BANK FRAGILITY IN THE CARIBBEAN

by

ROLAND C. CRAIGWELL
Chief Economist
Central Bank of Barbados

and

Tracy Polius
Summer Intern
Central Bank of Barbados
and
Graduate Student
University of the West Indies
St. Augustine Campus

Correspondence Address: Dr. Roland Craigwell, Research Department,
Central Bank of Barbados, P O Box 1016, Bridgetown
Barbados, West Indies.
Tel: (246) 436-6870, Fax: (246) 427-1431,
Email: Craigwell@sunbeach.net

Paper prepared for the XXIX Annual Conference of Monetary Studies to be held at Hilton International, Barbados, October 27-31, 1997.

October 1997

BANK FRAGILITY IN THE CARIBBEAN

by

Roland C. Craigwell and Tracy Polius

ABSTRACT

This paper seeks to determine the factors which contribute to fragility of the banking sector in the CARICOM region. A logit framework is used to examine the factors which determine the probability of bank failure while duration analysis is employed to investigate the factors which influence the timing of bank failure. The results indicate that profitability, market risk and the quality of management are important macroeconomic determinants of the probability of bank failure while the nominal exchange rate and the treasury bill rate are key bank- specific determinants of the probability of bank failure Deposit runs, the level of real gross domestic product and the treasury bill rate are significant variables influencing the timing of bank failure. The growth of the banking sector relative to the economy is a significant contagion effect as it relates to the probability and timing of bank failure.

JEL No: C41, E44, G21

BANK FRAGILITY IN THE CARIBBEAN

I. INTRODUCTION

Within the last decade Caribbean countries have been experiencing difficulties within their financial sectors, which as Forde (1996) points out, have led to negative effects on growth and other macroeconomic aggregates. With this in mind, and given the fragmented and underdeveloped nature of capital markets that exists in the Caribbean region, there is a need to obliterate these difficulties that are affecting the progress of the financial sector. As a first step to achieving this, requires determining the factors which influence the probability and timing of financial institutions failure.

Given this, an empirical methodology proposed by Gonzalez-Hermosillo et al (1996) for Mexico is utilized on the banking sector of a group of Caribbean countries. Specifically, panel data, estimated by limited dependent and duration models, is employed to gauge the significance of bank specific variables, macroeconomic effects and banking sector factors on the likelihood and timing of bank failure.

The paper proceeds as follows: Section II presents some background on bank fragility and the importance of banks; Section III is a brief review of the literature on bank fragility; Section IV discusses the preferred model; Section V presents the model actually estimated; Section VI describes the data used in the study; In Section VII the empirical methodology of limited dependent and duration models is discussed; Section VIII presents an analysis of the results from the estimation process and; Section IX concludes with a summary of the results and suggestions for future research.

II. SOME BACKGROUND

Why are banks important in the Caribbean?

Although the legal definition and activities of banks vary across countries, most banks share similar characteristics. Banks create liquid liabilities by accepting deposits from the public and acquire assets which are illiquid and of longer maturity than their liabilities. They assist in the financial intermediation and credit allocation processes and help maintain financial discipline among borrowers. Banks also produce the necessary information for intermediation, provide portfolio diversification for maturity transformation and risk reduction , allocate resources and also facilitate flows of revenue and payments.

In the Caribbean commercial banks dominate the financial system. For instance, in Barbados commercial banks account for about 60% of total liabilities in the financial sector and 50% of all loans of deposit taking institutions. [1] A sound banking system is therefore important because of the key role it plays in such economies, operating at the center of economic and financial activity and acting as the main providers of liquidity and a fulcrum for monetary policy implementation.

What is Bank Fragility?

A banking system is fragile when the banks which account for the major share of assets and liabilities are insolvent or likely to become insolvent. It is difficult to find a precise definition for bank fragility since there is no benchmark measure for systemic insolvency. However, there are few indicators which one can use to determine whether a bank is failing.

[1] The deposit taking institutions are commercial banks, trust companies, credit unions, finance companies and life insurance companies.

Insolvency is one of the major indicators of bank fragility. Solvency of a bank is indicated by the positive net worth of a bank as measured by the difference between assets and liabilities (excluding capital and reserves). Solvency of a bank is therefore linked to profitability, capitalization and quality of management of a bank. Thus profitability, efficiency, quality of management and capitalization are all possible indicators of the health of a financial institution.

The problems of a failing bank normally emerge through illiquidity. In most instances, failing banks are unable to meet their obligations to depositors. However, insolvency normally precedes illiquidity but banks are able to conceal their losses by attracting deposits and liabilities from the public.

III. A BRIEF LITERATURE REVIEW

A few writers have examined banking sector crises in various countries in an effort to determine the contributing factors. Most of these studies have focused on explanation rather than prediction and have concentrated on the probability of failure rather than timing of failure.

Garcia (1994), in a case study approach to banking problems in Indonesia, Turkey and Venezuela, identifies a number of macroeconomic and banking sector variables as contributors to bank fragility. Baer and Klingebiel (1995) also use case analysis to conclude that macroeconomic and banking sector variables are important in explaining financial crises. Miskin (1994) adopts a forward looking approach by attempting to outline signals to the beginning of a financial crisis. He argues that declines in stock prices and unanticipated inflation and increases in interest rates and corporate indebtedness are important signals. Fischer and Gueyie (1995), in an option pricing framework, found that

a combination of bank balance sheet, macroeconomic and policy variables determines the probability of bank failure. Theatin (1997), the only study available on the Caribbean, found using a logit model that bank specific, banking sector and macroeconomic variables are important explanatory variables influencing the probability of failure of bank in Barbados. Gonzalez-Hermosillo et al (1996), who investigate factors that influence both the probability of failure as well as the timing of failure, contend that bank fragility is determined by a combination of bank specific factors, banking sector effects and macroeconomic conditions. Because Gonzalez-Hermosillo et al (1996) examine both the likelihood and timing of failure it is therefore used as a reference point for this study.

IV. THE PREFERRED MODEL

Gonzalez-Hermosillo et al (1996) examined profitability, the quality of management, market risk, credit risk, capital adequacy, deposit runs, interbank market and the size of the bank as bank specific determinants of bank failure. Profitability, proxied by the return on assets (ROA), is used because sustained losses incurred by a bank may lead to failure. On the other hand, increases in profitability are sometimes associated with allocation of funds to high risk projects.[2] A high proportion of loans to a vulnerable sector may contribute to bank failure. Considerable lending to sectors where revenue flows are volatile, such as agriculture, may increase the probability of bank failure as borrowers may fail to honor their debt during difficult periods. Therefore the sign on the profit variable may be ambiguous for both the probability and timing of bank failure.

The quality of management, measured here by expenditure to assets (OEX), impacts on profitability, credit risk, market risk, and hence, costs and efficiency of any bank. Imprudent

---

[2] Recent experience in Jamaica indicates that bank failure is caused to some extent by higher levels of profitability which are related to the funding of high risk projects.

management implies higher costs, which in turn lead to an increase in the probability of failure and a decline in the survival time. However, a problem bank searching for additional funds may tap into the interbank market (IBF), at least temporarily and at a higher premium. Thus, an increase in IBF may increase the probability of failure.

Market risk (measured by the amount of agricultural loans to total loans (AGR) and consumer loans to total loans (CONS)), involves the riskiness and concentration of a bank's portfolio. In general, a large exposure to vulnerable sectors like agriculture, would increase the likelihood of failure and reduce the expected survival time. Credit risk, proxied by nonperforming loans to total loans (NPL), is possible when considerable exposure to bad credit increases the likelihood of failure and decreases the survival time. Capital adequacy, measured by the risk-adjusted capital ratio (CAR), serves as a cushion to absorb shocks and therefore it is expected that banks with higher capacity of capital are less likely to fail.

Deposit runs, proxied by private deposits to loans (DEP), can occur when depositors lose confidence in a particular bank, and it is likely that they will withdraw their funds, thus increasing the probability of failure and reduce the time of failure. Finally, the size of the bank in terms of assets (SIZE), is used to assess whether relatively large banks are more likely to survive because, for example, they are better able to diversify.

With respect to banking sector variables, Gonzalez- Hermosillo et al (1996) considered banks' capacity to extend credit and the riskiness of the overall banking sector as important influences on the likelihood and timing of bank failure. The more risky the overall banking system (OBR) the more prone it will be to failure. The experience of certain countries indicates that banking crises are often associated with a rapid increase in loans relative to gross domestic product (LNI). In an environment of increasing credit and slow economic activity, business people may not be able to generate enough revenue to meet obligations to

the banking sector, leading to pressure on banks and ultimately failure. Though not mentioned by Gonzalez-Hermosillo et al (1996), banks who are controlled by foreign companies (OWN) may be less likely to fail since they are likely to obtain funds from their parent company.

Moving on to the macroeconomic conditions , Garcia et al (1996) contend that banks are derivative institutions in that the solvency of banks reflects the health of customers and the economy as a whole. Thus it should therefore be possible to establish relationships between macroeconomic variables and microeconomic and contagion indicators of fragility. A number of macroeconomic variables, including the economy's real output (GDP), exchange rate (NEXR), interest rates (TBR) and inflation (CPI), are expected to affect the health of the banking system. For instance, unexpected inflation and recessionary conditions are expected to impact negatively on banks' performance. The above discussion gives rise to the following preferred models :

$$\text{INTERVENTION} = \beta_1 DEP + \beta_2 CONS + \beta_3 AGR + \beta_4 ROA + \beta_5 OEX + \beta_6 SIZE + \beta_7 CAR + \beta_8 NPL + \beta_9 IBF + \beta_{10} LNI + \beta_{11} OBR + \beta_{12} GDP + \beta_{13} CPI + \beta_{14} NEXR + \beta_{15} TBR$$

$$\text{DURATION} = \beta_1 DEP + \beta_2 CONS + \beta_3 AGR + \beta_4 ROA + \beta_5 OEX + \beta_6 SIZE + \beta_7 CAR + \beta_8 NPL + \beta_9 IBF + \beta_{10} LNI + \beta_{11} OBR + \beta_{12} GDP + \beta_{13} CPI + \beta_{14} NEXR + \beta_{15} TBR$$

Table I below lists the variables and the expected signs of the coefficients for the probability of failure model as well as the duration model.

V. THE ESTIMATED MODEL

Due to data limitations the preferred models could not be estimated. Instead, the following three models are estimated. Models I and II examine the factors which determine the probability of bank failure, while Model III examines those which influence the timing of bank failure. In Model I, the number of variables is reduced to those for which there were about four hundred observations. Model II includes an additional variable, the ratio of non performing loans total loans, for which there was limited number of observations. Thus, only about one hundred observations were included in Model II.

MODEL I

$$\text{INTERVENTION} = \beta_1 DEP + \beta_2 CPI + \beta_3 CONS + \beta_4 ROA + \beta_5 OEX + \beta_6 TBR + \beta_7 NEXR$$

MODEL II

$$\text{INTERVENTION} = \beta_1 DEP + \beta_2 \text{LNI} + \beta_3 OEX + \beta_4 NPL + \beta_5 NEXR + \beta_6 GDP + \beta_7 ROA + \beta_8 CPI$$

MODEL III

$$\text{DURATION} = \beta_1 DEP + \beta_2 \text{LNI} + \beta_3 NPL + \beta_4 GDP + \beta_5 TBR$$

VI. ECONOMETRIC METHODOLOGY

As panel data is being employed , the econometric techniques should consider not only possible structural changes over time but possible changes over the units used, which in this case, are banks and countries. Although some work is available for panel data with limited dependent variables (see Baltagi (1995)), this work is in its infancy stage and indeed only considers two elements of variability (time and banks, say). The analysis done here requires three elements of variability (time, banks and countries). As a result, this paper follows

previous work and assumes similarity exists across countries, across time and across banks. To the extent that these assumptions do not hold the results may be biased. With these assumptions the text book limited dependent and survival models can be straightforwardly applied (see, for example, Greene (1997)).

Limited Dependent Variable Models

Logit/Probit models belong to a class of models called Qualitative Response models or Limited Dependent Variable models. Qualitative response models are regression models where the dependent variable assumes discrete values. In this paper, a univariate qualitative response model which is defined below is used:

$P(Y=1) = F(\beta' x)$

$P(Y=0) = 1 - F(\beta' x)$

The parameter Y represents a set of dependent binary random variables which assume a value of 1 where there was no intervention within a bank and 0 when there was some form of intervention. β is a set of unknown parameters which will be estimated and they reflect the impact of changes in the explanatory variables on the probability of bank failure. The parameter x represents the set of explanatory variables. The probability that any given bank was intervened is modeled as a linear combination of the explanatory variables (x_i) with weights given by the β coefficients. The estimation exercise seeks to find the optimal values for the β coefficients which involves choosing the most appropriate functional form for F. Two functional forms are generally used:

Probit Model

$F(x) = \Phi(x) = \int^{x}_{-\infty} (2\Pi)^{-½} \exp(-t/2)dt$

Logit Model

$F(x) = \Lambda(x) = (exp(x))/(1+exp(x))$

which are based on the cumulative normal distribution and the logistic distribution, respectively. These two distributions are quite similar in large samples and therefore parameter estimates from logit and probit models, in many instances, tend to be very close. For this reason, this study utilizes the logit model to test the probability of bank failure. Estimation in this model is based on the method of maximum likelihood. Each observation is treated as a single draw from a Bernoulli distribution. The model with success probability $F(\beta' x)$ and independent observations leads to the joint probability or likelihood function:

$$L = \prod [F(\beta' x)]^{y_i} [1 - F(\beta' x)]^{1-y_i}$$

Maximum likelihood estimation is consistent with the idea of finding values for β estimates which maximize the probability of obtaining the observed sample.

Survival analysis

Survival analysis involves the use of data which measures the time to achieve a particular state or complete an action such as failure, death, response or divorce. Such times are subject to random variations and form a distribution which is characterized by three mathematically equivalent functions. These functions are the survival function, the hazard function and the probability density function. For the purposes of this study, the survival function $S(t)$ is defined as the probability that a bank survives longer than time t. The probability density function of survival time is defined as the probability of failure with a small time interval. The survival time has a hazard function which is defined as the probability that a bank fails in a very short interval, given that it has survived until the

beginning of the interval.

Estimation of the hazard and survivor functions may be done by parametric, non-parametric and semi parametric methods. The survival analysis presented in this paper focus on the use of a semi parametric method, the Cox Partial Likelihood Method. This method facilitates the use of exogenous explanatory variables and imposes minimal assumptions about the underlying distribution. Thus, the data is allowed to determine the shape of the hazard function rather than assumed a priori as in Gonzalez-Hermosillo et al (1996) . In this context, this may be important as it is not known a priori how the probability of bank failure behaves over time.

Cox (1972) derived a regression - like survival model which can be estimated when one or more of the covariates are observed along with the duration data. This approach therefore analyses the effect of the covariates on the hazard rate. The formal model is based on the hazard rate at time *t*,

$$h(t,x) = h(t,0)e^{\beta' x}$$

where $h(t,0)$ is the baseline hazard rate at time t for covariate vector 0. In principle, the parameter $h(t,0)$ is a parameter for each observation which must be estimated. The partial likelihood estimator provides a method of estimating β without the estimation of $h(t,0)$.

Cox's model allows for censored data in the measured durations. In the context of this paper an observation is censored when the bank did not survive the sample period. If $T_1 \ldots\ldots T_k$ is allowed to be the set of *k* distinct times in *n* observations. R_i be the vector of banks which are at risk prior to time T_i (that is, the set of banks which have survived longer than or a period equal to time T_i). For every bank j in the index $R_i, t_j \geq T_i$, the probability that a bank fails at time T_i, given that one bank failed at time T_i, is given by,

$$e^{\beta' x} / \Sigma_{j \in R_i} e^{\beta' x}$$

This conditioning eliminates the baseline hazard. If one bank fails and no observations are censored, the partial log likelihood is expressed as:

$$\ln(L) = \sum_{i=1}^{k} [\beta' x - \ln \Sigma_{j \in R} e^{\beta' x}]$$

If $m_i \geq 1$ banks fail at the same time, the partial log likelihood is the sum of the two individual likelihoods,

$$\ln(L) = \sum_{i=1}^{k} [\beta' \Sigma_{j \in Tr} x_j - m_i \Sigma_{j \in Ri} e^{\beta' x}]$$

VII. DATA AND RELATED PROBLEMS

The bank specific data used was sourced from the Central Banks of the various countries. The sample which contains 68 banks, includes all commercial banks operating in Barbados and the OECS and a sample operating in Belize, Guyana and Jamaica. Banking sector and macroeconomic data were collected from various publications of the World Bank, the International Monetary Fund and the countries' Central Banks. Since a sample was drawn from some of the countries, the model does not capture all the banks which failed in the region during the period under consideration and therefore accounts for possible sample selection bias. The model was built using panel data from the various countries for the years 1990 to 1996.

A few variables related to individual banks are examined in this paper. As mentioned earlier, these include the ratio of private deposits to total loans (DEP) which is used as a measure for deposit runs. Profitability is captured by the return on assets ratio (ROA), which

is the ratio of net income to total assets. The quality of bank management is proxied by the ratio of operating expenses to total assets (OEX). Credit risk is measured by the ratio of nonperforming loans to total loans (NPL), while market risk is proxied by the ratio of consumer loans to total loans (CONS).

Only one banking sector variable is examined in this paper. The growth of credit relative to growth of the economy which is proxied by the ratio of total loans to real gross domestic product (LNI). Real gross domestic product (GDP), the treasury bill rate (TBR), consumer price index (CPI) and the nominal exchange rate(NEXR) are the macroeconomic variables used in this study.

There are two data - related problems which could affect the reliability of the estimates from the models. One, there were insufficient observations for a few variables which would probably increase the probability of bank failure. The level of non-performing loans, risk adjusted capital adequacy ratio, residential mortgages, foreign borrowing, interbank funds and central bank borrowing were not available for a large number of the observations. As a result of this data limitation, only non-performing loans was used in the estimation process. Due to this problem two models were estimated; the first was estimated using the more consistent series and the second using the series with many missing observations.

Second, in this paper a bank is considered to be intervened when the bank ceases operation, the central bank or government agency assumes operation or when the government agency or central bank injects funds into the bank. An element of bias may be introduced in the model due to the fact that intervention as defined above is not necessarily synonymous with failure of the bank in question. In one of the countries examined there was intervention in two banks. Government intervened to prevent the failure of Bank F in 1993. In 1991, the Central Bank sold the assets of the second bank , Bank G. Bank G can be divided into two

banks, Bank G_1 and Bank G_2. This intervention however was not due to the financial situation of bank G or the economic and financial environment, but to problems met by the head office. In 1993, the activities of Bank G_1 were suspended and assets sold to Bank G_2. It was thought that the level of foreign ownership of a bank would assist in explaining the probability of bank failure but due to data limitation the variable was not included.

The results for the determination of the factors influencing the probability of bank failure may be biased because intervention does not always occur at the time a bank fails. A bank may become insolvent years before there is any decision to intervene in the operations of the bank. The estimates from the survival analysis may suffer a similar fate. The dependent variable, duration, should be defined over the life of the bank, however it is defined over the sample period.

VIII. RESULTS

Probability of Failure

This section presents the findings from the estimation of Models I and II which are presented in Tables II and III below. In Model I seven variables were examined. Five of these were found to have a significant influence on the probability of bank failure. However, it must be noted that the effects of the banking sector variables were not investigated in Model I. From the results it is evident that bank fragility is determined by a combination of microeconomic and macroeconomic factors.

The return on assets ratio (ROA) is significant and positively related to the probability of bank failure. This implies that as the net profits of a bank increases, the probability that it will fail also increases. This result seems unusual given what is known about Caribbean countries but it must

be noted that higher levels of profitability may be associated with risky and mega projects which could increase the probability of failure, as in the case of Jamaica. Higher levels of profitability may also be associated with holding of volatile short term financial instruments and foreign exchange speculation.

The quality of management (OEX) is significant and also positively related to the probability of failure. It is not unreasonable to assume that continuous increases in operating expenses without the mitigating effects of profitability gains or boosts in capital will increase the probability of bank failure. Market risk (CONS) is significant at the 10% level. This indicates that as the level of consumer loans expands, the level of loan default and hence the probability of bank failure increases. This result suggests that there is a high level of risk associated with increased consumer borrowing from the banking system.

The nominal exchange rate (NEXR) shares a significant negative relationship with the probability of failure. As the domestic currency depreciates the probability of failure augments. Currency depreciation is usually accompanied by increases in domestic and foreign prices. This inflationary effect may reduce businesses' overall profitability and the level of loan default. Thus, this negative relationship is consistent with theoretical expectations. The treasury bill rate (TBR) is positively related to the probability of failure. High treasury bill rates may signal difficult economic circumstances (such as excessive government deficits) which may increase the fragility of the banking system. The Consumer price index (CPI) is negatively related to the probability of failure. This result is contradictory to a priori expectations that increases in prices will increase the probability of bank failure. In an inflationary environment, banks may request higher values of collateral to costs. If collateral values are greater than costs the probability of bank failure may decrease.

The ratio of private deposits to total loans (DEP) is insignificant. Experience has indicated that banks have failed in the Caribbean mainly because of credit and market risk. The fact that the deposit run proxy is insignificant is therefore not a surprising result.

Model II included two new variables. The ratio of non-performing loans to total loans (NPL) and the ratio of total loans to gross domestic product (LNI). Gross domestic product was included while, the ratio of consumer loans to total loans and the treasury bill rate were dropped from the model based on initial runs and to preserve degrees of freedom. Likewise, more banking sector variables could not be included in the model as there would not be sufficient degrees of freedom to facilitate estimation.

The results from Model II show that most of the variables which were significant in model I remained significant. However, the signs of all these variables except the consumer price index changed. The change in sign may be due to the small number of observations included in the model. The ratio total loans to gross domestic product (LNI) is significant at the 10% confidence level and is positively related to bank fragility. This result is in keeping with the experience of countries which have experienced financial crisis. Banking crises are often associated with a rapid rise in loans relative to GDP. Sustained increases in LNI would therefore imply a higher probability of bank failure.

Profitability (ROA) in this model is negatively related to the probability of failure. In general, increases in the level of profitability enables a bank to improve economic viability, thus being negatively related to bank fragility. The quality of management (OEX) is also negatively related to the probability of failure. This suggests that as operating expenses increase the probability of failure is reduced. In the Caribbean increases in operating expenses during the period under consideration could be explained by an increase in process innovation and modernization costs. Financial innovation and modernization are often associated with an increase in efficiency. Thus, increases in operating expenses may be compensated for by increased profits.

The nominal exchange rate is positively related to the probability of failure. This could be explained by the fact that as a currency appreciates exports become less competitive. As a consequence, domestic producers may find it difficult to maintain their market share and therefore increase loan defaults. The ratio of private deposits to total loans is negatively related to bank failure, suggesting

that as the share of private deposits in a bank's loans portfolio becomes smaller the probability of failure increases. Nonperforming loans do not exert any significant influence on bank fragility in this model. This is a surprising result but this may due to the small number of observations. The level of real Gross Domestic Product is also insignificant. The consumer price index is again inconsistent with our expectations. The coefficient is negative and significant.

Timing of Failure

Table IV presents the results from the survival analysis. Model III was estimated using five time dependent covariates. All the variables examined in the model are significant. Four of these variables carry the anticipated signs. The proxy for credit risk (NPL), while significant, is positively related to survival time. This suggests that as the level of non performing loans increases the survival time of the bank increases.

Real Gross Domestic Product is positively related to survival time and is consistent with the a priori notion that increases in the level of real output will increase banks' survival time through stimulation of business and financial activity. The treasury bill rate is negatively related to survival time. It has been hinted earlier that increasing treasury bill rates may be an indication of economic stress which would have a negative impact on banking activity. The proxy measure for deposit runs (DEP) is negatively related to bank survival time. Thus, as this ratio becomes smaller the survival time of the bank is reduced. This is expected because, it may indicate that the general community is losing confidence in the bank's ability to safeguard their interests. The proxy measure for the growth of credit in the banking sector relative to growth of the economy (LNI) is negatively related to bank survival time. This is in keeping with the view that banking crises are often associated with the rapid growth of credit relative to growth of the economy.

IX. CONCLUSION

This paper argues that bank fragility in the Caribbean is determined by bank-specific factors as well as macroeconomic conditions. Due to data limitations, the study was unable to adequately assess the effect of other banking sector variables on the probability of bank failure.

The results suggest that profitability (ROA), the quality of management (OEX) and the ratio of consumer loans to total loans (CONS) are the most important microeconomic variables in terms of determining the probability of bank failure. The survival analysis indicates that the proxy for deposit runs and excessive growth of credit relative to growth of the economy are important in terms of determining the timing of bank failure. Thus, market risk, profitability, deposit runs and management and growth of the banking sector relative to the economy seem to be crucial indicators of fragility.

The performance of the macroeconomic variables suggest that adverse macroeconomic shocks may put tremendous pressure on the banking system and increase the likelihood of bank failure. Real GDP and the treasury bill rate were found to be significant in relation to the timing of bank failure. The exchange rate is an important tool for economic adjustment and the results suggest that there should be many considerations when a country is contemplating devaluation. Devaluation may be an important policy but this study suggests that it may have undesirable fallout of increasing bank failure.

Future research should include examining the contribution of other banking sector variables and microeconomic variables to the probability of bank failure. It may be useful to use an alternative method to determine which factors contribute to the probability of bank failure and time to bank survival. A case study approach focusing on explanation rather than prediction may be complementary to this study. This paper serves as a point of departure in examining the problems of the banking sector of the region. It is hoped that the paper demonstrates the importance of such an exercise and that data may be made more readily available for future research.

REFERENCES

Baer, Herbert and Dariela Klingebiel, "Systemic Risk When Depositors Bear Losses: Five Case Studies" in *Banking, Financial Markets, and Systemic Risk*, Vol. 7, George E. Kaugman, Jai Press: Greenwood, Conneticut, 1995, pp. 195-302.

Baltagi, Badin H., *Econometric Analysis of Panel Data*, John Wiley & Sons: New York, 1995.

Cox, D., "Regression Models and Life Tables" *Journal of Royal Statistical Society*, Series B, 34, 1972, pp. 187-200.

Fischer, Klaus P. and Jean-Pierre Gueyie, "Financial Liberalization and Bank Solvency", paper presented at the Symposium on Business Finance in Emerging Markets, University of Laval, Quebec, August, 1995.

Forde, Penelope, "Financial Crises in Trinidad and Tobago", *Money Affairs*. Vol. IX (2), July - December, 1996, pp. 53-71.

Garcia, Gillian, "Comparing and Confronting the Recent Banking Problems in Indonesia, Turkey and Venezuela", International Monetary Fund, mimeo, December 1994.

Garcia, Gillian, Lindgren Carl-Johan and Matthew Saal, *Bank Soundness and Macroeconomic Policy,* International Monetary Fund: Washington, D.C., 1996

Greene, W. H., *Econometric Analysis*, Prentice-Hall International: London, 1997.

Gonzalez-Hermosillo, Brenda at al. "Banking System Fragility: Likelihood versus Timing of Failure - An Application to the Mexican Financial Crisis" International Monetary Fund Working Papers No. 142, December 1996.

Miskin, Frederic S. "Preventing Financial Crises: An International Perspective", NBER Working Paper No. 4636, February 1994.

Theatin, Laurence, "Predicting the Fragility of the Financial Institution in the Caribbean Community", mimeo, Central Bank of Barbados, June 1997.

Table I

EXPLANATORY VARIABLES

Variable	Expected Sign Failure	Expected Sign Survival
Bank Specific Variables		
Consumer loans to total loans (CONS)	+/-	+/-
Agriculture loans to total loans (AGR)	+/-	+/-
Capital adequacy ratio (CAR)	-	+
Net income to total assets (ROA)	+/-	+/-
Expenditure to total assets (OEX)	+	-
Private deposits to total loans (DEP)	+	-
Bank assets to total banking sector assets (SIZE)	+/-	+/-
Interbank funds to total loans (IBF)	+/-	+
Non-performing loans to total loans (NPL)	+	-
Banking Sector Variables		
Risk of the banking sector (OBR)	+	-
Assets of foreign banks to total banking assets	-	+
Total loans to GDP (LNI)	+	-
Macroeconomic Variables		
Inflation (CPI)	+	-
Real GDP (GDP)	-	+
Nominal exchange rate (NEXR)	+	-
Treasury bill rate (TBR)	+	-

Table II

LOGIT MODEL

Results from estimation of Model I

Dependent Variable: Intervention				
Variable	*Coefficient*	*Standard Error*	*T-Statistic*	*Probability*
TBR	1.005	0.292	3.439	0.006
DEP	0.110	0.443	0.250	0.802
CPI	-0.057	0.016	-3.613	0.000
NEXR	-0.163	0.042	-3.868	0.000
CONS	7.874	4.783	1.646	0.101
ROA	36.589	14.682	2.491	0.013
OEX	33.232	13.806	2.407	0.017

.Source: Econometric Views Output

Table III

LOGIT MODEL

Results from estimation of Model II

Dependent Variable :Intervention				
Variable	*Coefficient*	*Standard Error*	*T-Statistic*	*Probability*
NPL	-32.726	32.233	-1.015	0.313
DEP	-9.587	6.422	-1.493	0.139
OEX	-200.66	112.025	- 1.791	0.077
CPI	-0.551	0.341	-1.618	0.109
ROA	-346.77	187.37	-1.850	0.068
NEXR	19.832	9.567	2.072	0.041
LNI	0.477	0.286	1.668	0.092
GDP	0.024	0.019	1.245	0.216

Source: Econometric Views Output

Table IV

COX PARTIAL LIKELIHOOD MODEL

Results from estimation of Model III

Dependent Variable : Duration			
Variable	*Coefficient*	*Standard Error*	*Probability*
DEP	-27.785	0.038	0.000
LNI	-0.0015	0.0054	0.005
NPL	567.18	0.0301	0.000
TBR	-22.45	0.0274	0.000
GDP	0.281	0.0007	0.000

Source: LIMDEP output

BANK SPECIFIC VARIABLES	
Profitability	ROA
Quality of Management	OEX
Interbank	IBF
Market Risk	AGR, CONS
Credit Risk	NPL
Capital Adequacy	CAR
Deposit Runs	DEP
Size	SIZE

Table IV

COX PARTIAL LIKELIHOOD MODEL

Results from estimation of Model III

Dependent Variable : Duration			
Variable	*Coefficient*	*Standard Error*	*Probability*
DEP	-27.785	0.038	0.000
LNI	-0.0015	0.0054	0.005
NPL	567.18	0.0301	0.000
TBR	-22.45	0.0274	0.000
GDP	0.281	0.0007	0.000

Source: LIMDEP output

BANKING SECTOR VARIABLES	
Risk in Banking System	OBR
Loans Relative to Growth	LNI
Foreign Control	OWN

MACROECONOMIC VARIABLES	
Real Growth	GDP
Inflation	CPI
Interest Rate	TBR
Exchange Rate	NEXR