Determinants of the Venezuelan Banking Crisis of the Mid-1990s: An Event History Analysis

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Abstract: This paper uses event history analysis to test the significance of several macro-economic and bank-specific variables in explaining bank failures during the Venezuelan banking crisis of the mid-1990s. Poor bank profitability, proxied by a low net interest margin, and low GDP growth are found significant in increasing the probability of bank failure. Other useful indicators, for some model specifications, are the share of non-performing loans and that of non productive assets to banks' own funds, which raise the likelihood of crisis. A large amount of bank liquid assets, in turn, reduces the likelihood of failure for some model specifications. The opposite is true for high real deposit rates. Although it could be interpreted, at first sight, as a too restrictive monetary policy, this is not supported by the lack of significance of the real lending rate and, even more so, real money growth, a more direct indicator of the monetary policy stance.

Keywords: Venezuela, banking crisis, early indicators.

Resumen: Este trabajo utiliza un análisis de historia de eventos para evaluar empíricamente qué variables macroeconómicas y bancarias pueden explicar las quiebras bancarias que se produjeron durante la crisis de la segunda mitad de la década de 1990 en Venezuela. Una baja rentabilidad, medida por el margen financiero neto, y el escaso crecimiento económico resultan significativos en aumentar la probabilidad de quiebra bancaria. Otros indicadores útiles, para algunas especificaciones del modelo, son el porcentaje de activos impagados y el de activos improductivos respecto a los recursos propios, que aumentan la probabilidad de crisis. Por el contrario, una proporción elevada de activos líquidos reduce la probabilidad

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de quiebra en algunos casos, mientras que tipos de interés altos sobre depósitos la aumentan. Aunque este último resultado podría hacer pensar que la política monetaria en Venezuela fue excesivamente restrictiva antes de la crisis, no existe evidencia que lo confirme en el caso de otras variables clave como los tipos de interés reales sobre préstamos y, más aún, el crecimiento de la masa monetaria en términos reales.

Palabras clave: Venezuela, crisis bancarias, indicadores adelantados.

Introduction

Recurrent events of banking crises around the world have generated an extensive literature from causation to prevention. However, there is still no consensus on which are the main determinants of bank failure, so that an early warning systems constructed to prevent such failures, or at least minimize their impact. This explains the efforts made by the International Monetary Fund and national authorities from different countries to identify a set of financial soundness indicators to be used as a surveillance tool of potential crises (Sundararajan *et al*., 2002). However, the validity of a specific set of indicators is still not firmly confirmed by empirical analysis, particularly for emerging countries.

In the mid-90s, Venezuela experienced a systemic banking crisis, with a large amount of bank failures and a fiscal cost estimated at 17% of the GDP. Notwithstanding the severity of the crisis, there is no empirical analysis of the determinants of these bank failures. Such analysis could contribute to building early indicators of bank unsoundness for the Venezuelan banking system, particularly if they do not require much calculation and can be easily tracked.

The most obvious indicators, and also those analyzed first in the literature, are bank specific variables from bank balance sheets or financial statements. More recently, macroeconomic indicators have received large attention, especially in the case of emerging countries. This is because macroeconomic imbalances are generally larger and more frequent in these countries and also tend to have bigger consequences, financial systems being shallower. However, macroeconomic variables alone can hardly explain the failure of a particular institution, which limits policy conclusions to the aggregate level. It seems important, therefore, to include both bank-specific and macroeconomic variables as potential determinants of banking crisis.

This paper uses event history analysis to test the significance of several macro-financial and bank-specific variables in explaining bank failures during the Venezuelan banking crisis of the mid-1990s. Of special interest is the role of monetary policy since several observers have argued that a too restrictive monetary policy stance was at the origin of the Venezuelan crisis. Although data availability is an issue, which constraints the robustness and generality of the results, poor bank profitability and low GDP growth are found significant in increasing the likelihood of bank failure. In addition, bank solvency, asset quality and liquidity indicators are significant in some bi-variate and three-variate model specifications. The same is true for high real deposit rates, which, however, do not seem to be related with the monetary policy stance as will be explained.

The structure of the paper is as follows. Section I reviews the main early warning indicators of bank failures, found in the literature, and the different methodologies used. Section II describes the origin and developments of the Venezuelan banking crisis. Section III sets out the paper's objective. Section IV explains the methodology used. Section V describes the variables included and the expected results. Section VI reports the results and Section VII draws some conclusions and possible extensions to the paper.

I. A Review of the Literature

The empirical research on the determinants of bank failures started as early as the 1970s and concentrated on bank-specific variables. This strand of the literature, but also future ones, is generally non-structural since its main focus is finding "early warning indicators" of bank insolvency or failure on the basis of the available data. Most indicators are drawn from bank balance sheets and income statements and very few (and virtually only for the US) are market-based. The latter are based on the assumption that all available information relevant to the financial health of a bank is reflected in bank asset prices, generally equity and/or debt prices.

In the 1990s, the large number of crisis in emerging countries, associated in many instances with macroeconomic instability, drew researchers' attention to macroeconomic variables. Most studies focused on systemic banking crises rather than individual bank failures so conclusions are hard to draw for individual bank failures. There

are a number of studies, though, which deal with bank failures exploring the relevance of macroeconomic and bank-bank specific factors (Whalen, 1991; Cole and Ghunter, 1995; González-Hermosillo *et al*., 1996; González-Hermosillo, 1999; and Arreaza *et al*., 2002). In addition, most of the studies have been applied to US banks and only a few to emerging countries. In particular, there is one study for Venezuela, which focuses on bank unsoundness during the most recent period but not during the mid-1990s banking crisis (Arreaza *et al*., 2002). Tables 1 and 2 summarize the main findings of the literature. The first lists the empirical studies using only bank-specific variables together. The second shows those with macroeconomic variables or both together.

The methodologies used have also evolved over time. In the early 1970s, the main tool was discriminant analysis based on banking indicators (Sinkey, 1975, and Altman, 1977, among others). These are *a priori* undefined models, which simply discriminate between problem and non-problem institutions rather than estimating the probability of failure on the basis of certain independent variables. To this end, a linear or quadratic discriminant function is estimated, which maximizes the difference between the two groups. Starting in 1977, *ex post* empirical models, mainly binary ones, are employed to estimate the probability of failure conditional on certain bank-specific variables (Martin, 1977). The main difference between the two is that the former is a mere classification technique while the latter analyzes a causal relationship. The same technique has been used in the 1990s to test the relevance of macroeconomic variables in explaining banking crises.

More recently, survival models have been applied to explaining bank failures. Most of the studies are parametric and continuous, based on proportional hazard functions. The most widely used is the Cox proportional hazard function because it partially avoids the strong distributional assumptions associated with parametric survival models (Wheelock and Wilson, 2000). One of the caveats of these models, though, is that coefficients are kept stable, while there is evidence that they are not (Hooks 1995). Another important weakness of this methodology is that the difference between the determinants of bank failure and the factors affecting the timing of bank failure cannot be separated since it is implicitly assumed that all banks will ultimately fail. This is why some authors separate the factors influencing the likelihood of bank failure –allowing for a probability of failure below one– from those that condition the timing of failure (Cole and Gunther, 1995; Wheelock and Wilson, 1994; and González-Hermosillo *et al*., 1996).

Table 1. Review of the Literature on Bank-specific Indicators of Bank Failures

Only banking variables	*Sinkey (1975)*	*Altman (1977)*	*Martín (1977)*	*Avery and Handweck (1984)*	*Barth* et al. *(1985)*	*Benston (1985)*	*Lane* et al. *(1986)*	*Gajewski (1988)*	*Barker and Holdsworth (1993)*	*Berg and Hexeberg (1994)*	*Anastasi* et al. *(1998)*		*Wheelock and Wilson (2000)*	*Logan (2001)*
											PF	*Timing*[a]		
Capital adequacy	X	X	X	X	X	X	X	X		X	X	X	X	X[b]
Asset quality	X	X	X	X				X	X	X	X	X	X	X
Management competence	X						X	X		X		X	X	X
Earnings	X	X	X	X	X	X	X	X	X	X	X	X	X	
Liquidity					X		X							X
Other								Fraud	Loans (+) Fraud (+) Size (-)				Freedom to branch (–)	Loan growth (–)
Methodology	DA	DA	L	L	L	L	CPHM	TwostepL	L	L	L	PHM*	PHM*	L
Sample	US (1969-1972)	US (1966-1977)	US (1970-1976)	US (1978-1977)	US (1981-1984)	US (1981-1985)	US (1979-1983)	US (1984-1986)	US (1986-1992)	Norway (1988-1992)	Argentina (1994-1997)		US (1984-1993)	UK (1990-1994)

DA: Discriminant analysis.
L: Logit, P: Probit.
PHM: Proportional Hazard Model (Cox).
PHM*: Proportional Hazard Model with time-variant coefficients.
[a] A positive sign indicates a longer survival rate.
[b] In contrast to the other studies, a higher capital adequacy ratio is found to increase the probability of crises.

Table 2. Review of the Literature on Bank-specific and Macro-financial Indicators of Banking Crises[a]

	Whalen (1991)	*Cole and Gunther (1995)*		*González-Hermosillo* et al. *(1996)*		*Demirgüç-Kunt and Detragiache (1997)*	*Ardí and Pazar-basioğlu (1998)*	*González-Hermosillo (1999)*		*Arreaza et al. (2002)*
		PF	*Timing*	*PF*	*Timing*			*PF*	*Timing*	
Banking Variables										
Capital adequacy	X	X	X	X	X				X	X[b]
Asset quality	X	X	X	X	X				X	
Management competence	X									
Earnings	X		X		X				X	
Liquidity										X
Other		Size	Agriculture and real state loans (+)		Residential to total loans (+) Size (+)				Loan. int. rate (–)	

D.A.: Discriminant analysis.

L: Logit, P: Probit.

PHM: Proportional Hazard Model (Cox).

PHM*: Proportional Hazard Model with time-variant coefficients.

[a] Results are also reported for US Southwest (1986-92), US Northeast (1991-92), California (1992-93) and Mexico (1994-1995). The latter are virtually the same as in González-Hermosillo *et al.* (1996). Results for the US are not reported because of the very large number of studies available for that economy and the lack of space.

[b] In contrast to the other studies, a higher capital adequacy ratio is found to increase the probability of crises.

Table 2. (continued) Review of the Literature on Bank-specific and Macro-financial Indicators of Banking Crises

	Whalen (1991)	*Cole and Gunther (1995)*		*González-Hermosillo* et al. *(1996)*		*Demirgüç-Kunt and Detragiache (1997)*	*Ardí and Pazar-basioğlu (1998)*	*González-Hermosillo (1999)*		*Arreaza et al. (2002)*
		PF	*Timing*	*PF*	*Timing*			*PF*	*Timing*	
Macro-financial Variables										
				Real ex. rate appreciation (–)	Real exchange rate appreciation (–)		Real ex. rate appreciation (+)			Real exchange rate appreciation (+)
					Real int. rate (+)	Real int. rate (+)		Real Interest rate (+)		
						Real GDP growth (–)	Real GDP growth (–)			Real GDP growth (-)
Other	Change in housing permits (+)		Oil (+)	Bank credit to GDP (+)		Inflation (+)	Credit expansion (+)	Adverse trade shocks (+)		Real deposit rate (+)
							Rising real int. rates (+)			
							M2/Reserves (+)			
							Bank foreign liabilities (+)			
Methodology	CPHM	L	PHM	L	PHF	L	L	L	PHF	P
Sample	US (1987-1990)	US (1986-1992)		México (1994-1995)		65 countries (1980-1994)	50 countries (1975-1997)	Colombia (1982-1987)		Venezuela (1997-2000)

D.A.: Discriminant analysis.
L: Logit, P: Probit.
PHM: Proportional Hazard Model (Cox).
PHM*: Proportional Hazard Model with time-variant coefficients.

Regardless of the method of estimation, the variables which are found significant across different studies are rather similar. This is particularly interesting if one takes into account that the definition of bank failure varies widely in the literature. In general, no distinction is made between insolvency and failure (Demirgüç-Kunt, 1989a). Some authors encompass both concepts in relatively objective definitions, such as book-value insolvency (when the book value of a bank's assets is less than the book value of its liabilities) or market-value insolvency (when the market value of a bank's assets is less than the value of its liabilities net of the value of insurance guarantees) or the concession of financial support by the central bank to a given institution (González-Hermosillo *et al*., 1996). Others use more subjective definitions, such as official insolvency (i.e., when capital is judged inadequate by the regulators and the institution is closed or merged), or *de facto* failure (when a bank ceases to conduct autonomous operations induced by the regulator). A few authors separate insolvency from failure, considering the latter a regulator-determined event (Gajewski, 1988, and Demirgüç-Kunt, 1989b).

There are a few core factors which are generally found significant in affecting the likelihood of failure, not only for US samples but also for other countries. These are measures of capital adequacy (e.g., capital to total loans or assets, or capital to risk-adjusted assets), asset quality (e.g., non performing loans or loan loss reserves to total loans or assets) and profitability indicators (e.g., net or gross income or earnings to total assets or capital). However, early indicators of capital adequacy have sometimes a counterintuitive sign, indicating an increase in the probability of bank failure when capital adequacy is high (Logan, 2001, and Arreaza *et al*., 2002). Management quality and liquidity measures are significant in fewer studies. The relatively weaker significance of management quality is probably related to the difficulty in proxing it. Some recent studies have made large strides in finding management-related early indicators of bank failures but they are very difficult to apply for countries where data is poorer or scarce (Wheelock and Wilson, 2000). As for liquidity, some studies do not test liquidity indicators under the assumption that liquidity problems are symptoms of a crisis rather than the cause of it (Berg and Hexeberg, 1994).

The evidence for market-based indicators (e.g., return on bank stocks but also option pricing techniques and subordinated debt) is drawn practically only for US samples and is mixed. Pettway (1980),

Pettway and Sinkey (1980) and Shick and Sherman (1980) show that problem banks experienced unexpectedly low stock market returns before being classified as problem banks by the regulators. However, Simons and Cross (1991) find no such evidence. In the same vein, Randall (1989) argues against the usefulness of both bank stock prices and ratings as early-warning signals of bank problems.

Finally, a number of macroeconomic variables are generally found significant in aggregate empirical studies of banking crises. This is the case of low economic growth and high interest rates, which appear to anticipate banking crises (Hardy and Pazarbasioğlu, 1998; Demirgüç-Kunt and Detragiache, 1997), as well as adverse trade shocks, real exchange rate appreciation and banks' large foreign liabilities. The first two variables, and particularly high real interest rates, are also robust in bank-to-bank estimations (González-Hermosillo *et al*., 1996; González-Hermosillo, 1999; and Arreaza *et al*., 2002). Rapid growth in bank credit to the private sector appears to increase the likelihood of banking crises in macroeconomic studies, but the evidence is not supported by micro-studies with bank-specific variables. As example of the latter is Logan (2001), who finds the opposite result for UK banks.

II. The Venezuelan Banking Crisis

Prior to the adoption of a bold program of macroeconomic stabilization and financial liberalization in 1989, the Venezuelan banking system was composed of a large number of privately-owned, specialized banks belonging to a few financial groups. These were undercapitalized and remained, to a large extent, outside the control of the supervisory authority (SUNDEBAN). A number of banks failed during this period but the government bailed them all out. The 1989 economic program, which included the opening up of the Venezuelan banking system to foreign competition, was not fully introduced. While restrictions on interest rates and foreign currency transactions were abolished and the Bolivar was allowed to float, measures to increase competition in the financial sector were held back by Congress. This meant that the structure of the financial system remained virtually unchanged until the crisis erupted, with foreign-banks holding less than 1% of total assets and state-owned banks holding no more than 10%. The oligopolistic structure of the Venezuelan financial system constrained the power of the supervisory authority, particularly as regards the

accuracy of the data that banks reported. In addition, because of the absence of consolidated supervision, financial groups had all the incentives to divert problem loans and losses to their affiliates, particularly those off-shore. Finally, the lack of competition allowed for an excessive cost structure and low efficiency within the banking system.

The early part of the 1990s was characterized by fast growth, largely driven by a rapid expansion in the non-oil sector. However, the government fiscal position deteriorated significantly. Two attempted military coups during 1992 heightened the uncertainty about the country's political and economic stability. During this period monetary policy switched from a tight stance to a lax one, avoiding increases in interest rates. There were several runs on the Bolivar, which depreciated sharply.

The fast economic expansion came to a halt in 1993 and real GDP fell by 0.1% that year. The budget deficit further deteriorated. Political uncertainty persisted as Congress removed President Pérez from office, on charges of misuse of funds. Inflation accelerated and economic activity further slowed down and contracted by about 4.7% in the first quarter of 1994.

Despite financial liberalization and the high economic growth during 1991-92, the stock of commercial bank credit declined from an average of about 22% of GDP in the period from 1989 to 1992 to 16% in 1992. The worsening of the economic conditions and political uncertainty contributed to the sharp reduction in bank credit. At the same time, non-performing loans rose sharply from 1991 to 1992.

In October 1993, a new financial legislation was approved, aimed at increasing competition in the banking sector and strengthening supervision. This legislation permitted multipurpose banking and established stricter capital requirements for banks and other financial institutions shortly after, and despite the spirit of the new financial legislation, a banking crisis broke out against a background of macroeconomic imbalances and political uncertainty.

The crisis was triggered by the collapse of Banco Latino in mid-January 1994, the second largest bank in terms of deposits.[1] From the last quarter of 1993, when rumors spread about its distressed financial situation, Banco Latino had to meet major deposit withdrawals through large scale asset sales and borrowing from the Central Bank of Venezuela (CBV). These withdrawals became unsustainable by end-

[1] The next paragraphs describing the crisis developments are drawn from García Herrero (1997).

1993 when they reached twice the amount of the bank's capital. Consequently, Banco Latino and its related institutions were closed. Through the closure, the group's financial liabilities were frozen, affecting over 10% of total commercial banks' deposits, including a large share of trust funds, pension funds, government deposits and interbank deposits. Among the reasons which contributed to Bank Latino's failure, reportedly the most important ones were inappropriate lending practices, which allowed collateral to be used for multiple loans, poor loan quality, and a high concentration in real state loans.

The uncertainty created by the freezing of Banco Latino's deposits led to deposit runs in two banks, which belonged to the same financial group. Soon thereafter, deposit runs started in other banks perceived by the public as financially weak.[2] There were also runs from the trading desks and offshore operations of these banks, especially after it became known that there were large amounts of hidden off-balance sheet deposits with virtually no asset coverage. At the same time, other institutions perceived as sound managed to maintain the deposit base and even to attract deposits but practically did not lend their extra-funds in the interbank market. The Deposit Guarantee Fund (FOGADE) reacted to the deposit runs by offering financial assistance on a large scale. By February 1994, FOGADE had depleted its own resources and had to start receiving funds from the CBV in order to continue providing loans to distressed institutions. The CBV did not manage to sterilize these large injections fully and inflation continued to creep up.

Despite the authorities' efforts to restore confidence in the banking system, which included reopening Banco Latino as a state-owned bank,[3] market expectations worsened. This was due, at least in part, by the uncertainty surrounding the new government's economic policies, and more specifically the widespread fears of exchange controls, devaluation and partial freezing of bank deposits. By end-March 1994, seven banks and a financial company, with a share of about 21% of total deposits, had been virtually excluded from the overnight interbank market. The eight institutions were closed in June 1994.

During the weeks following their closure, money demand fell sharply and there was widespread capital flight leading to a large loss in reserves. In early July, the government decided to fix the exchange rate against the dollar and to impose strict exchange rate controls. These measures slowed down the fall in the deposit base for

[2] This group of weak banks accounted for over 30% of total banking system deposits.
[3] The bank was reopened on April 4, after it received funds equivalent to 3.5% of the GDP.

some weeks but, in July and August, rumors about the financial situation of two large banks, Banco Consolidado and Venezuela, led to deposit runs again. FOGADE's precarious financial situation made additional liquidity injections unfeasible so the government decided to nationalize these banks. By then, the failed banks (either nationalized or closed) were nearly 50% of total bank deposits, and roughly the same share of total assets.[4]

In December 1994, it became clear that two other banks, Banco Progreso and República, were not viable since they had not managed to improve their financial situation notwithstanding the massive financial assistance received from FOGADE. The authorities decided to close Banco Progreso because of the very large irregular operations in its balance sheets. In turn, Banco República, with a more stable and regular deposit base, was nationalized. Shortly after, in January 1995, three other banks, which found themselves in the same situation as Banco Progreso, had to be closed. By then, the economy was in deep recession (GDP fell 5% in real terms in 1994), only supported by the oil sector. The weakness of the economy avoided a further surge in inflation, notwithstanding the large liquidity injections made by the CBV. Finally, in August 1995, a small private bank was intervened. Since then, and in large part, due to the positive impact of the large devaluations of December 1995 and April 1996, after capital controls were lifted, no more banks failed. The foreign exchange profits and the recovery of the economy helped banks improve their prudential ratios, including solvency. However, inflation also rose further.

In sum, the Venezuelan banking crisis acquired a large dimension and had a huge cost both in economic and fiscal terms. Reportedly, the main factors behind the crisis were macroeconomic and bank-specific ones. Among the first, fiscal imbalances were large and growing and economic growth had fallen sharply in the run up to the crisis. Among the bank-specific factors, poor management and loan quality are generally considered (García Herrero, 1997a, and De Krivoy, 2000).

III. Paper Objective

This paper tests the relevance of bank-specific and macro-financial variables as determinants of bank failures during the Venezuelan crisis of the mid-1990s.

[4] Pérez and Feldman (1995).

Bank-specific and macro-financial variables may affect the probability of bank failure since they influence liquidity, market and credit risks. Liquidity risk, in the context of bank failures, is linked to the possibility that customers withdraw their deposits in large amounts, while the assets are not liquid and/or the interbank market or the central bank does not provide with enough liquidity to banks in need. Market risk is related to changes in market conditions, which affect the value of assets. Credit risk is related to the impossibility, or unwillingness, of debtors to repay their debts. The degree of exposure to these risks that individual banks decide to assume depends on their risk preferences, strategies and regulatory guidelines. The bank-specific and macroeconomic indicators to be introduced in this empirical analysis should constitute an appropriate summary of these preferences and strategies.

Bank specific indicators are obviously important for explaining bank failures but have several caveats, particularly in emerging countries. Those drawn from bank balance sheets and financial statements are less reliable than in industrial countries because of the relatively poor quality of accounting rules and regulation and supervision. In addition, market-based indicators are bound to be useless if markets are not liquid (or do not exist) for bank stocks, subordinated debt or other market instruments. All in all, indicators from bank balance sheets and financial statements seem a better choice for a country, such as Venezuela, where most banks are not quoted and those stocks quoted are illiquid.

To ensure coverage of the most important aspects, the choice of indicators is structured on the basis of the CAMEL[5] system, traditionally used by US regulators as an early warning tool and often employed in the literature. The CAMEL has five components: capital adequacy, asset quality, management quality, profitability and liquidity.

Capital adequacy is a measure of an institution's buffer against future unanticipated losses. Asset quality generally refers to loan quality, based on the probability of repayment, and is directly related to credit risk. Management quality is key in determining the approach of a bank to risk. However, it is a very subjective indicator for which information is not readily available. Typically, measures of efficiency are used as a proxy of bank management but it is acknowledged to reflect only one of the several dimensions of management quality and,

[5] CAMEL stands for Capital adequacy, Asset quality, Management, Earnings and Liquidity.

in some cases, could be swamped by macroeconomic factors. Liquidity indicators are key to assess an institution's ability to meet unanticipated withdrawals of deposits.

Macro-financial variables may be relevant in emerging countries, due to their large volatility. A clear example is a sharp reduction in economic growth, which tends to increase credit risk. Too high interest rates should also raise credit risk although they could be beneficial for banks' profitability as long as they imply large interest rate spreads. The monetary policy stance is another key factor. In principle, a laxer monetary policy should reduce liquidity risk but, if maintained too long, it may raise market and credit risks through a surge in inflation.

IV. Methodology

This paper uses discrete event history analysis to test empirically which are the most relevant early warning indicators of bank failure for the Venezuelan banking crisis of the mid-1990s. Until recently, history event analysis was mainly used in social sciences to study transitions across a set of discrete states (Allison, 1982; Allison, 1984; Kiefer, 1988; Yamaguchi, 1991; and Blossfeld and Rohwer, 1995). However, economists have started to apply it as a useful tool for causal analysis because it fits the discrete nature of the available data (quarterly). This implies that bank failures at the beginning and at the end of the quarter cannot be differentiated in this dataset. In addition, this methodology is particularly useful for small datasets, such as this one, because they do not necessarily require any assumption about the distribution process and the computation is simple. Another advantage is that time-varying explanatory variables are easily incorporated in this type of event history analysis (Allison, 1982).

Among the existing techniques of event history analysis, the one chosen in this paper is for non-repeated events of a single kind. It is of a single kind, because of the definition of bank failure chosen. A bank is considered failed when the government or the central bank intervenes, closes or nationalizes a bank, whatever happens first. In other words, the type of action is not relevant in determining whether a bank fails. This rather open definition of failure suits the Venezuelan crisis well since ailing banks were treated differently depending on when they experienced problems although they were all insolvent and unviable.

In addition, such definition avoids differentiating between insolvency and failure as government action is in this case synonymous of bank insolvency. Finally, bank failures are considered non-repeated events and, as such, they disappear from the sample after the first government action, be it intervention, nationalization or closure (or after they "fail" on the basis of the above described definition). In reality, during the Venezuelan crisis some of the banks were closed first and then nationalized, or closed and then intervened. These are not considered to have failed twice but only once. The implicit assumption here is that banks were insolvent at the time of the first government action. Given how the crisis developed (see Section II), it seems quite a safe assumption.

Moving to briefly describing the methodology, it is assumed that time can take on only positive integer values ($t = 1, 2, 3, \ldots$) and that we observe a total of n independent individuals ($i = 1, \ldots, n$), beginning at a starting point $t = 1$.[6] The risk set is the number of individuals who are at risk of event occurrence at each point in time. In this case, the risk set is the number of banks subject to failure at each time.

Every observation continues until time t_i, at which point either an event occurs or the observation is censored. As usual, it is assumed that the time of censoring is independent of the hazard rate. The variable δ_i is set equal to 1 if i is uncensored; otherwise it is zero. Also observed is a $K \times$ I vector of explanatory variables $\boldsymbol{x}_{it}$, which may take on different values at different discrete times. The discrete-time hazard rate (P_{it}) is defined as the estimated probability that a bank fails at time t from the banks that are still at risk.

$$P_{it} = Pr[T_i = t \mid T_i \geq t, \boldsymbol{x}_{it}] \tag{1}$$

Where T is the discrete random variable giving the uncensored time of event occurrence. In this paper, the hazard rate is the estimated probability of a bank failure within a particular quarter for those banks that have not yet failed. While the hazard rate is an unobserved variable, it controls both the occurrence and the timing of events. As such, it is the fundamental dependent variable in event history analysis.

Among the discrete techniques of event history analysis, life tables are chosen to calculate the hazard rate rather than Kaplan-Meier (or

[6] This section draws heavily from Allison (1982).

product limit) estimates. Life tables need less computing and are usually applied to a small number of observations. Furthermore, their potential disadvantage, the subjective choice of discrete time intervals, is not relevant for this sample because the intervals are determined by the quarterly nature of the data and no other choice exists. Life tables, thus, facilitate the calculation of non-parametric estimates of the survivor function, the density function and the transition rate, given a set of episodes (i.e., bank failures). In our specific case, the estimate of the hazard rate in each quarter is calculated dividing the number of events (failures) by the number of banks at risk.

The most popular distribution to specify how this hazard rate depends on time and the explanatory variables is the logistic regression function. This is a binary distribution in which $y_{it} = 1$ if a bank fails (on the basis of the definition given above) and $y_{it} = 0$ if a bank does not fail. Then:

$$P_{it} = 1 - \exp(-\alpha_t - \beta' \mathbf{x}_{it})/(1 + \exp(-\alpha_t - \beta' \mathbf{x}_{it})) \text{ if } y_{it} = 1 \qquad (2)$$

or

$$1 - P_{it} = 1/[1 + \exp(-\alpha_t - \beta' \mathbf{x}_{it})] \qquad \text{if } y_{it} = 0 \qquad (3)$$

The ratio of (2) over (3) is the odds ratio in favour of a bank failure. Taking natural logs of this ratio, we obtain:

$$\text{Log}[P_{it}/(1 - P_{it})] = \alpha_t + \beta' \mathbf{x}_{it} \qquad (4)$$

Although the choice of the logistic regression model is somewhat arbitrary, it does have a number of advantages. First, it constrains P_{it} to lie between zero and one for any values of β and $\mathbf{x}_{it.}$ Second, it is computationally simple and statistics are readably available. Third, it has been proven that the estimates of β obtained with this discrete model are also those of the underlying continuous model (Prentice and Gloecker, 1978). The significance of the β coefficients shows whether the regressors explain the likelihood of bank failure, i.e., the hazard rate. The estimation is carried out by Maximum Likelihood.

Regressors include bank-specific and macro-financial variables. The former vary through individual bank and time and the latter only through time. In addition, regressors are lagged to limit endogeneity problems. Since data were not reported to the Superintendency in the case of some of the failing banks close to the failure, two lags (i.e., two

quarters) are taken for all regressors for all banks.[7] This seems like a reasonable timeframe for macroeconomic variables to avoid endogeneity.[8]

This modifies equation (4) in the following way:

$$\text{Log}[P_{it}/(1 - P_{it})] = \alpha_t + \beta' \Sigma \mathbf{X}_{it-2} + \mu' \Sigma \mathbf{Z}_{t-2} \quad (5)$$

where $\mathbf{X}_{it}$ are the bank specific variables and $\mathbf{Z}_t$ are the macro-financial ones. Quarterly time dummies are not included in the baseline exercise because macroeconomic variables already pick up most of the time variation in the sample.[9]

Finally, it is important to note that this methodology treats all observations (for each bank in each t) as independent observations. This implies that the possibility of contagion from one bank to another cannot be analyzed with this methodology. While this is a general weakness, the Venezuelan crisis is one where contagion was not a big issue since failing banks were insolvent although public data did not show it clearly.

V. Variables Included and Expected Results

On the basis of the description of events in Section II, this empirical investigation of the Venezuelan banking crisis of the mid 1990s starts several months before the crisis (before economic growth came to a halt) and ends when there were no clear risks of additional bank failures. The sample, thus, starts in the second quarter of 1992 and ends in the second quarter of 1996. It would have been interesting to start even before 1992, not only to increase the number of observations, but also to include other bank failures prior to the crisis of the mid-1990s. Unfortunately bank-specific data is not readably available.

In the above described sample, the number of banks was 44 at the start and dropped to 26 by the end of the period considered. Since no bank closed as a consequence of a business decision (i.e., granting the

[7] The small number of observations also limits the number of additional lags that can be taken.

[8] Only one lag is taken for macroeconomic variables as a robustness test and results do not change.

[9] A robustness test was conducted to ensure that the significance of bank-specific variables does not change depending on whether time dummies are taking instead of macroeconomic variables.

full payment of bank liabilities), it is easy to infer that 18 banks failed during that period. This implies that the sample has a maximum of 519 observations.

The dependent variable (called *FAIL*) is a binary variable, which takes the value of one when the individual bank fails and zero otherwise, as described in the previous methodological section. The information on bank failure, as previously defined, is compiled from reports from the CBV and SUNDEBAN.

Bank-specific variables are financial ratios of individual banks from banks' balance sheets and income statements, available in the quarterly bulletins of SUNDEBAN. Market indicators are not included because they would not be relevant in the Venezuelan case. In fact, most banks belonged to private individuals and were not quoted. Furthermore, the few bank stocks which were quoted were illiquid, clearly limiting the information content of stock prices.

The bank-specific indicators chosen reflect the five components of the CAMEL rating (exact definitions and sources can be found in Appendix 1). The first, capital adequacy, is proxied by four different indicators: *i)* the share of own funds (capital and reserves) to total assets (*CAPITAL*), which should reduce the likelihood of bank failure and, thus, have a negative prior (the prior of each variable can be found in Table 3; *ii)* the share of productive assets to total assets (*PRODUCTIVE ASSETS*). Productive assets are understood as those generating a flow of financial revenues, such as loans and government paper but not real state or *NPL*s. This variable also has a negative prior; *iii)* the share of non-productive assets to own funds (*NON PRODUCTIVE ASSETS*), with a positive prior; and *iv)* other assets to own funds (*OTHER ASSETS*), which includes the most illiquid assets, mainly real state. It also has a positive prior.

The second is asset quality, proxied by three indicators: *i)* the ratio of non-performing loans to total loans (*NPLs/LOANS*); *ii)* the ratio of non-performing loans to own funds (*NPLs/CAPITAL*); *iii)* and the share of provisioned loans over gross *NPL*s. The prior of the first two is clearly positive since they should reflect poor asset quality. The third is harder to interpret. A large mount of provisioned loans should reflect a prudent behavior on the part of banks. However, large provisions may also indicate that the bank is undergoing a difficult situation. In addition, provisioning reduces banks' profitability.

The third is management competence, which is also the hardest to proxy. Most studies use indicators of bank efficiency, but it should be

acknowledged that they only reflect an angle of management competence and could be swamped by macroeconomic factors. Based on data availability to indicators of the degree of bank inefficiency are chosen: *i)* the share of expenses related to the normal business (*STRUCTURAL EXPENSES*), which included financial and administrative expenses, as well as headcount, all as a percentage of average assets; *ii)* the share of financial and administrative expenses to the average cost of funding (*OPERATIONAL EXPENSES*). This excludes headcount expenses. The higher these proxies the lower management competence, which implies a positive prior of both ratios in explaining bank failure.

The fourth is earnings (also known as profitability). There are two main indicators of earnings in the SUNDEBAN statistics: *i)* the net interest margin, or the difference between financial revenues to financial expenses as a percentage of total assets (*NET INTEREST MARGIN*); and *ii)* inverse of financial expenses to the average cost of funding (*FINANCIAL EXPENSES*). The higher these indicators, the more profitable a bank will be, which should reduce the likelihood of bank failure since earnings can be used as a buffer to respond to potential losses.

The fifth CAMEL indicator is liquidity adequacy, measured by the amount of very liquid assets, in domestic and foreign currency, to total deposits (*VERY LIQUID ASSETS*). Very liquid assets include cash in domestic and foreign currency and short-term central bank or government bills in domestic or foreign currency. The higher this ratio, the lower the probability of bank failure since bank liquidity either reflects bank soundness or, at least, helps mask solvency problems for longer than if a bank were illiquid.

The macro-financial variables included follow the existing literature (definitions and data sources can be found in Appendix 1). The first is real GDP growth (*REALGDP*), with an expected negative sign as high growth should reduce the likelihood of bank failure (see Table 3 for a list of variables and expected signs). The second is the growth in real broad money (*REALM2*), proxing the stance of monetary policy. A laxer policy stance should help banks with their liquidity problems, at least in the short run. This is why the expected sign is negative, as for the bank-specific indicator of liquidity. However, a lax monetary policy will generally lead to inflation in the future, which may be detrimental for the soundness of the financial system. This longer-term effect could be picked up in the inflation variable (see below). The third and fourth variables are real interest rates on bank loans and on bank deposits (*REAL DEPOSITE RATE AND REAL LENDING RATE*). These

Table 3. Expected Signs for Each Variable

Bank specific	*Expected sign*
Capital adequacy	
Capital	–
Productive assets	–
Non-productive assets	+
Other assets	+
Asset quality	
*NPL*s/loans	+
*NPL*s/capital	+
Provisioning	– (in principle)
Management competence	
Structural expenses	+
Operational expenses	+
Profitability	
Net interest margin	–
Financial expenses	+
Liquidity	
Very liquid assets	–
Macro-financial	
Real GDP	–
RealM2	–
Real lending rate	+
Real deposit rate	+
Interest rate spread	–
Current account balance	–
Real credit	+ in principle
REER	+
Inflation	+ in principle

should increase the likelihood of bank failure in as far as they contribute to lower economic growth and indirectly higher non-performing loans. However, two low real deposit rates may discourage the public from placing their savings in the banking system. In addition both variables may also reflect the monetary policy stance if the transmission mechanism works appropriately. The fifth variable, banks' interest rate spread (*SPREAD*), picks up the difference between the real deposit rate and the real lending rate. The spread should in principle lower the likelihood of bank failure since it is one of the main sources of bank profitability. However, the maintenance of very large spreads may discourage disintermediation in the long run. Sixth, a frequently

used early indicator of banking and currency crises is the current account deficit. Since deficits are associated with crises, the prior for the current account balance is negative.

This indicator, however, might not be very relevant in the case of Venezuela, where the current account is generally in surplus because of the country's large oil exports. The seventh macro-financial variable included is the real growth of bank credit to the private sector (*REAL CREDIT*). A rapid increase (which generally occurs with financial liberalization) should, in principle, raise the probability of failure although the opposite is found in a number of studies with bank specific data. This very much depends on the number of lags taken since the credit to the private sector appears to decelerate before a banking crisis or prior to the failure of a particular bank. The eight macro-financial variable, real exchange rate movements (*REER*), is also associated with currency and banking crises. A real appreciation has a positive prior. Finally, the change in the consumer price index (*INFLATION*) appears to increase the likelihood of a banking crisis. On the other hand, inflation is also a source of revenues for banks, thanks to the profitable float it generates.

VI. Results

On the basis of the above described methodology, we now test empirically the relevance of the bank-specific and macro-financial variables in determining the likelihood of bank failures during the Venezuelan crisis.

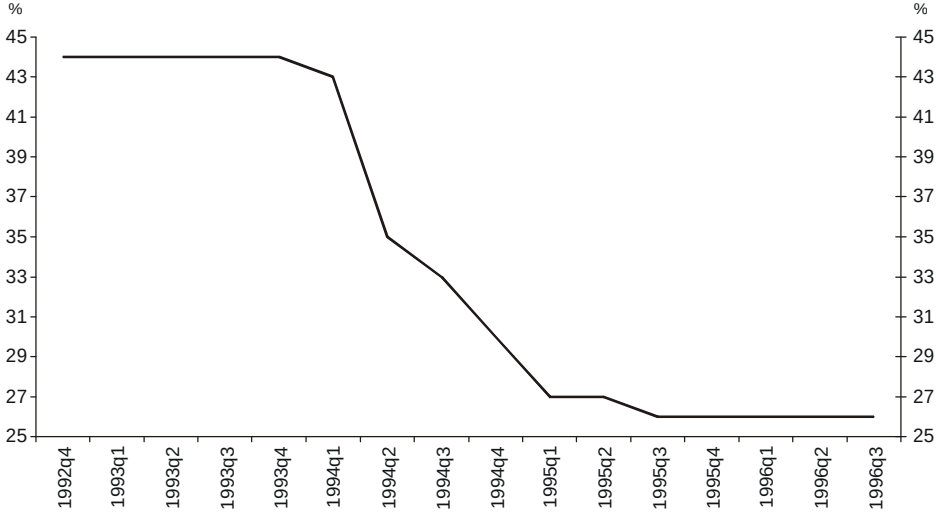
The first step is the calculation of the hazard rate, on the basis of the number of banks which were at risk in each period. Starting with a sample of 44 banks in the second quarter of 1992, all of them were at risk until the first bank failed in the first quarter of 1994. In that period, the number of banks at risk decreased to 43 (see Figures 1 and 2 for the number of banks failed and those at risk).

The life table method only requires that the number of banks failed be divided by those still at risk to obtain the hazard rate. Figure 3 shows the evolution of the hazard rate. It is interesting to note that, because the number of banks at risk diminishes steadily,[10] it is pos-

[10] This is due to the fact that no new banks entered the Venezuelan banking system during the crisis so the number of banks in the banking system decreased exactly by the number of banks that failed.

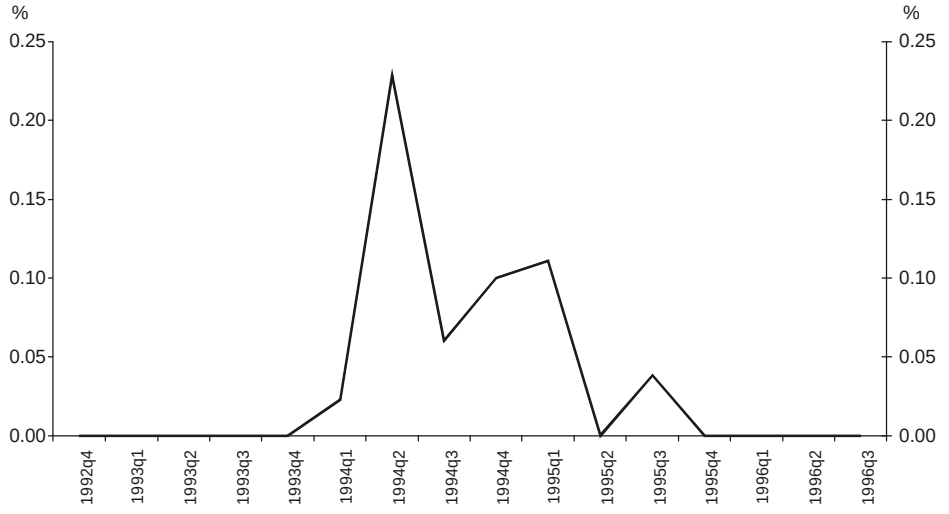
Figure 1. Number of Bank Failures

Figure 2. Number of Banks at Risk



sible for the hazard function to increase even when the number of failing banks falls. This is what happened in the third and fourth quarters of 1995. The highest hazard ratio was in the second quarter of 1994, which coincides with the peak of the crisis.

Figure 3. Estimated Hazard Rate



As a second step, the statistical properties of the regressors are analyzed as well as the correlation between them. The number of observations is in many instances the maximum possible given the number of existing banks during our sample (519). However, there are some missing observations for a few variables, as shown in Table A.2 in the Appendix. In addition, several of the bank-specific ratios are extremely large, with no economic sense. This is particularly the case for very small banks. Instead of dropping these potential outliers, they are capped to a maximum value so as to maintain enough degrees of freedom.

The correlation among regressors is generally low except for very similar ratios such as *NPLs*/*LOANS* and *NPLs*/*CAPITAL* (where it reaches 0.70). This is one of the reasons, other than the small number of observations, not to include all variables in a benchmark equation, as would be expected in a general to specific approach. The correlation between the regressors and the dependent variable (*FAIL*) generally has the expected sign, except for the variables proxing management competence and a number of macroeconomic variables (*CURRENT ACCOUNT*, *REER*, *REAL CREDIT* and *INFLATION*). In any case, these are only bivariate correlations from which non firm conclusions can be drawn.

A set of figures in Appendix 3 depicts the evolution of macroeconomic variables together with the hazard rate. Real GDP growth, but also real money growth and real bank credit to the private sector,

show a rather similar trend to the hazard rate. This is less so for the real interest rate particularly since it does not increase before the peak of the hazard rate in the second quarter of 1994. The other variables seem quite unrelated.

To assess the explanatory power of the above described regressors, a large set of different model specifications is run. Although we would have preferred a general-to-specific approach, we follow the opposite one due to the very small number of observations at our disposal.

As a first step, in order to avoid collinearity and to have as many original observations and degrees of freedom as possible, bi-variate logit regressions (i.e, only one variable explaining bank failure) are run. It should be acknowledged, though, that there may be a problem of misspecification in these regressions when relevant variables are omitted. Still, it is useful as a exploratory tool to identify –with the previously mentioned caveat– the potentially more relevant variables to include in the final regression.

Several variables are found significant in explaining the probability of bank failure alone, and with the expected sign (see Table A.4 in Appendix 3). As regards capital adequacy, the positive coefficient of *OTHER ASSETS* indicates that a large share of very illiquid and non productive assets increases the likelihood of bank failure. As for asset quality, both *NPLs/LOANs* and *NPLs/CAPITAL* increase the probability of bank failure. Concerning profitability, a high *NET INTEREST MARGIN* reduces the likelihood of bank failure. The same is true for *VERY LIQUID ASSETS*, albeit at a lower confidence level (10%). As regards the macroeconomic factors, high *REAL GDP GROWTH* reduces the probability of failure. The opposite is true for a high *REAL DEPOSIT RATE*, but at a lower confidence level (10%). It is interesting to note that the lax monetary policy which the CVB conducted prior and during the crisis does not appear to have helped reduce the likelihood of bank failure, as shown by the insignificant coefficient of *REALM2*.

As a second step, two explanatory variables are now included as regressors in the logit model. Only those variables found significant in the bi-variate exercise are reported in Table A.5 in Appendix 3. They all have the expected sign. The variables which are clearly more significant are, from the bank side, asset quality (*NPLs/LOANS* and *NPLs/CAPITAL*) and profitability measures (*NET INTEREST MARGIN*). The only relevant measure of capital adequacy found in the bi-variate regressions (*OTHER ASSETS*) is significant if combined with macroeconomic

variables and, to a lesser extent, with bank liquidity (measured by *VERY LIQUID ASSETS*). In the same way, bank liquidity adequacy (*VERY LIQUID ASSETS*) is only significant when combined with *REAL GDP*. As for the macroeconomic variables, *REAL GDP* is significant in all cases while the *REAL DEPOSITE RATE* is only significant when combined with *REAL GDP* but not with other variables.

As a third step, the same exercise is conducted with three regressors, with the caveat that the number of observations and degrees of freedom tends to be reduced. The results (Table A.6 in Appendix 3) show that the *NET INTEREST MARGIN* and *REAL GDP GROWTH* continue to be significant in virtually all specifications. *OTHER ASSETS*, *NPLs/ LOANS* and the *REAL DEPOSIT RATE* maintain their explanatory power in some specifications. Bank liquidity adequacy (*VERY LIQUID ASSETS*) is the least robust. Finally, the same exercise is conducted with four regressors and very similar results are obtained (Table A.7 in Appendix 3).

On the basis of these preliminary results, we conduct a set of regressions in which we include all the variables which were found significant in the bi-variety regressions. This exercise has the caveat of the small number of observations and degrees of freedom, which will be tackled later in a robustness test. For the time being, only original observations are included for each variable, which reduces the sample to 320 observations (Table 4, first column from the left). Even in this case, the *NET INTEREST MARGIN* and *REAL GDP GROWTH* are highly significant in explaining the likelihood of failure, with the expected negative sign. To increase the number of observations to the maximum possible (519), extrapolation is used and missing observations are filled with the median of each variable. The results continue to hold (Table 4, second column from the left).

In a second robustness exercise, we include an additional regressor so as to have one for each of the aspects of CAMEL. The missing one was management capacity since neither of two proxies had been found significant in the bi-variety regressions. Each of them is added separately in the model and extrapolation is used again to fill missing observations. As before, neither of the two indicators of management competence is found significant (Table 4, third column from the left shows the results with one of them, *FINANCIAL EXPENSES*). The *NET INTEREST MARGIN* and *REAL GDP* are significant in this specification as well. The last robustness exercise reduces the time span covered in the regression to the crisis period. This means that only the quarters

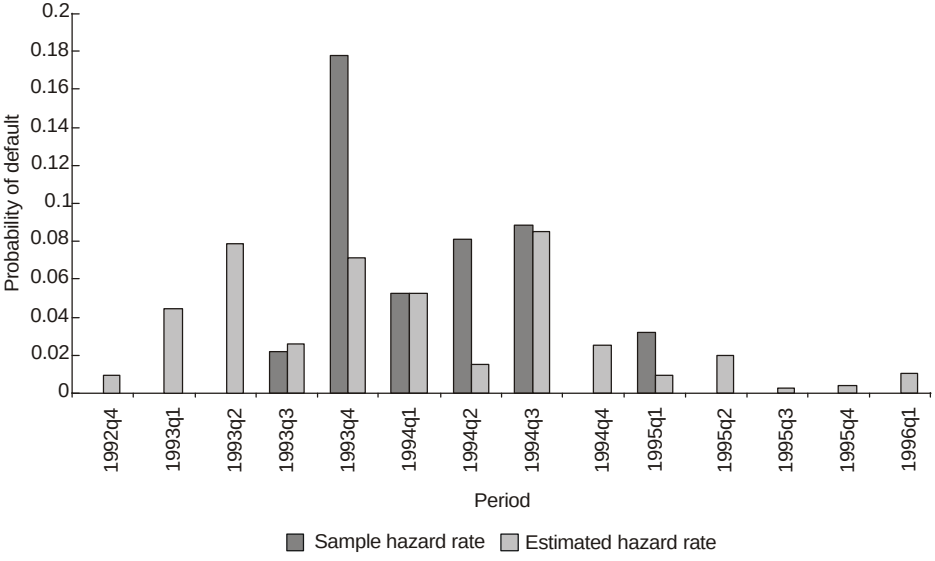
Table 4. Main Results

	Total sample	*Total sample with extrapolation*	*Total sample Full CAMEL with extrapolation*	*Only crisis with extrapolation*
Number of Observations *FAIL* = 0	312	501	501	224
Number of Observations *FAIL* = 1	18	18	18	18
Probability (LR stat)	0.001472	0.000139	0.000885	0.013319
Dependent Variable *FAIL*	0.160863	0.173219	0.180284	0.211007
Akaike info criterion	0.383928	0.276098	0.28553	0.318173

Bank Specific Variables	*Coefficient*	*Probability*	*Coefficient*	*Probability*	*Coefficient*	*Probability*	*Coefficient*	*Probability*
Capital					0.005063	0.8139		
Net Interest Margin	*–0.218907*	*0.0059*	*–0.151999*	*0.0275*	*–0.175331*	*0.0125*	*–0.164816*	*0.0579*
Financial Expenses					0.064639	0.3718		
Very Liquid Assets	–0.014045	0.3206	-0.012353	0.3593	-0.013996	0.2906	–0.011369	0.5497
NLPs/LOANs	0.015396	0.5976	0.026788	0.3491	0.026688	0.3603	0.03084	0.3514
Other Assets	0.002275	0.4302	0.002697	0.2702	0.002699	0.2924	0.003221	0.2785
Macro-financial Variables								
Real GDP	*–0.204355*	*0.041*	*–0.240461*	*0.0132*	*–0.228212*	*0.0191*	*–0.133459*	*0.2502*
Real Deposit Rate	–0.015861	0.2853	0.003548	0.8025	0.011166	0.6006	0.010065	0.5998
Spread					0.029528	0.7906		

Note: Bold letters show significance at 5% level.

Figure 4. Hazard Rate by Quarter



in which at least one bank failed are included (namely from the first quarter of 1994 to the fourth of 1995). This drastically reduces the number of observations (242) even when filling missing observations through extrapolation. The *NET INTEREST MARGIN* continues to be significant in this case although the result should be taken with care due to the few observations.

In order to assess the predictability of bank failures on the basis of the two main determinants only, GDP growth and bank profitability, the hazard rate calculated above is compared with the one obtained with these two variables. As can be seen in the Figure 4, the model (with GDP growth and net interest margin) would have predicted a number of bank failures before they actually happened and a fewer number of failures at the peak of the crisis in the fourth quarter of 1993. The predictive power is relatively good in the quarters thereafter except for the second quarter of 1994.

The results are compared with those of the other available study for the Venezuelan banking system (Arreaza *et al*., 2002) even if the latter on the recent years and not the crisis period. High profitability, liquidity and economic growth are relevant early indicators in their study as well. High real interest rates on deposits are also found to be a useful early warning. Bank management indicators, the monetary

policy stance, the growth in bank credit and the current account are irrelevant in both studies. Capital adequacy, not significant in this study, has the opposite sign in Arreaza *et al*. (2002). The main difference lies on the real exchange rate appreciation, which is highly significant in their case but does not seem to be a relevant early warning indicator in my sample period. This is probably related to the strong capital controls which were introduced during the crisis period.

In more general terms, one may wonder why some of the potentially relevant indicators are not found significant. This is probably more the case for the capital adequacy ratios since they are at the heart of a bank's solvency. From the review of the literature (Section I) it seems quite common that capital adequacy indicators are not found significant or even worse than that, they are significant with the opposite sign than expected. One of the explanations usually offered for these weak results relates to the systemic differences that may be found between small and large banks, concealing differences between problem and non-problem banks of the same size (Berg and Hexeberg, 1994). In this case, the small size of the sample does not allow us to eliminate the largest and smallest banks as a robustness exercise. Also adding a variable, such as total assets or liabilities, was not a solution because of collinearity problems. In any event, in the case of Venezuela, the size of the banks is unlikely to be a reason for the weak explanatory variables of some bank-specific indicators, particularly solvency ones, since banks of all sizes (large, medium and small) were affected by the crisis. The explanation may rather lie on the poor enforcement capacity of the Venezuelan Superintendency at the time of the crisis, which allowed the banks to report solvency ratios not reflecting the true state of the bank or even to improve cosmetically their capital position by selling assets on which they had capital gains while deferring the sales of assets on which they had capital losses. As for the lack of significance of the bank management capacity, it is in line with the findings on the literature which use bank efficiency as a proxy. In addition, its significance could have been swamped by macroeconomic factors, such as real GDP growth, as has been the case in other studies.

Finally, the monetary policy stance does not seem to have had an impact on the probability of bank failure, contrary to what many analysts in Venezuela argued at the time of crisis. High real deposit rates did increase the likelihood of bank failure in some model specifications, which could be interpreted, at first sight, as a restrictive monetary policy. However, real lending rates were not found significant,

not even the real growth of broad money, a more direct indicator of the monetary policy stance. The strong significance of the poor profitability hints to the possibility that real deposit rates were kept too high, shrinking thereby the net interest margin, in order to attract depositors due to the falling confidence in the banking system.

VII. Conclusions

This paper uses discrete event history analysis to test empirically the significance of several macro-economic and bank-specific variables for the bank failures that occurred during the Venezuelan banking crisis of the mid-1990s.

There are two highly significant indicators across the several model specifications that have been conducted. The first is a bank-specific variable, the net interest margin, which is usually considered the best proxy for bank profitability. The second is a macroeconomic variable, real GDP growth. Both a high net interest margin and real GDP growth appear to reduce the likelihood of bank failure. With the benefit of hindsight, these two could have been useful early warning indicators in the run-up to the crisis. This does not mean, however, that they could be useful indicators of bank failures in future banking crises in Venezuela since the sample taken is short and only includes one crisis event.

There are other, less robust, determinants of bank failure, such as the share of the most illiquid and nonproductive assets to own funds, as a measure of capital adequacy, the share of non-performing loans, proxing asset quality, and the share of very liquid assets, measuring bank liquidity, all with the expected sign. In addition, another macroeconomic variable, the real deposit rate, was found to increase the likelihood of bank failure in some model specifications. The latter should not be interpreted as the monetary policy stance being too restrictive for bank soundness since the lending deposit rate and, particularly, the real growth of broad money –a more direct indicator of the monetary policy stance– was not found significant. In turn, the strong significance of the poor profitability hints to the possibility that real deposit rates were kept too high, shrinking thereby the net interest margin, to attract depositors in view of the lack of confidence in the banking system. It is important to point out that these determinants are, not only less robust, but also subject to potential misspecification

because they stem from bi-variate, and sometimes three- and four-variate models with potential missing variables. In addition, the fact that no measure of bank efficiency is found significant is another caveat of the analysis, mainly related to the lack of data on the quality of the bank administration.

In sum, these results show that bank profitability and real economic growth could have been useful early warning indicators of the Venezuelan banking crisis. The use of a simple method, such as the one employed in this paper (discrete event history analysis), would have facilitated updating the relevant information regularly to recalculate the likelihood of bank failure. In turn, public information on bank solvency (particularly the ratio of own funds to total assets) does not seem to have been good enough to allow depositors to distinguish between solvent and insolvent banks. This is not too strange given the poor enforcement capacity of SUDENBAN at the time of the crisis.

Appendix 1. Data Details

Table A.1. Variable Definition and Source

Bank specific	*Venezuelan Superintendency of Banks (SUNDEBAN)*
Capital adequacy	
Capital	Capital and reserves to (unweighted) total assets
Productive assets	Productive assets (i.e., liquid ones) to total assets
Non-productive assets	Share of non-productive assets (i.e., the most illiquid ones) to capital and reserve
Other assets	Other assets (the least liquid ones) to capital and reserves
Asset quality	
*NPL*s/loans	Non-performing loans to total loans
*NPL*s/capital	Non-performing loans to capital and reserves
Provisioning	Share of provisioned loans over gross *NPL*s
Profitability	
Net interest margin	
Financial expenses	Financial expenses to the average cost of funding
Management	
Structural expenses	Expenses related to the normal business (financial, administrative and headcount) to average assets
Operational expenses	Operational expenses (financial and administrative to average cost of funding)
Liquidity	Share of very liquid assets to total assets
Very liquid assets	Very liquid assets in domestic and foreign currency to total deposits
Macro-financial	*IFS and Central Bank of Venezuela*
REAL GDP	Interanual GDP growth rate in real terms
*REAL M*2	Interanual growth rare of broad money, in real terms
Real lending rate	Average lending rate offered by banks
Real deposit rate	Average deposit rate offered by banks
Spread	Difference between deposit rate and lending rate
Current account	Current account as a percentage of GDP
Real credit	Interanual growth rate of bank credit to the private sector, in real terms
REER	Real effective exchange rate
Inflation	Interanual change in consumer price index

Appendix 2. Stylized Facts

Table A.2. Main Statistics

	Mean	*Median*	*Maximum*	*Minimum*	*Std. Dev.*	*Skewness*	*Kurtosis*	*Observations*
FAIL	0.034	0.000	1.000	0.000	0.183	5.086	26.869	519
Capital	13.263	7.700	99.500	2.900	16.175	3.207	13.464	518
Productive assets	51.607	52.950	91.300	3.300	17.914	–0.161	2.090	516
Non productive assets	222.997	169.300	1 108.700	4.800	180.035	1.719	6.359	513
Other assets	101.788	85.500	784.700	4.000	85.813	3.496	23.473	517
NPLs/loans	8.356	6.300	47.800	0.100	7.631	1.893	7.773	329
NPLs/capital	36.419	28.800	205.700	0.100	34.159	1.624	6.166	326
Provisioning	52.882	28.600	600.000	1.000	88.204	4.390	25.374	481
Net interest margin	10.414	9.800	41.000	–4.000	6.360	1.072	5.332	513
Financial expenses	59.587	36.200	600.000	8.300	97.609	4.865	26.345	353
Structural expenses	7.786	6.500	55.700	0.700	5.760	3.519	23.712	517
Operational expenses	30.646	7.700	600.000	1.300	99.940	4.986	27.297	509
Very liquid assets	90.373	47.300	15 166.700	0.000	669.475	22.139	498.478	518
Real GDP	1.003	0.545	7.516	–6.931	3.504	–0.112	3.024	519
Real M2	–3.908	–11.353	45.092	–33.430	23.338	0.799	2.518	519
Real lending rate	1.906	16.930	29.798	–32.423	22.282	–0.368	1.490	519
Real deposit rate	–10.256	5.103	20.701	–48.255	25.640	–0.269	1.411	519
Spread	12.136	13.008	18.562	5.619	4.435	–0.010	1.657	519
Current account	–0.483	–2.877	6.822	–7.209	4.539	0.228	1.554	519
Real credit	4.402	5.573	48.389	–39.527	24.265	0.067	2.406	342
REER	64.391	61.433	84.766	56.100	8.452	0.966	2.844	519
Inflation	53.544	47.360	98.100	31.980	18.276	0.712	2.791	519

Table A.3. Correlation Matrix

	FAIL	Capital	Productive assets	Non-prod. assets	Other assets	NPL/s loans	NPL/s capital	Prov.	Net interest margin	Financial expenses	Structural expenses	Operating expenses	Very liq. assets	Real GDP	Real M2	Real lend. rate	Real dep. rate	Spread	Current account	Real credit	REER	Inflation
FAIL	1.000	−0.091	−0.082	0.254	0.623	0.154	0.223	−0.166	−0.307	−0.063	−0.232	−0.078	−0.036	−0.027	−0.119	0.110	0.119	−0.129	−0.107	−0.081	−0.067	−0.098
Capital	−0.091	1.000	−0.022	−0.359	−0.347	−0.143	−0.338	0.155	0.032	0.062	0.098	0.075	0.040	0.066	0.010	−0.042	−0.039	0.020	0.046	0.003	−7.320	0.032
Prod. assets	−0.082	−0.022	1.000	−0.292	−0.208	−0.240	−0.200	0.353	0.213	0.037	0.084	0.026	−0.745	−0.210	0.247	−0.205	−0.216	0.212	0.196	0.161	−0.083	0.222
Non-prod. assets	0.254	−0.359	−0.292	1.000	0.881	0.360	0.575	−0.446	−0.261	−0.061	0.047	−0.046	−0.125	0.031	−0.048	0.122	0.101	−0.009	−0.133	0.069	−0.076	−0.106
Other assets	0.623	−0.347	−0.208	0.881	1.000	0.334	0.550	−0.390	−0.322	0.007	−0.044	0.012	−0.090	0.068	−0.169	0.247	0.229	−0.125	−0.256	−0.013	−0.029	−0.231
NPLs/loans	0.154	−0.143	−0.240	0.360	0.334	1.000	0.753	−0.577	−0.141	−0.087	−0.011	−0.106	0.110	−0.153	0.144	−0.051	−0.074	0.140	0.034	0.177	−0.177	0.084
NPLs/capital	0.223	−0.338	−0.200	0.575	0.550	0.753	1.000	−0.642	−0.144	−0.158	0.038	−0.140	−0.001	−0.008	−0.016	0.116	0.088	0.022	−0.130	0.105	−0.088	−0.095
Provisioning	−0.166	0.155	0.353	−0.446	−0.390	−0.577	−0.642	1.000	0.142	0.161	−0.057	0.176	−0.134	0.006	0.075	−0.181	−0.155	0.038	0.194	−0.063	0.068	0.157
Net int. margin	−0.307	0.032	0.213	−0.261	−0.322	−0.141	−0.144	0.142	1.000	0.183	0.761	0.264	−0.151	−0.207	0.489	−0.408	−0.446	0.496	0.387	0.414	−0.175	0.422
Fin. expenses	−0.063	0.062	0.037	−0.061	0.007	−0.087	−0.158	0.161	0.183	1.000	0.407	0.972	0.059	0.096	−0.017	0.069	0.046	0.040	−0.078	0.098	−0.062	−0.065
Struct. expenses	−0.232	0.098	0.084	0.047	−0.044	−0.011	0.038	−0.057	0.761	0.407	1.000	0.484	−0.081	−0.091	0.497	−0.377	−0.438	0.567	0.349	0.519	−0.192	0.386
Op. expenses	−0.078	0.075	0.026	−0.046	0.012	−0.106	−0.140	0.176	0.264	0.972	0.484	1.000	0.029	0.082	−0.036	0.059	0.048	0.000	−0.063	0.039	−0.037	−0.058
Very liq. assets	−0.036	0.040	−0.745	−0.125	−0.090	0.110	−0.001	−0.134	−0.151	0.059	−0.081	0.029	1.000	0.216	−0.143	0.110	0.110	−0.090	−0.104	−0.060	0.055	−0.130
Real GDP	−0.027	0.066	−0.210	0.031	0.068	−0.153	−0.008	0.006	−0.207	0.096	−0.091	0.082	0.216	1.000	−0.549	0.559	0.506	−0.233	−0.561	0.050	−0.139	−0.599
Real M2	−0.119	0.010	0.247	−0.048	−0.169	0.144	−0.016	0.075	0.489	−0.017	0.497	−0.038	−0.143	−0.549	1.000	−0.920	−0.961	0.927	0.891	0.666	−0.303	0.948
Real len. rate	0.110	−0.042	−0.205	0.122	0.247	−0.051	0.116	−0.181	−0.408	0.069	−0.377	0.059	0.110	0.559	−0.920	1.000	0.988	−0.766	−0.997	−0.406	0.082	−0.992
Real dep. rate	0.119	−0.039	−0.216	0.101	0.229	−0.074	0.088	−0.155	−0.446	0.046	−0.438	0.048	0.110	0.506	−0.961	0.988	1.000	−0.854	−0.854	−0.854	−0.854	−0.854
Spread	−0.129	0.020	0.212	−0.009	−0.125	0.140	0.022	0.038	0.496	0.040	0.567	0.000	−0.090	−0.233	0.927	−0.766	−0.854	−0.976	−0.976	−0.976	−0.976	−0.976
Current account	−0.107	0.046	0.196	−0.133	−0.256	0.034	−0.130	0.194	0.367	−0.078	0.349	−0.063	−0.104	−0.561	0.891	−0.997	−0.976	−0.536	−0.536	−0.536	−0.536	−0.536
Real credit	−0.081	0.003	0.161	0.069	−0.013	0.177	0.105	−0.063	0.414	0.098	0.519	0.039	−0.060	0.050	0.686	−0.406	−0.536	0.172	0.172	0.172	0.172	0.172
REER	−0.087	−7.320	−0.083	−0.076	−0.029	−0.177	−0.086	0.068	−0.175	−0.062	−0.192	−0.037	0.055	−0.139	−0.303	0.082	0.172	−0.988	−0.988	−0.988	−0.988	−0.988
Inflation	−0.098	0.032	0.222	−0.106	−0.231	0.084	−0.095	0.157	0.422	−0.065	0.386	−0.058	−0.130	−0.599	0.946	−0.992	−0.988	0.793	0.983	0.461	−0.177	1.000

Figure A.1. Real GDP Growth

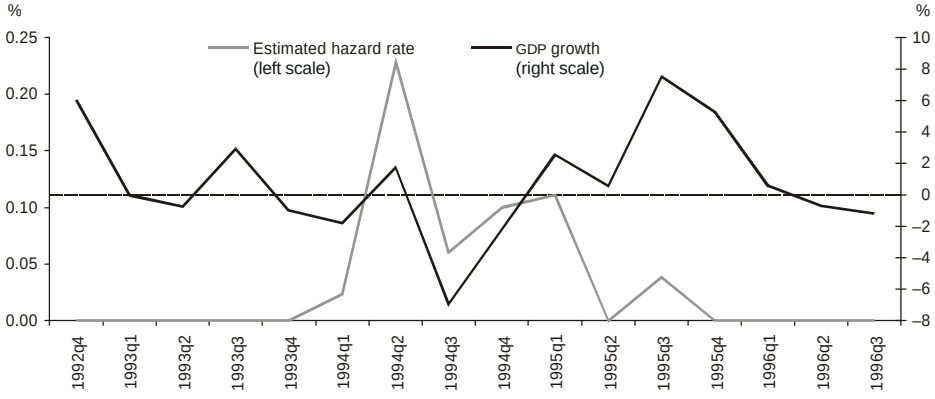


Figure A.2. Real Money Growth

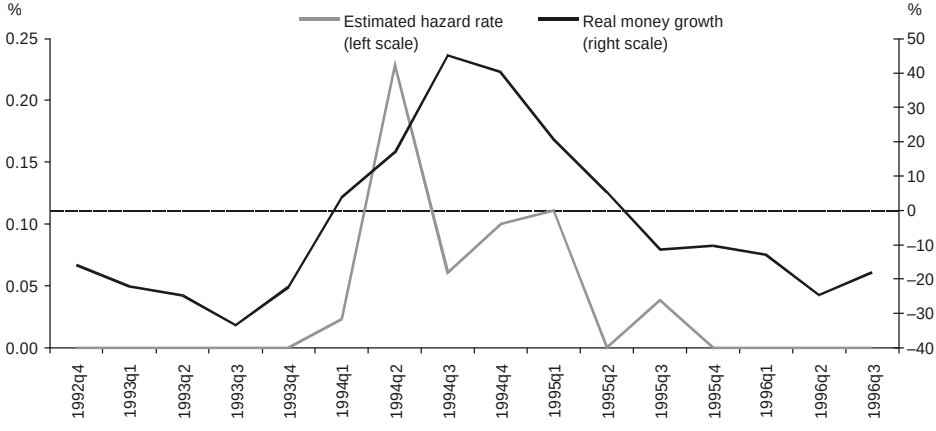


Figure A.3. Real Interest Rates

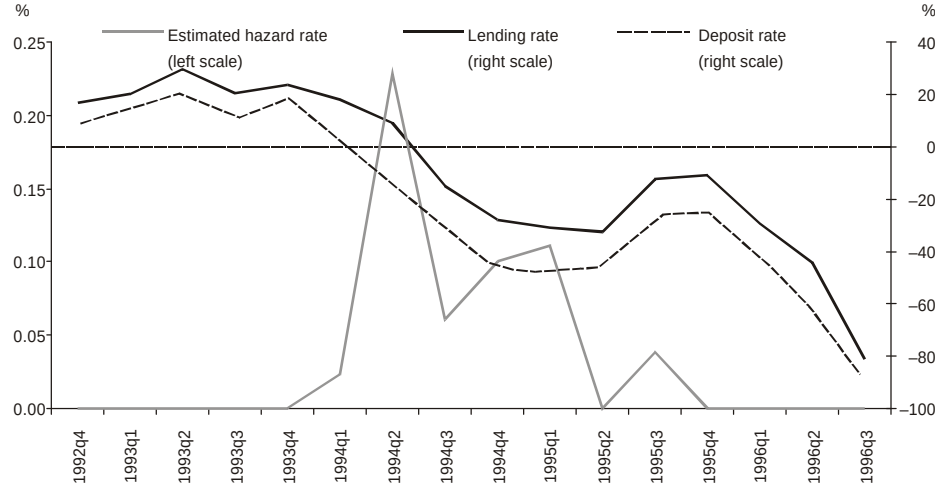


Figure A.4. Interest Rates Spread

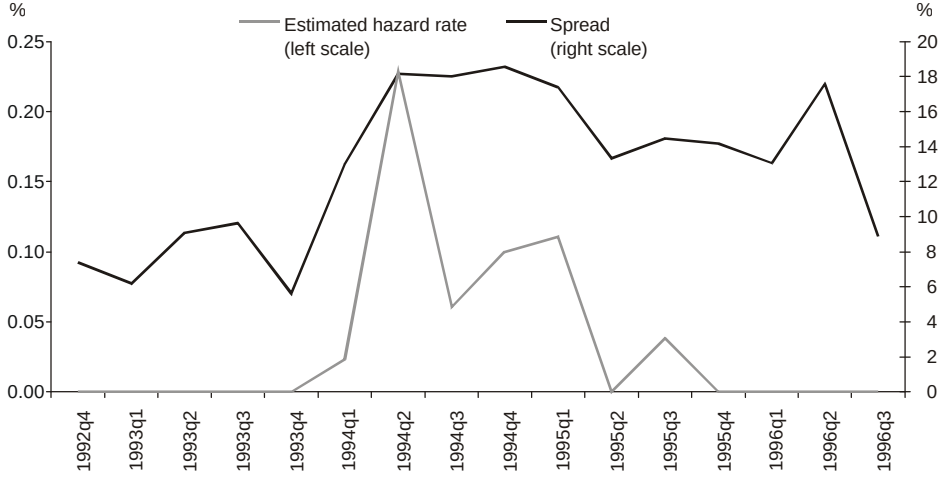


Figure A.5. Current Account Balance (percent of GDP)

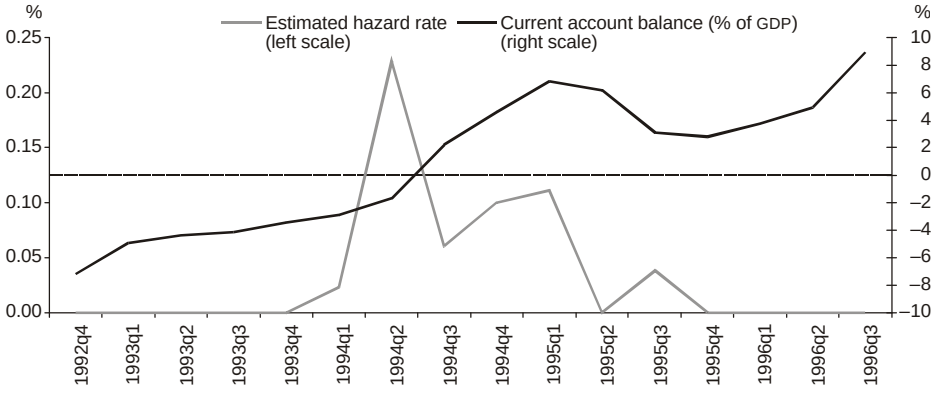


Figure A.6. Real Claims on Private Sector

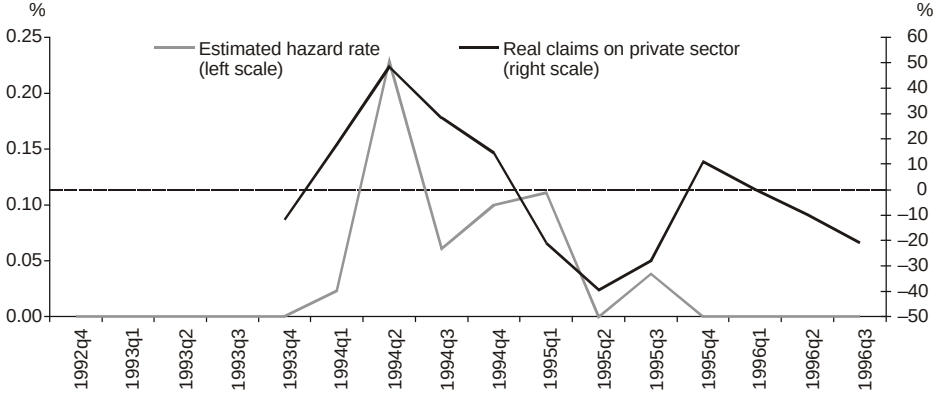


Figure A.7. Real Effective Exchange Rate (Index 2000 = 100)

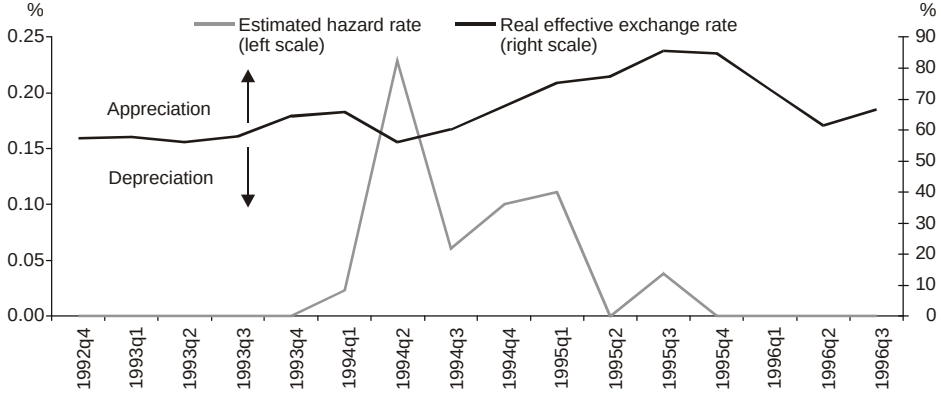
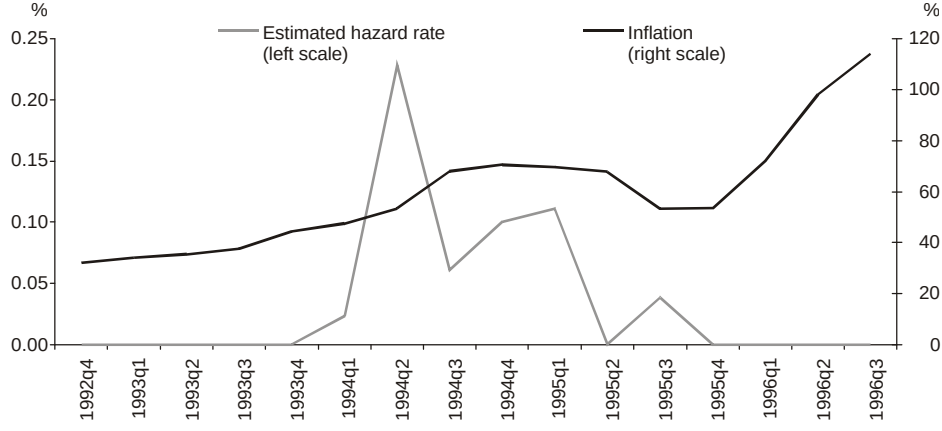


Figure A.8. Inflation



Appendix 3. Additional Results

Table A.4. Single Variable Regressions

Bank specific	*Impact on likelihood of bank failure*
Capital adequacy	
Capital	
Productive assets	
Non-productive assets	
Other assets	+ **
Asset quality	
NPLs/loans	+ **
NPLs/capital	+ **
Provisioning	
Profitability	
Net interest margin	–**
Financial expenses	
Management	
General expenses	
Operational expenses	
Liquidity	
Very liquid assets	– *
Macro-financial	
Real GDP	–**
Real M2	
Real lending rate	
Real deposit rate	+*
Spread	
Current account	
Real credit	
REER	
Inflation	

Note: A minus (plus) sign shows that the variable significantly reduces (increases) the likelihood of failure (or lengthens the time a bank remains open).

* Indicates significance at the 10% level.

** Indicates significance at the 5% level.

Table A.5. Bi-variate Regressions

Other assets	+*	NPLs/capital	+**
Other assets		NPLs/loans	+ **
Other assets		Net interest margin	–**
Other assets	+*	Very liquid assets	
Other assets	+ **	Real GDP	–**
Other assets	+ **	Real deposit rate	+*
NPLs/loans	+*	Net interest margin	–**
NPLs/loans	+ **	Very liquid assets	
NPLs/loans		Real GDP	–**
NPLs/loans	+ **	Real deposit rate	
NPLs/capital	+ **	Net interest margin	–**
NPLs/capital	+ **	Very liquid assets	
NPLs/capital	+ **	Real GDP	–**
NPLs/capital	+ **	Real deposit rate	
Net interest margin	–*	Very liquid assets	
Net interest margin	–**	Real GDP	–**
Net interest margin	–**	Real deposit rate	
Very liquid assets		Real GDP	– **
Very liquid assets		Real deposit rate	
Real GDP	–**	Real deposit rate	+ **

Note: A minus (plus) sign shows that the variable significantly reduces (increases) the likelihood of failure (or lengthens the time a bank remains open).

* Indicates significance at the 10% level.

** Indicates significance at the 5% level.

Table A.6. Three Variable Regressions

Other assets		NPLs/loans	+*	Net interest margin	–**
Other assets		NPLs/loans	+**	Very liquid assets	
Other assets	+**	NPLs/loans		Real GDP	–**
Other assets	+**	NPLs/loans	+*	Real deposit rate	
NPLs/loans	+**	Net interest margin	–**	Very liquid assets	
NPLs/loans		Net interest margin	–**	Real GDP	–**
NPLs/loans		Net interest margin	–**	Real deposit rate	
Net interest margin	–**	Very liquid assets		Real GDP	–**
Net interest margin	–**	Very liquid assets		Real GDP	–**
Net interest margin	–**	Very liquid assets		Real deposit rate	
Very liquid assets		Real GDP	–**	Real deposit rate	+**

Note: A minus (plus) sign shows that the variable significantly reduces (increases) the likelihood of failure (or lengthens the time a bank remains open).

* Indicates significance at the 10% level.

** Indicates significance at the 5% level.

Table A.7. Four Variable Regressions

Other assets		NPLs/loans	+**	Net int. margin	–*	Liquid assets	
Other assets		NPLs/loans		Net int. margin	–**	Real GDP	–**
Other assets		NPLs/loans		Net int. margin	–**	Real deposit r.	
NPLs/loans		Net int. margin	–**	Liquid assets		Real GDP	–**
NPLs/loans		Net int. margin	–**	Liquid assets		Real deposit r.	+*
Net int. margin	–**	Liquid assets		Real GDP	–**	Real deposit r.	

Note: A minus (plus) sign shows that the variable significantly reduces (increases) the likelihood of failure (or lengthens the time a bank remains open).

* Indicates significance at the 10% level.

** Indicates significance at the 5% level.

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