893)	(0.34744)	(0.05580)	(0.39878)	(0.23222)	(0.25410)
Conglomerate	-0.30871*	24.2005**	0.15942***	14.5165	0.11874	11.81536
	(0.00956)	(11.5476)	(0.09346)	(45.0504)	(0.22064)	(23.2517)
Structural:						
Domestic	1.25173***	–	-3.54966*	–	-5.62811***	–
	(0.69492)		(0.80602)		(3.0616)	
Model Statistics:						
Model χ^2	10440000	65.54	197.51	41.46	49.05	37.63
Prob>χ^2	0.000	0.000	0.000	0.000	0.000	0.000
Pseudo R^2	–	0.730	–	0.634	–	0.575
Log lik.	22.990	-12.074	-4.831	-11.949	-10.959	-13.862
p(Weib.)	852.2***	–	6.802*	–	3.970***	–
	(473.1)		(1.976)		(2.981)	

Notes:

1. * indicates significance at the 1 percent level.
2. ** indicates significance at the 5 percent level.
3. ***indicates significance at the 10 percent level.
4. Huber-White robust standard errors are given in parentheses.
5. The 'Domestic' variable was dropped from the conditional logit specifications because of no within group variance.
6. Insurance= 1, if bank is affiliated with a failed insurance company and, zero otherwise.
7. Conglomerate= Insurance*Liberalization*'asset size'.

Table 4-a.
Determinants of NPL Ratio & Coverage Ratio.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Bank-Specific:						
Asset Size	0.78109	-5.29916*	-1.31436***	-6.33944*	0.82168	-1.09898
	(0.64600)	(1.98178)	(0.72679)	(2.43768)	(0.69128)	(1.61568)
Capital	0.00192	-0.03847	-0.01128	-0.04272	–	–
	(0.01942)	(0.02683)	(0.01920)	(0.02888)		
Loans	-0.04787	-0.04902**	-0.17210*	-0.13806**	0.01754	0.01534
	(0.03018)	(0.02497)	(0.05923)	(0.06617)	(0.02066)	(0.01902)
Net Income	-0.27039**	-0.00232	-0.24225***	-0.07757	-0.50491*	-0.25901***
	(0.12705)	(0.15864)	(0.13715)	(0.16824)	(0.13484)	(0.15247)
Structural:						
Liberalization	0.65195	0.65675	0.88288	3.89741***	-1.98111*	0.35608
	(0.58064)	(1.78802)	(0.78496)	(2.28501)	(0.76796)	(1.91943)
Macroeconomic:						
Private	–	-0.04900*	–	-0.05119**	–	-0.03455***
		(0.01754)		(0.02306)		(0.02074)
Inflation	–	-0.02464	–	-0.04862**	–	-0.02404
		(0.01654)		(0.02386)		(0.01794)
Equity	–	-0.00009	–	0.00006	–	-0.00017***
		(0.00006)		(0.00007)		(0.00010)
Exchange Rate	–	0.25326*	–	0.12583	–	0.08978
		(0.08520)		(0.09800)		(0.08558)
M2/Reserves	–	-0.00007	–	-0.00010	–	0.00015
		(0.00022)		(0.00027)		(0.00060)
Model Statistics:						
Model χ^2	30.71	41.49	30.82	35.67	27.46	30.47
Prob>χ^2	0.000	0.000	0.000	0.000	0.000	0.000
Pseudo R^2	0.138	0.230	0.197	0.296	0.169	0.212
Log likelihood	-95.833	-69.423	-62.516	-42.308	-67.208	-56.351

Notes:
1. * indicates significance at the 1 percent level.
2. ** indicates significance at the 5 percent level.
3. ***indicates significance at the 10 percent level.
4. Huber-White robust standard errors are given in parentheses.
5. The 'Domestic' variable was dropped from the conditional logit specifications because of no within group variance.

Table 4-b.

Determinants of NPL Ratio & Coverage Ratio: Accounting for the Role of Financial Conglomerates.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Bank-Specific:						
Asset Size	1.69461*	-5.95486*	-0.64859	-5.51238**	0.21802	-1.36518
	(0.56738)	(2.05290)	(0.60678)	(2.41674)	(0.55669)	(1.66618)
Capital	0.01198	-0.04619***	-0.00196	-0.03694	–	–
	(0.01742)	(0.02801)	(0.01714)	(0.02796)		
Loans	-0.05692***	-0.03554	-0.19385*	-0.13437**	0.025568	0.02039
	(0.03177)	(0.02518)	(0.05909)	(0.06380)	(0.02149)	(0.02211)
Net Income	-0.27568**	0.01503	-0.26322***	-0.07669	-0.44520*	-0.25331***
	(0.12412)	(0.16036)	(0.13637)	(0.16428)	(0.11290)	(0.15247)
Conglomerate	-0.17505***	-0.25776***	-0.05991	2.96637	-0.23474**	-0.12894
	(0.09572)	(0.15242)	(0.12385)	(3.39924)	(0.10522)	(0.16733)
Macroeconomic:						
Private	–	-0.05143*	–	-0.03934***	–	-0.03621***
		(0.01798)		(0.02327)		(0.02091)
Inflation	–	-0.01513	–	-0.01713	–	-0.01943
		(0.01231)		(0.01792)		(0.01371)
Equity	–	-0.00005	–	0.00003	–	-0.00014
		(0.00004)		(0.00005)		(0.00008)
Exchange Rate	–	0.32171*	–	0.16575***	–	0.12125
		(0.08054)		(0.09206)		(0.07760)
M2/Reserves	–	-0.00012	–	-0.00016	–	0.00012
		(0.00022)		(0.00027)		(0.00060)
Model Statistics:						
Model χ^2	33.60	44.25	29.77	34.62	25.23	31.05
Prob>χ^2	0.000	0.000	0.000	0.000	0.000	0.000
Pseudo R^2	0.151	0.245	0.191	0.287	0.155	0.216
Log likelihood	-94.385	-68.042	-63.040	-42.834	-68.323	-56.061

Notes:

1. * indicates significance at the 1 percent level.
2. ** indicates significance at the 5 percent level.
3. ***indicates significance at the 10 percent level.
4. Huber-White robust standard errors are given in parentheses.
5. The 'Domestic' variable was dropped from the conditional logit specifications because of no within group variance.
6. Insurance= 1, if bank is affiliated with a failed insurance company and, zero otherwise.
7. Conglomerate= Insurance*Liberalization*'asset size'.

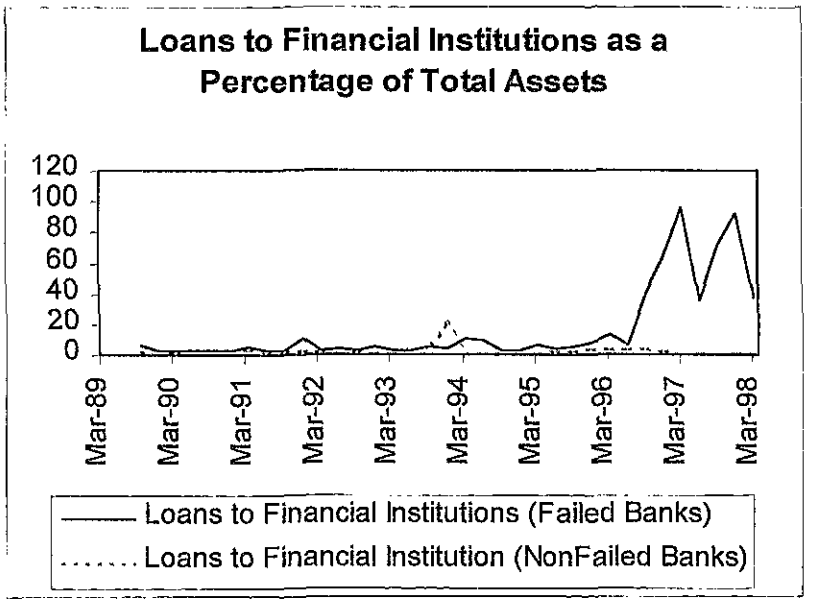
Table 5.
Regressions of Financial Ratios on the Asset Size of Banks (Relative to Total Banking Sector Assets).

Dependent Variable	Size	Liberalization	R^2
Domestic Banks:			
Capital	0.378176***	0.500415	0.01
	(0.203866)	(1.65498)	
Coverage Ratio	0.003841***	0.006169	0.02
	(0.002014)	(0.006169)	
Loans	-0.624242	-54.59213	0.02
	(0.894450)	(43.01418)	
Deposits	0.018152**	0.359186*	0.05
	(0.009275)	(0.101236)	
Liquid Assets	0.007021*	-0.009230	0.16
	(0.001171)	(0.015770)	
Troubled Assets	-0.506040***	7.11965*	0.04
	(0.306077)	(2.22169)	
Net Income	0.186988	-1.306317***	0.02
	(0.114452)	(0.673705)	
Fixed Assets Expense	-0.004111**	0.175493*	0.15
	(0.001916)	(0.020766)	
Salary Expense	0.000363	0.150971**	0.01
	(0.003722)	(0.059534)	

Notes:

1. The 'Size' variable is measured as the log(total assets of bank *i*/total banking sector assets).
2. * indicates significance at the 1 percent level..
3. ** indicates significance at the 5 percent level..
4. ***indicates significance at the 10 percent level.
5. Huber-White robust standard errors are given in parentheses.

Figure 1. Financial Institution Loans and Non-performing Loans.



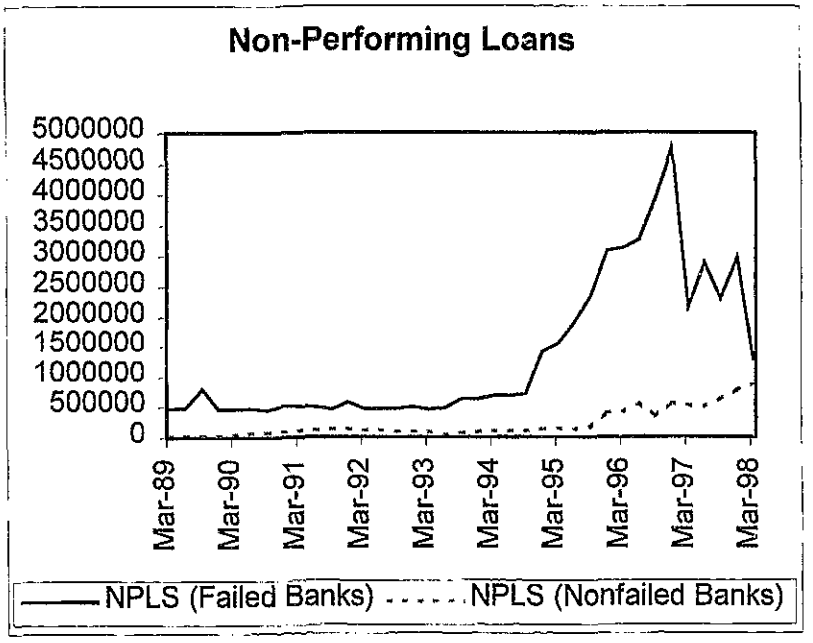
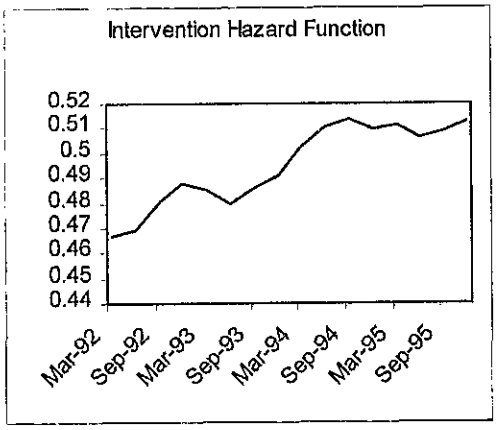
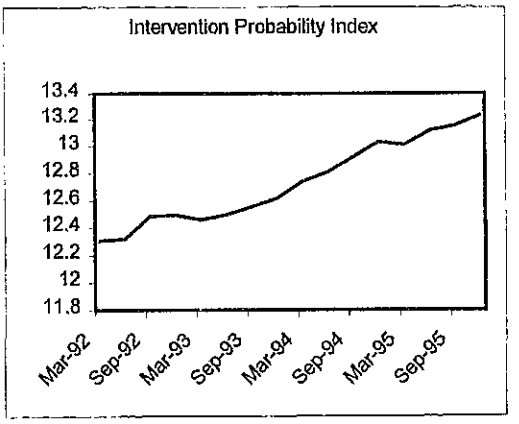
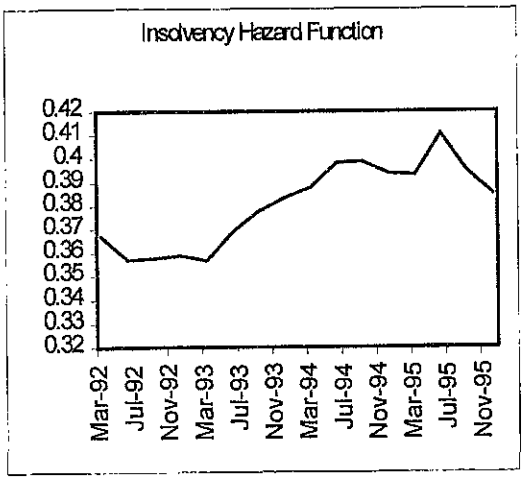
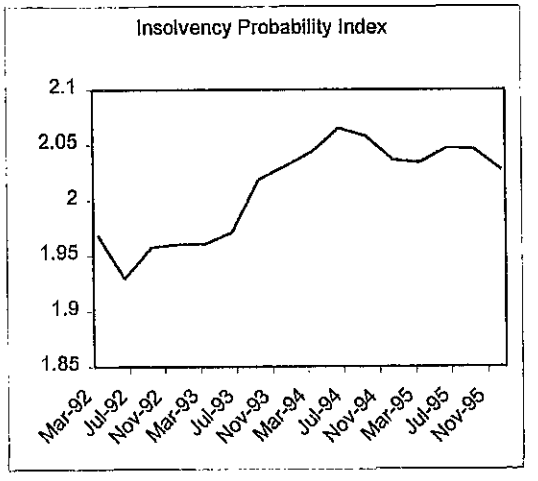


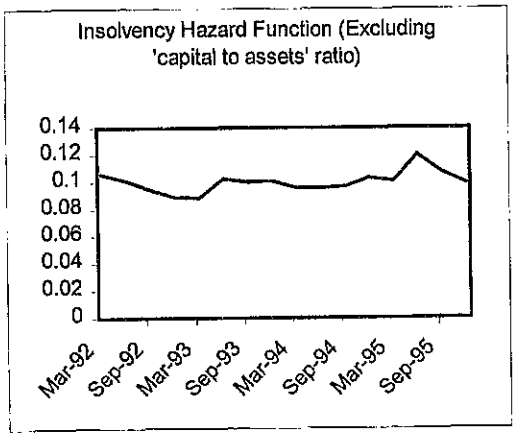
Figure 2-a.
Intervention and Insolvency Hazard Functions and Probability Indices.











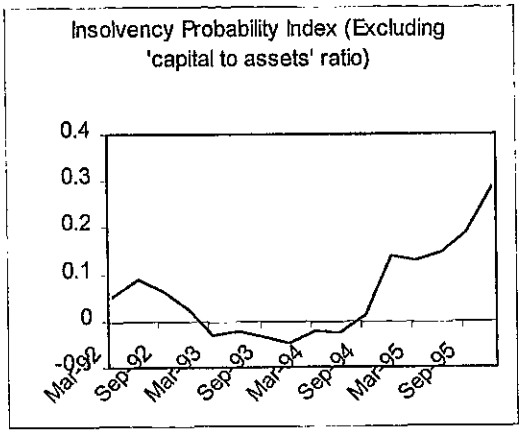
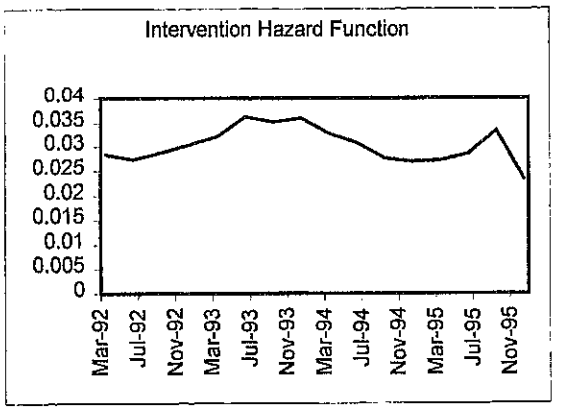
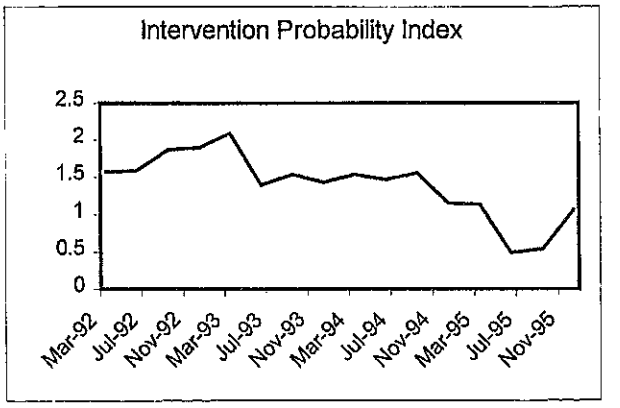
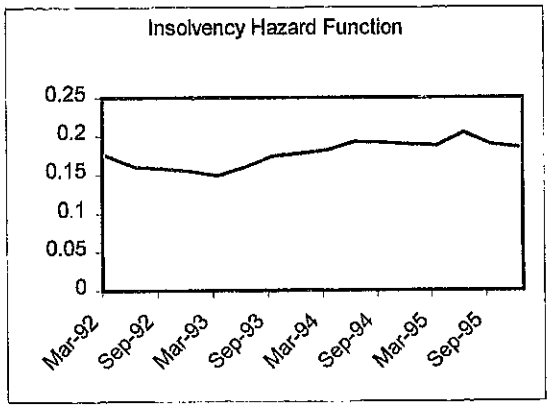
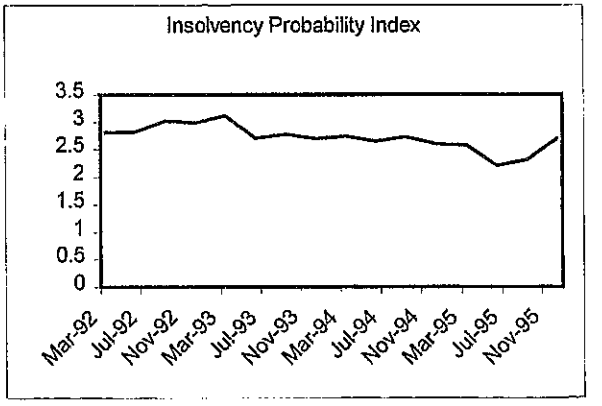


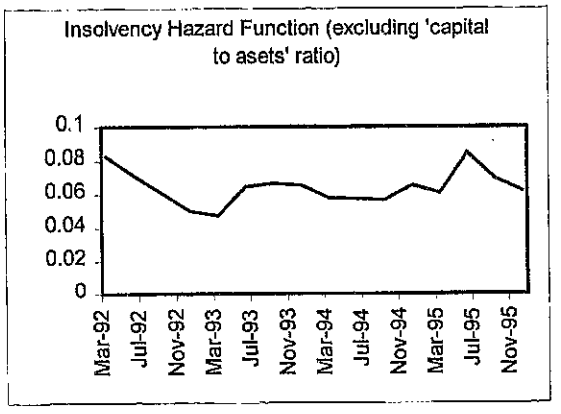
Figure 2-b.
Intervention and Insolvency Hazard Functions and Probabilities: Accounting for the Role of Financial Conglomerates.











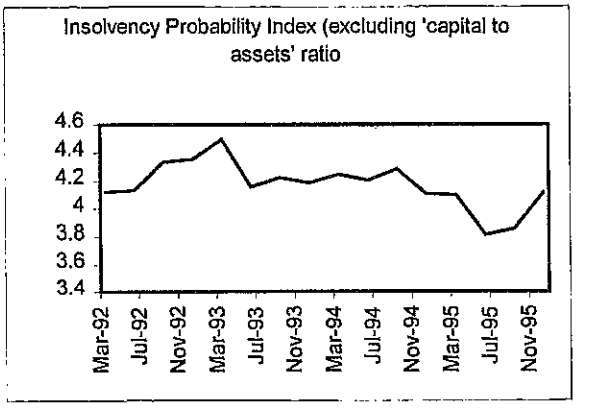
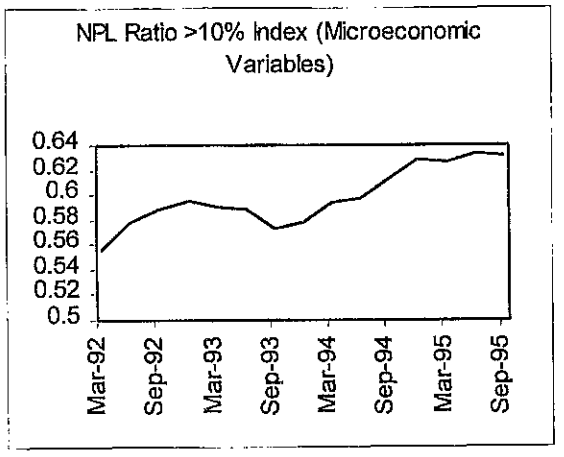
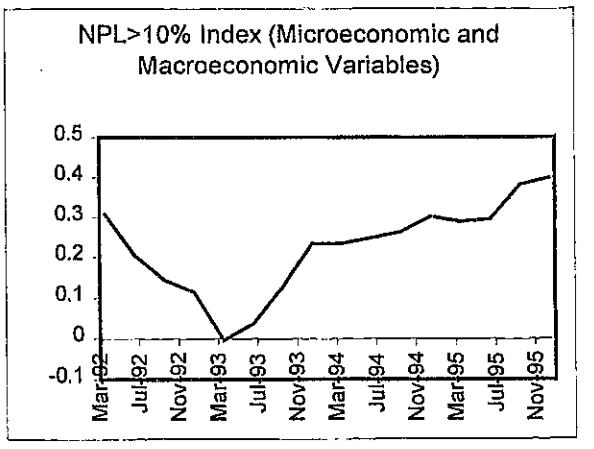
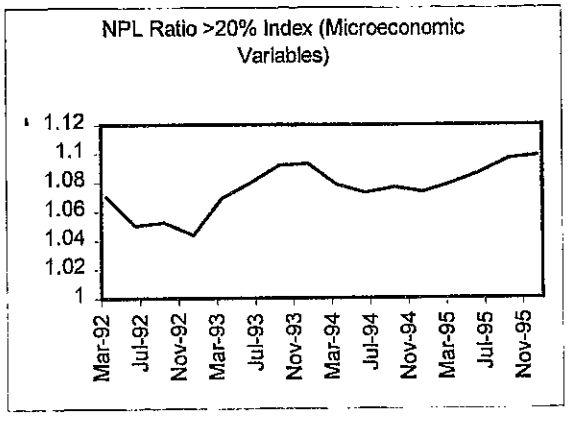
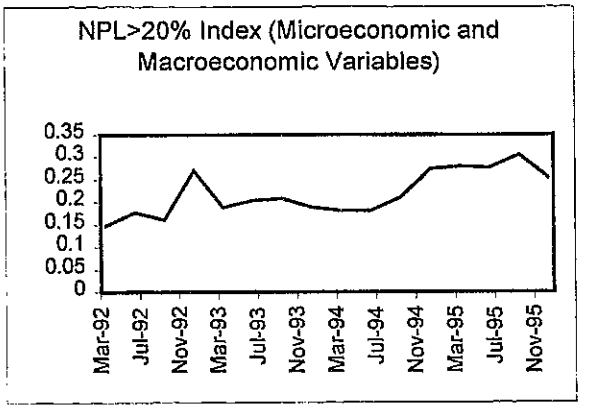


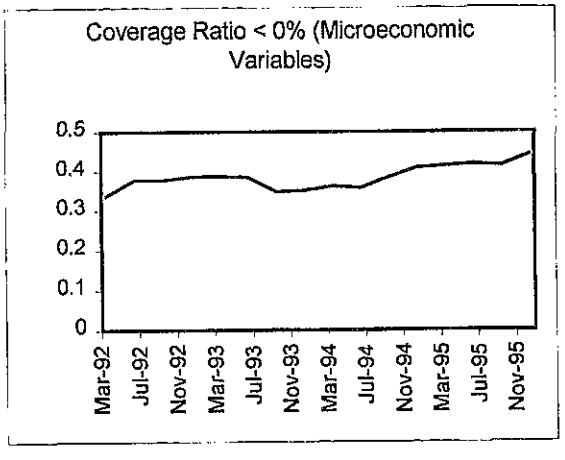
Figure 3-a.
NPL Ratio and Coverage Ratio Indices.











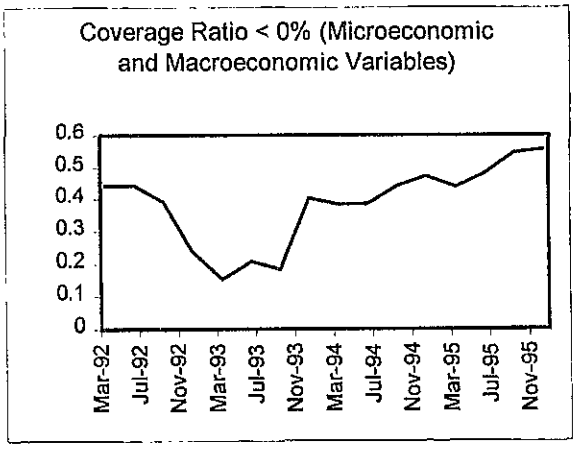


Figure 3-b
NPL Ratio and Coverage Ratio Indices: Accounting for the Role of Financial Conglomerates.