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Abstract

Regarding the causality of Japanese banking crisis, two views are popular: (i) slow and undirected financial deregulations in the 1980s caused trouble for the banks in adjusting with the new environment, and (ii) banks shifted their business in SME market and real estate businesses aggressively in the era of protracted monetary easing in the mid 1980s, that finally contributed to banking failures after the curbed down of asset prices. Instead of these two views, this paper shows that the continuous declining trend of banks profitability (e.g. ROA or ROE) from 1970 was a warning signal for banking crisis, which was just accelerated by the bubble burst. Without any shock (monetary or bubble phenomenon) during the later half of the 1980s, it would take some more time to reach the crisis situation. The paper also highlights some potential causes of declining trend of banks profitability. For analysis, Kaplan-Meire's Product-Limit method is applied to estimate the survival functions and cause-specific hazard rates for the Japanese banks, along with Cox's Proportional Hazards Model is used to find the significance of regression coefficients. Again, Accelerated failure time model is used to see whether collapse of the bubble accelerated the failure of the banks. Moreover, cointegration test and Granger causality test have been performed to identify the long- term causality of banks' declining profitability. The issue is not only important for the Japanese economy, but also instructive for other big Asian economies.

Key words: Japanese banking crisis, Bubble economy, and Survival analysis.
JEL classification: E44, G21, G28, G33, C41.

[+] The views expressed in this paper are my own and do not necessarily reflect those of the institutions with which I am affiliated. Any remaining errors are, of course, mine.

1. Introduction

The failure of a large number of Japanese banks during the 1990s following the burst of the asset price bubble in early 1990 synthesizes a vast literature during last few years focusing the causes and consequences of the crisis, which is still growing. The growing concern on this issue indicates that the issue has not yet ended. Since the crisis afflicted the economy, therefore it becomes a vital policy issue- why has the successful banking system of the 1960s and 1970s failed? The experience of 1990s suggests that economic, social and political cost of crisis, whatever it may be policy induced or structural could be formidable.

Two stylized facts have emerged in explaining the crisis- one, the transition from highly regulated main bank system through slow and undirected financial deregulations caused problems for the banks to adjust with the new environment; and that's why their speculative behavior during the asset price bubble to increase short-term profit made them vulnerable after burst of the bubble (among others, see Hoshi, 2001; Ueda, 2000; Cargill, 2000). The other focuses on the monetary policy effectiveness in the 1980s. Their view is that in the era of protracted monetary easing during the mid 1980s, banks expanded their business aggressively to the SME market, real estate businesses as they lost their big customers of main bank arrangements, which created the problem of moral hazard and asymmetry of information. Since their loan was secured by collateral assets (land), the continuing plunge of land prices made the loan uncollectible and a huge burden of non-performing loan occurred that ultimately contributed to banking failures (for example, see Okina, 2001; Aoki et al. 1994, Cargill, 2000). Moreover, some researches combine 'the both' as the causes of the banking crisis.

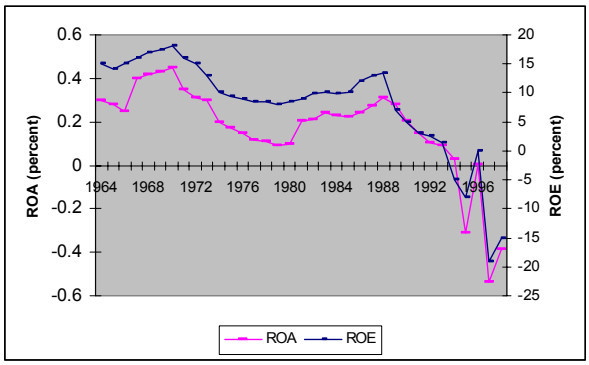
In contrast, the objective of this paper is to reexamine the causality of banking crisis from different point of view. It is apparent that banks were becoming weaker during the main bank regime in terms of their earnings. We may guess that this weak position leads the management to behave speculative in the era of protracted monetary easing and asset price bubble just to survive. If they were strong in their financial position, they would not behave speculative, or their speculative behavior would not make them vulnerable to crisis. Therefore the proposition gives importance singularly on the management efficiency of the Japanese banking industry.

This paper argues that long-term declining profitability since 1970 (Figure 1) was a *warning signal* of banking crisis, which was just *accelerated* by the burst of the bubble. This declining trend indicates that the bank-management was not so efficient to handle the profitable lending opportunities in liberalized condition too. Total decrement of ROA per year is estimated around -0.025 between 1970 and 1980. Without any exogenous shock (monetary shock in the 1980s

increased ROA somewhat) and with this decrement rate of ROA, it would take around 10 more years from 1980 to become zero profit and some more years to reach negative profit, a situation of banking crisis. Although it is not certain whether without any shock it could create any crisis, but definitely it could create some turmoil situation in the banking system. Thus this paper aims to analyze: (1) the determinants of banking crisis, (2) whether declining profit was a warning for banking crisis, (3) whether the bubble burst has accelerated the crisis, as well as (4) the determinants of profit.

The paper analyzes the trend of financial ratios of the ordinary banks to identify the potential causes of the failure of banks by applying different types of survival methods. It also estimates the probable time to failure with or without the bubble condition. This paper mainly highlights the 'problems in corporate governance of the Japanese banks' in its structure as the important factor of failure, rather than blaming only the monetary policy or bubble phenomenon of the 1980s. The contribution of this paper to the existing literature is that it identifies the potential causes of failure in a very clear and concise manner by applying some comparatively new econometric methods, known as survival methods.

Figure-1: Japanese Banks Profitability during 1964-1998



Three types of survival methods are used to check the robustness of the results: (1) Kaplan-Meire's product-limit method, a non-parametric approach of estimating survival function and hazard function is used to analyze the probability of cause-specific failure and probable failure time of the banks, (2) A semi-parametric Cox's proportional hazards (PH) model is also applied to generate the same information along with to identify significant determinants of the banking crisis in a multivariate setting, and (3) Accelerated Failure Time (AFT) model, a parametric model developed by Cox (1972) is also used to see whether the shock in the late 1980s accelerated the crisis. A detailed discussion of the application of hazards model to economic duration data are available in Kiefer (1988). Moreover, cointegration test and Granger

causality test have been performed to identify long-term causal relationship of significant determinants of banks' failure and low profitability.

The paper proceeds as follows. After the introduction, Section 2 discusses about the evolution and failure of the Japanese banks. Section 3 highlights potential determinants of banking failure, Section 4 gives a short description of data, Section 5 describes the empirical survival methods as well as demonstrates results, Section 6 discusses about potential determinants of banks profitability and identifies long term determinants of banks profit by performing time series analysis, and finally Section 7 concludes the paper.

2. Evolution and Failure of Japanese banking system

2.1 Evolution of banking system

The Japanese financial system is predominantly bank-based. Post-war Japanese financial system was highly regulated and banks were heavily dependent on Bank of Japan's (BOJ) subsidies (window guidance) and borrowings of enterprise groups. The characteristics of Japanese model of financial system during post-war economic growth included high debt/equity ratios, greater reliance on bank loans than securities markets, closer relationship between banks and borrowers, extensive corporate cross-shareholding, greater guidance from the government in credit allocation etc. The system is well known as 'main bank' system. It is evident from many research works that this 'main bank' system in Japan contributed greatly to the post-war economic growth of Japan although the varieties of functions played by the main bank were not usually associated with the concept of commercial banking. This type of Japanese banking system is characterized by clearly defined structural policy on the part of the government for stimulating and maintaining specialization among financial institutions, which has been termed as 'convoy system'[1] by some economists. It is noteworthy that Japanese structural policy was oriented toward particular concrete objectives rather than toward achieving maximum competition and leaving the results to the working of the free market (Wallich H. and Wallich M., 1976).

The main bank system had important historical antecedents as the pre-war banking system and industrial system (including Zaibatsu) evolved (Aoki and Patrick, 1994). There is a vast literature on how main bank system played a very important role in Japanese economy and financial system. The core of an enterprise group is usually the *Main Bank*. Group affiliation interlocks stock shares among industrial enterprises, banks and other financial institutions. The

[1] Suzuki Y. (1987) used the term 'convoy system' of management in describing the situation of the absence of destructive competition through interest rate control and other regulatory measures during high growth period of Japan.

arrangements between main-bank and group involved both the financial and non-financial. The financial arrangements included the sharing financial risk through mutual support, preferential loans from the financial institutions and the control of stock voting power through ownership within the group. The non-financial arrangements included joint sale and purchase arrangements, for instance through a trading company- vertical integration, assured markets and sources of supply, technological affinity, combined research, and cooperative planning. This structure of Japanese banks might be the so-called "Industrial bank" (also available in Germany as House bank) rather than modern commercial bank.

Unlike American and many other countries' banks, Japanese banks are allowed to own equity in other corporations. The shares of group member firms owned by banks form an important link in the interlocking structure of enterprise groups. In addition to interlocking shares, banks provide preferential loans and board members to the group affiliated firms. A group bank serves as a screening agent for the investment projects of the group firms and stands ready to lend funds whenever they are needed (Hoshi et al. 1991).

The structural changes in the financial system have been started from the mid 1970s in the form of financial deregulations. The main features of these deregulations were interest rate deregulation, relaxation of regulation to raise funds in the securities and investment market by firms, initiation of freely floating exchange rate and allowing banks and firms to participate in the capital market etc. to increase the ability of the Japanese banking system to meet international competition. These deregulations also aimed at dissolution of cross-shareholding[2]. Many have attributed the significant financial liberalization that has taken place to the sharp increase in government budget deficits in the late 1970s and the resulting need to sell large amounts of government bonds (see Cargill and Royama, 1988).

The recent developments in regulatory frameworks after 1990 (right after burst of the bubble) allow banks to do business in the capital and risk market to increase their profit as compensation to the loss of main bank customers. Under these regulatory frameworks, Japanese banks are given license to do conventional non-banking activities like lease financing, investment and merchant banking, underwriting, insurance business etc. Thus, these types of regulatory frameworks allow banks to expand their businesses in risk market (security and insurance),

[2] The Anti Monopoly Law Reform, 1977 was one-step forward in reducing cross-shareholding. Okabe (2001) shows that cross-shareholding is gradually reducing in the Japanese financial system.

capital market (investment banking) as well as money market. This model follows universal banking-type system rather than complete modern commercial banking.

2.2 Types of banks

The City, Regional and Regional II banks are together known as ordinary banks. The city banks are operating on a large scale in large cities of Japan. The number of city banks varies within 10 to 15. There are 64 regional banks, usually operate in principal cities of a prefecture. Their business is limited within a prefecture.

There are around 65 *regional tier II* banks, all of them (except one which *shinkin* banks) were *sogo* banks before 1989. These banks have been started to operate as ordinary banks within their geographical region, but they are comparatively smaller than traditional regional banks. They serve smaller companies and individuals.

Moreover, two types of banks- Long-term Credit Bank (LTCB) and Trust bank are also operating for specialized purposes. There were three LTCBs up to 1998, namely Industrial Bank of Japan, Long-term Credit Bank of Japan, and Nippon Credit Bank. Their main business is long-term lending. Seven trust banks are long-term specialized financial institutions that obtain most of their funds from trusts, and supply funds to major corporations as capital investment.

Table 1: Development of ordinary banks over time

	1960	1970	1980	1990	2000
City banks	13	15	13	13	9
Regional banks	64	63	63	64	64
Regional Tier-II	--	--	--	68	54
Long Term Credit bank	3	3	3	3	1
Trust Bank	7	7	7	7	9
Total	87	88	86	155	137

Source: Japanese Bankers Association (JBA).

Specialized institution for small business

Some types of specialized banks for small business are *shinkin* banks, *credit cooperatives, Labor banks, Shoko chukin banks, agricultural cooperatives, fishery cooperatives* etc. These banks have been established with a view to financing and promoting the small businesses. As of March, 1993, there are 435 *shinkin* banks, 393 *credit cooperatives*, 47 *labor* banks, 3073 *agricultural cooperatives* nationwide.

2.3 Failure of banks

Up to 2003, a total of 180 banks failed. Of them, 19 are ordinary banks, 27 are Shinkin banks and 134 are credit cooperatives (Table 2). Among the failed ordinary banks, 1 city bank, 2 Long-term Credit banks, 1 regional bank and the rest are regional tier II banks.

Table 2: Number of failure of banks over the period 1991-2003

	Failed Banks			
FY	Ordinary Banks	Shinkin Banks	Credit Cooperatives	Total
1991-94	1	2	5	8
1995	2	0	4	6
1996	1	0	4	5
1997	3	0	14	17
1998	4	0	25	29
1999	5	10	29	44
2000	0	2	12	14
2001	1	13	41	55
2002	1	0	0	1
2003	1	0	0	1
Total	19	27	134	180

Source: Bank of Japan; Deposit Insurance Corporation, Annual Report 2002

Since the crisis started just after burst of the bubble in the early of the 1990s, most of the literatures mainly focus on the implicit causality of the asset price bubble as the causes of banking crisis.

Table 3: List of failed ordinary banks

Number	Name of banks (Code)	Date of failure	Type	Situation
1.	Toho Sogo (577)	24/7/1991	Regional Tier II	Merged
2.	Hyogo (561)	3/8/1995	Regional Tier II	Transfer of operations
3.	Taiheyo (524)	29/3/1996	Regional Tier II	Transfer of operations
4.	Hanwa (559)	21/11/1996	Regional Tier II	Transfer of operations
5.	Kyoto Kyoei (549)	14/10/1997	Regional Tier II	Transfer of operations
6.	Hokkaido Takushoku (12)	17/11/1997	City bank	Transfer of operations
7.	Tokuyo city (511)	26/11/1997	Regional Tier II	Transfer of operations
8.	Midori*	15/5/1998	Regional Tier II	Merged
9.	Fukutoka and Naniwa (533)	22/5/1998	Regional Tier II	Particular merger
10.	Long Term Credit Bank (397)	23/10/1998	Long term credit	Special management by public sector
11.	Nippon Credit Bank (398)	13/12/1998	Long term credit	Special management by public sector
12.	Kokumin (528)	11/4/1999	Regional Tier II	Transfer of operations
13.	Kofuku (552)	22/5/1999	Regional Tier II	Transfer of business
14.	Tokyo Showa (526)	11/6/1999	Regional Tier II	Transfer of business
15.	Namihoya *	7/8/1999	Regional Tier II	Transfer of operations
16.	Niigata Chuo (532)	2/10/1999	Regional Tier II	Transfer of operations
17.	Ishikawa (535)	28/12/2001	Regional Tier II	Transfer of operations
18.	Chubu (539)	8/3/2002	Regional Tier II	Transfer of operations
19.	Ashikaga (129)	29/11/2003	Regional banks	Transfer of operations

*Source: Bank of Japan, Deposit Insurance Corporation, Japan.*Hyogo Bank has been reorganized as Midori, and Fukutoka and Naniwa Bank has been reorganized as Namihaya after its failure. Finally both the banks again failed.*

Although most of the failed banks have been either merged or recapitalized, it is still not certain that the crisis has been finished. If the crisis is related to only monetary easing and bubble economy of the 1980s, the crisis should have to be ended earlier. If the crisis is inherent in banking operations and management efficiency, the issue is worrisome. This is the focus of this paper.

3. Potential determinants of banking crisis

The prospects of failure of banks can be explained by analyzing the following characteristics of the banking business: (i) asset risk, (ii) capital adequacy, (iii) liquidity, (iv) management and operating efficiency, and (v) earnings. Banks usually are threatened with failure because of losses on assets; on the other hand, liquidity, capital adequacy and earnings measure the ability of a bank to open in spite of these losses. Capital adequacy and earnings allow losses to be offset by current or past income (Mishkin, 2003). Some argue that ample liquidity after the 1985 Plaza Accord provided the funds for speculation (Arayama and Mourdoukoutas, 2000), but our analysis shows that only the city banks had had high liquidity after the Plaza accord and except regional banks tier II, other banks liquidity position over the time period has not been found significantly different (Table B in Appendix-I).

Generally, each of these above five characteristics may have influence on banks prospect of failure. Asset quality is important for determining the current and future profitability of the bank; it deteriorates with the significant increase of non-performing loan. On the other hand, capital adequacy can reduce risk of failure and absorb losses. Capital acts as buffer against loan losses, it may prevent the failure whose customers default on their loans. According to Nelson (1977), the probability of failure is a function of current level of capital, and the estimated mean and variance of earnings and charge-offs.

Management and operating efficiency of the Japanese banks is a widely discussed topic. Management sets the profitability objectives of bank and determine loan portfolio by proper lending risk analysis. Earning is measured by either of the ratios ROA, ROE or Net Interest Margin. A low ROA may either be due to conservative lending and investment policies or excessive operating expenses. Regarding low profitability of Japanese banks, one view is that banks expanded their sizes and assets that required high operating expense which have negative effect on profit.

In this paper, an attempt has been made to find the determinants of banking crisis by analyzing financial ratios. In Table 4, we define some financial ratios that are widely considered

as indicators of banking distress (for example, see Rahman et al., 2004; Lane et al., 1986; Martin, 1977). For application of survival (alternate, hazard) methods, the use of financial ratios is found to be an advantageous because it represents the individual bank's financial situation on an average for the term.

The following variables are defined for analysis.

Table 4: Definition of financial ratios (independent variables)

Criteria	**Measurement/Financial ratios**	**Variable Name**	**Expected sign for probability of failure**
Asset quality:	1.Total Loans outstanding/Total loan	ASSET1	+
	2. Total gross loan/ Total asset	ASSET2	+
	3. Real estate loans outstanding/Total loans outstanding	ASSET3	+
1. Management efficiency	1. Interest expense/Total loans	ME1	-
	2. Interest income/ Interest expense	I/E	-
2. Operating efficiency	3. Total operating expense/Net income after tax	ME2	+
Capital adequacy	1. Capital reserve/Total asset	CAP	-/+
	2. Net worth/Total asset	CAP1	-
Liquidity	1. Liquid asset/Total asset	LIQ	-
Earnings	1. ROA= Net income after tax/Total asst	ROA	-
	2. ROE = Net income after tax/ Total equity	ROE	-
	3. Net Interest Margin	PM	+

4. Data

The sources of data are mainly Bank of Japan's 'Economic and Financial Statistics Monthly', Japanese bankers association's 'Annual Report of Financial Statement' of all banks. Yearly data from 1977 has been used for analytical purpose.

The average estimated financial ratios over the period, and ratios of the year of failure are demonstrated in Table B of Appendix. The ME1 and ME2 variables have not been calculated for the period of before 1988 for individual ordinary banks due to lack of easy access to data. Bank of Japan only provides aggregated data on interest expense and operating expense from 1988 onward.

Although Regional Tier II banks have been operating from 1989 as an ordinary bank, we use their financial statements that are available from the 1970s. Before 1989, the statement includes the performances of the so-called *sogo* banks.

The details of data management for the application of survival models are discussed in respective sections.

5. Empirical Methodologies and Results

5.1 Kaplan-Meire's Product-Limit Method

Kaplan-Meire's product-limit method can be used for estimating survival probability as well as hazard functions with competing cause of bank failures.

Suppose T denote the survival time of each failed bank and C={1,2,..,k) denote the vector of causal variables. Thus the joint distribution of T and C can be approached through cause-specific hazard, survivor or probability density functions defined as follows for j=1,2,….,k.

$$h_j(t) = \lim_{\Delta t \to 0} \frac{Pr(t \le T \le t + \Delta t, C = j \mid T \ge t)}{\Delta t}$$

$$S_j(t) = Pr(T \ge t,\ C=j)$$

$$f_j(t) = \frac{-dS_j(t)}{dt}.$$

The marginal distribution of C has probabilities

$\pi_j = Pr(C = j) = S_j(0)$ and $\sum_{j=1} \pi_j = 1$ since there is no censored observations.

The marginal distribution of survival function, S(t) and hazard function H(t) is

$$S(t) = \prod_{j=1}^{k} G_j(t) \text{ and } H(t) = -\log(S(t)) = \sum_{j=1}^{k} H_j(t)$$

where $\hat{G}_j(t) = \prod_{\substack{i:t_i<t \\ C_i=j}} \frac{n_i - d_{ji}}{n_i}$ is the maximum likelihood estimates (*Product Limit estimates)*; n_i is the number of banks at risk just prior to t_i and d_{ji} denote the number of failed banks from cause j at t_i.

The marginal survivor function S(t) can be estimated by the product-limit method ignoring cause of failure too as follows:

$\hat{S}(t) = \prod_{\substack{t_i<t \\ \delta_i=1}} \frac{n_i - d_i}{n_i}$; δ_i=1 indicates no censoring.

Then plots of log ($\hat{H}_j(t)$) or log (-*S(t)*)for different j's should be roughly parallel if hazard rates for different causes are proportional. Theoretically, plot of survival function should be step function since it assumed to be constant between two observed exact survival times.

Results:

To apply the P-L method, we consider a total of 155 banks that were surviving from 1977 and fraction of survival years for the failed banks is rounded.

Table 5: Survival time by potential prognostic variables for failure of banks (for all banks).

Variable	Number of failed banks	Estimated median survival time (in year; from 1977 to 2003)	*p*-value	Comments Categorization of variables for the period:
CAP(percent)				
<0.8	4	19	0.003	Before 1990
≥0.8	15	24		After 1990
ROA (percent)				
<0.10	15	21	0.06	-Before 1980, and after 1993
≥0.10	4	26		-Monetary easing and bubble period
ASSET1				
<1.0	1	16*	0.06	-1988-1993 (bubble period)
≥1.0	18	23		-Before 1988, and after 1993
ASSET2				
<0.55	-	-	-	-Before 1985
≥0.55	19	23		-After 1985
ASSET3				
<0.10	16	23	0.12	-Before 1987 and after 1993
≥0.10	3	16*		-1987-1993
ME1				
< 0.10	19	23	-	-1983-2003
≥0.10	-	-		-Before 1983
ME2				
<30	11	24	0.13	No clear trend
≥30	8	20		
LIQ				
≤0.06	17	23	0.01	-Before and after bubble
>0.06	2	19		-Bubble period
PM				
≤0.30	1	16*	0.13	-Before and immediately after bubble
>0.30	18	21		-Bubble and after 1993

**Mean survival time; Log-rank test has been used to compare the factor; Median survival time has been estimated from interpolation of survival functions.*

The above results show that capital adequacy requirements (CAP), ROA, ASSET1 and LIQ have significant effect on bank's failure. Categorizations of the variables have done with a view to comparing the pre-crisis and post-crisis period. Categorization of ASSET1, which is the ratio of total loans and discounts outstanding to total loan is done in such a way that it can capture the situation of the bubble period. Calculation shows that before 1988 and after 1993 the ratio was mostly stable which is somewhat higher than 1.0 (Table B). That is, banks asset risk was higher in the 1970s too. Significance of ASSET1 indicates that the asset price bubble has accelerated the failure of banks. Categorization of ROA has captured the significant difference of the 1980s which includes both monetary policy and bubble phenomenon. The analysis also indicates that

higher value of ASSET1, ASSET2 and CAP and lower value of ROA, ASSET3, ME1, LIQ increases the probability of failure of the Japanese banks (Figure 2). The significance of low ROA (as it is evident in the 1970s too) to the failure therefore provides a warning of future crisis. Moreover, higher value of ASSET3, ME2, LIQ and lower value of CAP, ROA, and ASSET1 decreases the median survival time (Table 5). This finding indicates that emergence and burst of the bubble in the late 1980s led to an early crisis, the estimated median survival time also indicates that without the shock it would take around 5-7 years more to reach the crisis situation.

All the variables are used to compare the pre and post-bubble period. Most of the banks failed mostly with the same financial condition of the pre-bubble period. Therefore we may conclude that the situation of banks in the 1970s was a warning for crisis and the situation has been accelerated to an early crisis by the burst of the bubble.

However, examination of each variable by PL estimate can give preliminary idea of which variables might be of prognostic importance. The simultaneous effect of the variables must be analyzed by an appropriate multivariate statistical method to determine the relative importance of each.

For this purpose, we discuss the Cox's (1972) proportional hazards model in the following section. The assumption of this model is that the hazards for different strata of each independent (or prognostic) variable are proportional over time. This assumption is verified graphically by plotting *log[-S(t)]* versus *t* for two subgroups of each variable(Figure-3). The two almost parallel curves indicate that the hazards of failure of banks are proportional. Therefore, it is justified to use the proportional hazards model.

5.2 Proportional Hazards Model

Let T be a continuous variable representing a bank's survival time and Z= (Z_1, Z_2,…..,Z_p) be a known vector of regression coefficients. With the assumption that different bank has hazard functions which are proportional to each other and independent of time, the Cox's (1972) proportional hazard model can be defined as

$$\lambda(t,z) = \lambda_0(t)e^{z\beta}$$

$$\Rightarrow log\frac{\lambda_i(t,z)}{\lambda_0(t)} = \sum_{j=1}^{p}\beta_j z_{ji} = \beta_1 CAP + \beta_2 ASSET + \beta_3 ROA + \beta_4 ME$$

where $\lambda_0(t)$ is only a function of time t and is known as base-line hazard rate which represents how the risk changes with time. The advantage of this model is that it does not require any distributional assumptions (for more details, see Cox(1972)).

The model has a partial likelihood function in which the only parameters are the coefficients associated with covariates. However, statistical inference based on the partial likelihood has asymptotic properties. The partial likelihood takes different forms based on the presence or absence of tied observations. Newton-Raphson Iterative procedure is required to get the estimates.

The underlying assumptions of the hazards model are to assign the characteristics of the subjects (e.g. banks) measured at start-point or end-point or any other specified time-point to the failure (or survival) time of the subjects in a prospective study. Nonetheless, there is no clear-cut rule about the time-specification of the covariates (or, explanatory variables), but the interpretation must depends on the specification (Kiefer, 1988)[3]. In this paper, I have examined different time-specifications of the covariates for the PH model, such as the start-point (1990), end-point (2003), and the average of the whole period. The use of aggregate average ratios of the whole period for the non-failed banks and specific aggregate ratio of the year of failure for failed banks has been found effective in analyzing the causes of failure of the Japanese banks. Only the ordinary banks have been considered for analysis as they are big in size.

I consider all covariates as time dependent except CAP and CAP1 since it is a legal requirement. I consider the 155[4] banks that were surviving at the beginning of 1990s and there were no tied observations. Since the financial ratios vary for different types of banks, stratified Cox's proportional hazards model has been used. The survival time has been calculated for the period 1990 to 2003.

In the first attempt, I have fitted stratified Cox's PH model by analyzing the ratios ASSET2, CAP1, I/E, ME1, ME2, ROA of the base-line year 1990 as covariates for the existing154 banks, of which 17 have failed. Among the estimated coefficients, only interest income over interest expense has been found significant[5] as a cause of future bank-failure (Table A in Appendix). The other variables have not been found significant, probably because of the fact that only one year's data is not enough to capture the long-term time series trend.

Therefore in another attempt I revitalize the assumption to estimate the Cox's regression coefficient. I assume that the failed banks represent the specific ratio of the year of failure, and

[3] Kiefer (1988) also mentioned that assigning economic meanings to coefficients is a matter of modeling and judicious use of prior information.

[4] The number of banks varies over time due to merging or newly emergence. For aggregate data analysis, I consider 155 banks; while for 1990, data of existing 154 banks has been analyzed. So far in survival analysis, this trivial variation in number of banks does not create any significant difference.

[5] ME1 and I/E are highly correlated, and in absence of I/E all other variables are not significant. But I/E has been found highly significant in all situations.

the rest non-failed banks continue with the average ratio for the period 1990-2003. From Table C in Appendix-II, it can be easily seen that the average ratios of 1990-2003 are mostly comparable with that of pre-1990, i.e. it maintains the long term trend pattern. A more detailed explanation about data analysis has been provided in Appendix-II. Therefore, the assumption makes it possible to compare the failed banks' financial situation with that of pre-crisis period's situation (see Table B in Appendix-I) without losing generality of the assumption of PH model. This specification also makes it possible to compare with that of end-point (e.g. 2003) ratios.

Table 6: Potential determinants of the failure of banks by PH model (1990-2003)

Prognostic Variable	Model-1 Coeff. *p-value*	Model-2 Coeff. *p-value*	Relative Risk (Exp(β))
ASSET1	--	5.12(1.84) 0.00	-
ASSET2	26.12(6.0) 0.00	--	-
CAP	-1.77(5.86) 0.76	-2.02(5.3) 0.71	-
ROA	--	-0.55(0.14) 0.00	0.58
ME1	-2.54(1.45) 0.08	--	0.08
ME2	0.04(0.011) 0.00	-0.06(0.02) 0.02	1.04
PM	0.244(1.13) 0.83	--	-
Log-likelihood	-33.92	-31.45	
Number of banks: 155, Number of failed banks: 19			

* *Standard errors are in parenthesis; Blank spaces indicate drop of the correlated variables.*

I have fitted two PH models to manage the highly correlated variables. The blank space indicates drop of the correlated variables. The variable LIQ has not been considered in the model since it creates bias in estimation as it is highly correlated with some other variables. These two models show that asset ratios have positive significant effect on the failure of banks. Management efficiency variables and ROA has significant effect on the failure of banks. Significance of ME2 indicates that high operating expenses (in other words, comparatively big size) of banks contributed to the failure of banks. Capital adequacy requirements has not been found significant, although some studies claim that increase of capital adequacy requirement in the early of 1990 contributed to the failure of banks.

Relative hazard ratio has been estimated only for the significant variables. About 50% lower risk of failure than those whose ROA is less than the average level of 1990-2003. Relative risk of ME2 is just 4% higher.

Since the above interpretations are based on the specification that the ratios are higher (or lower) for survived banks than the failed banks, these ratios together form a set of indicators for the failure of the Japanese banks. Therefore increase or decrease of ratios to a certain level may contribute to the failure of banks (Table C).

5.3 Accelerated Failure Time (AFT) Model

The AFT model of survival time (Cox, 1972) assumes that the relationship of logarithm of survival time T and covariates is linear and can be expressed as

$$log(T) = \beta_0 + \sum_{j=1}^{p} \beta_j Z_{ji} + \sigma\varepsilon$$

where Z_j's are the covariates, β_j's be the coefficients, σ (σ>0) is an unknown scale parameter, and ε, the error term, is a random variable with known forms of density function $\mathbf{g}(\boldsymbol{\varepsilon})$ and survivorship function $\mathbf{G}(\boldsymbol{\varepsilon})$. Thus the survival is dependent on both the covariate and an underlying distribution **g**. This model shows the covariate **Z** either 'accelerates' or 'decelerates' the survival time or time to failure.

Again assume that ε_i follows logistic regression model with density function

$$g(\varepsilon) = \frac{exp(\varepsilon)}{[1 + exp(\varepsilon)]^2}$$

and survivorship function

$$G(\varepsilon) = \frac{1}{1 + exp(\varepsilon)}.$$

Hence the model resembles the properties of log-logistic model.

Suppose S(t, β) denote the probability of surviving longer than t, then $S(t,\beta)/[1 - S(t,\beta]$ gives the odds of surviving longer than t. Let OR_i and OR_j denote the odds of surviving larger than *t* for specific conditions *i* and *j*, respectively. The logarithm of odds ratio is thus

$$log\frac{OR_i}{OR_j} = \frac{1}{\sigma}\sum_{k=1}^{p} \beta_k (x_{ki} - x_{kj}),$$

and, the ratio is independent of time. Therefore, the log-logistic regression model is a proportional odds model, rather than a proportional hazards model. Opposite sign of PH model is expected in this case.

Therefore, we define the model,

$$log\, T_i = \alpha_0 + \alpha_1 CAP + \alpha_2 ASSET + \alpha_3 ROA + \alpha_4 ME + \sigma\varepsilon$$

where $\sigma = 1/\gamma$; γ is a shape parameter. The odds of covariates can be estimated as

$log \frac{Odds_{NF}}{Odds_F} = \frac{\hat{\alpha}_i}{\sigma}$; where NF and F stands for non-failed and failed banks respectively.

Since the variables varied over different types of banks, strata of banks has been considered as gamma shared frailty group for estimates. The same assumptions of PH model have been made here for data analysis.

Table 7: Determinants of the Japanese banks' failure (AFT model estimate)

Potential Variable	Model-1 Coeff. *p-value*	Model-2 Coeff. *p-value*	Model-3 Coeff. *p-value*	Odds ratio $Exp(\alpha_i/\sigma)$
ASSET1	--	--	-4.42(0.85) 0.00	0.35
ASSET2	-3.09(3.39) 0.43	--	--	0.37
CAP	--	3.11(1.5) 0.04	--	2.95
ROA	0.97 (0.45) 0.03	1.46 (0.48) 0.00	0.87(0.32) 0.00	1.36 (Model-1)
ME1	3.43(5.2) 0.51	3.63(4.8) 0.44	1.17(3.03) 0.70	-
ME2	-0.02(0.01) 0.09 -	-0.02(0.01) 0.10	0.02(0.008) 0.00	0.99
PM	4.05(1.7) 0.02	--	--	3.65
Const.	6.13(2.57) 0.02	0.99(0.97) 0.92	6.68(0.97) 0.00	-
Gamma	0.32(0.07)	0.348(0.076)	0.238(0.05)	
Theta	0.72(1.59)	1.45(1.56)	0.0 (0.0)	
Log-likelihood	-41.16	-42.25	-31.47	
Number of banks: 155, Number of failed banks: 19				

* *Standard errors are in parenthesis; Blank spaces indicate drop of the correlated variables.*

Three AFT models have been fitted to tackle the correlated variables. ASSET1 and ROA, ASSET2 and CAP, ME1 and PM are found highly correlated and inclusion of these variables together creates bias in estimation and decrease the log-likelihood substantially. Model 3 has been fitted to see the significance of ASSET1 although its log-likelihood is somewhat lower comparatively.

The AFT model estimates indicate that ASSET1 has significantly negative effect while CAP, ROA and PM have significantly positive effect on survival of the banks. In other words, these variables positively and negatively accelerate the failure of banks respectively. Since the impact of the bubble collapse on banks is represented by these variables, therefore it can be concluded that the collapse of the bubble accelerated the failure of banks. This model indicates that increase

in capital adequacy requirement has decelerated the failure of banks. ASSET2, ME1 and ME2 have not been found significant by this model, may be due to omitted- variables bias.

However, the finding is very interesting and quiet opposite than those of the common view that increase in capital adequacy requirement in the late 1980s created problem for the banks. Capital adequacy requirement might have negative effect on those banks whose asset quality and other performance was not good. Increase in capital base decreases loanable funds of some banks which made them vulnerable to crisis.

The odds ratio implies that increase in ASSET1 and ASSET2 decreases the probability of survival while increase in ROA, PM and CAP increases the probability of survival substantially. One percent-increase in ROA increases the probability of survival by 36%.

5.4 Discussion on the findings of survival analysis

Although a wide application of survival methods is seen in the epidemiologic and bio-medical researches, it can be a useful econometric tool if it is applied appropriately to the bank-failure time series data. This analysis successfully tests the proposition that Japanese banks were becoming weaker during the main bank regime and it was a warning for any crisis. Banks speculative behavior in the 1980s was the consequence of their weak financial conditions. The robustness of the results has been verified by three different types of survival methods. Only the locally (or, directly) influential variables to the bank-failure are examined by survival methods.

Even though the asset ratios are found mostly similar before and after the 1980s, quality of asset was different for these two periods. This issue indicates that management was caring much about accounting, rather than asset risk. Increase in capital adequacy requirement has positive effect on survival instead of failure. It may have acted positively on the failure of those banks whose performance was not good. This finding is interesting in the sense that at the backdrop of the bubble economy, the increase of capital adequacy requirements hopefully safeguards many banks from failure.

Banks management has not been found significantly efficient in terms of operations. Banks were expanding their branches as well as sizes of human resources, but their return was low. Therefore, we may conclude that the management of the main bank system was not so dynamic to operate the banks in a liberalized environment after 1980.

However, all these consequences are reflected in banks' return, and therefore it has been found highly significant in all estimations. The continuous declining of ROA was a warning

signal for banking crisis. Therefore, it is necessary to identify the potential determinants of low profitability of the Japanese banks.

For survival analysis, either of the computer packages STATA, SAS, SPSS, or BMDP can be used.

6. Banks profitability and determinants

Highly significance of low ROA on bank's failure necessitates the analysis of declining profitability of Japanese banks. Figure-1 shows that the declining trend of profitability of Japanese banks continued from 1970 except during the asset price bubble and monetary easing period in the 1980s, and Figure 4 demonstrates the trend of different macroeconomic indicators.

Some authors argue that the low profitability during the sluggish economy was due to poor macroeconomic conditions. The economy at that time lacks enough profitable investments, or deflation and near-zero interest rate prevents banks earning from fair return on their investment. The usual question is why banks' profitability was declining during the high economic growth period of Japan? Were the banks ever caring about their declining trend of profit? It is important to analyze the declining trend of profits to avert any future collapse of the Japanese banks.

One important argument is that Japanese banks are unable or unwilling to exploit profitable lending opportunities. During the main bank regime, banks were caring much about market share rather than profit (Yoshino and Sakakibara, 2002). Some pundits argue that Japanese economic growth has been achieved at the expense of banks' profit.

We may guess some other reasons that might contribute to the Japanese banks' low profit during high growth period. Sometimes, to meet up the enterprise groups' excess demand for money, bank borrowed from call money market with high interest rate and lent it to its affiliated firm with the existing (usually lower) interest rate. This preferential loan might have impact on declining trend of banks' profit. Again, borrowing short and lending long created a mismatch in the financial system as there are some maturity gap (exact data are not available) between the deposit fund and loan portfolio in the Japanese banks (Ito, 1992; Smith, D.C., 2002). This structural weaknesses affected profitability of the main bank system of Japan. Moreover, lending risk analysis could be biased due to the presence of directors of enterprise firms in banks, which pinpoints inefficiency of the management. Also we cannot deny the possibility of window dressing[6] in bank's profit; if it is so, the actual profit of banks was lower than the reported one.

[6]Bank sometimes manipulate their financial statements to show a inflated position of their performance by taking favor from their own enterprise group. This unfair means is termed as Window Dressing. It could be a very difficult task to get proper information on window dressing in Japan.

Caves and Uekusa (1976, pp. 72-83) showed that group membership decline a firm's rate of profit; so does banks profit. Therefore preferential loan, window dressing, window guidance etc. trigger the efficiency of the management, in other words, the problems of corporate governance. Therefore these factors may be the determinants of profit during the main bank regime. However, it is difficult to find appropriate proxy to measure the effect of some of the above variables.

The Granger causality test and cointegration test have been performed to identify the determinants of low profitability of banks. The variables used are: log of asset (LASSET) as a proxy for size, call rate minus discount rate (DINT), interest income/interest expense (I/E) and ME1 as a proxy for management efficiency as well as a proxy for preferential loan, growth of money supply (M2CD), growth of land price index (LPIND), net interest margin (PM), operating efficiency (ME2), uncollateralized call rate (CR), discount rate (DR), GDP growth (GDP) and households savings rate.

6.1 Cointegration and Granger causality test

To test for long-run determinants of banks ROA, we first present in Table 8 unit root tests on the yearly data of all domestically licensed banks from 1977 to 2003. We are unable to reject the existence of a unit root for all the series except ME2 and DINT.

Table 8: Unit-root test (Dickey-Fuller statistic)

Variable	Dickey-Fuller Test Statistic	Variable	Dickey-Fuller Test Statistic
ROA	-1.25	LPIND	-0.524
PM	-2.94	M2CD	-2.58
I/E	1.92	HHSR	-1.75
DINT	-4.73*	CR	-3.15
ME1	-2.38	DR	-2.78
ME2	-5.17*	LASSET	0.76
GDP	-2.51		

Note: The unit-root tests include both trend and intercept.
**indicates rejection of null hypothesis at 1% level of significance.*

I next test for cointegration between ROA and these variables. Table 9 shows the test statistics for the null hypothesis of no cointegration between ROA and other variables. We find cointegration between ROA and I/E, growth of money supply, log of total asset (LASSET), growth of land price index (LPIND), ME1, household saving rate (HHSR), GDP growth rate and discount rate. The result indicates the existence of long-run relationship of this variables and ROA.

Table 9: Test for cointegration of ROA and the other variables

Variable	Likelihood Ratio	Variable	Likelihood Ratio
LASSET	33.77*	I/E	31.75*
LPIND	30.63*	ME1	55.59*
M2CD	33.74*	PM	19.02
HHSR	33.02*	DR	27.07**
CR	22.12	GDP	29.88**

Notes: Test allows intercept and linear deterministic trend in the data. The critical value is 25.32 for 5% and 30.45 for 1% significance level.
* and ** indicates rejection of null hypothesis at 1% and 5% level respectively.

Table 10 demonstrates Granger-causality tests of the ROA and other variables. We test the hypothesis that changes in other variables do not Granger-cause the changes in ROA. Results show that LPIND, HHSR, PM, DINT and ME1 do not Granger-cause ROA. Therefore, the size of the banks, operating expenses or efficiency (ME2), management efficiency (I/E), money supply and GDP growth rate have been found as a long term determinants of the Japanese banks' profit.

Table 10: Granger-causality tests

(Hypotheis tested: Changes in other variables do not Granger-cause the changes in ROA)

Variables	F-statistic	Probability	Lags
I/E	4.73	0.03	2
LASSET	6.07	0.05	7
M2CD	12.85	0.01	7
DINT	0.88*	0.68	8
LPIND	3.29*	0.13	7
PM	0.61*	0.55	2
ME2	7.34	0.00	2
ME1	0.32*	0.90	7
HHSR	2.48*	0.45	7
GDP	45.69	0.00	7
DR	0.46*	0.82	8
CR	2.47*	0.32	8

* indicates insignificance.

7. Conclusion

The findings of this paper suggest that declining profitability of Japanese banks from the main bank regime in the 1970s was a warning for crisis. As the banks are profitable organizations, their speculative behavior during the bubble economy can be described by thrust for maximizing profit. Asset ratios (due to low quality) have been found significant to the failure of banks which is completely a bubble phenomenon. Analysis also indicates that emergence and burst of the bubble in the late 1980s just accelerated the situation to an early crisis in the 1990s.

Moreover, the big size of the banks and lack of efficiency in the bank management and operations significantly contributed to the failure of the banks. The analysis also pinpoints that bank management was caring much about accounting rather than risk management. This result

indicates that expansion of the sizes of the banks have been done without caring much about return. The low return ultimately makes the banks vulnerable to crisis.

As a part of long run determinants of profit, a large number of variables have been checked with cointegration and Granger-causality tests. Banks size, ratio of interest income over interest expense, operating efficiency ratio, GDP growth and growth of money supply have been identified as significant long term determinants of profit.

The use of survival models to the Japanese banking failure data is quiet new to my knowledge, and the findings are interesting and robust. The findings have important policy implications too. Since the crisis occurring variables are inherently related to baking operations and management, we can not overrule the future possibility of Japanese banking crisis unless or until the corporate governance has been improved significantly.

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APPENDIX-I

Table A: Potential determinants of the failure of banks by using start-point (1990) data [PH model estimates]

Prognostic Variable	Coeff. (std. error)	*p-value*
ASSET2	-0.613 (0.79)	0.43
CAP1	-86.08 (47.7)	0.07
ROA	0.015 (0.085)	0.86
ME1	-16.35 (8.89)	0.07
ME2	0.002 (0.004)	0.61
I/E	-2.04 (0.65)	0.00
Log-likelihood	-53.55	

Table B: Trend of financial ratios of the Japanese banks over the period

Type of banks	Financial ratios	Average over the period 1977-1980	1981-87	88-89	90-2003	*p-value*	Ratio of the year of failure 91	95	96	**97**	98	99	01	02	03
City banks	ASSET1	1.28 (0.02)	1.16 (0.08)	0.96 (0.02)	0.96 (0.08)	0.00				1.03					
	ASSET2	0.47 (0.01)	0.52 (0.04)	0.56 (0.01)	0.59 (0.03)	0.00				0.59					
	CAP	0.06 (0.01)	0.06 (0.02)	0.34 (0.14)	0.81 (0.08)	0.00				0.90					
	ME1	--	--	0.18	0.09	--				0.05					
	ME2	--	--	21.06	26.18	--				-					
	ROA	0.79 (0.09)	1.12 (0.14)	0.70 (0.21)	0.36 (0.19)	0.00				0.08					
	PM	0.11 (0.09)	0.14 (0.21)	0.49 (0.09)	0.33 (0.10)	0.01				0.32					
	LIQ	0.07 (0.00)	0.07 (0.00)	0.11 (0.00)	0.06 (0.00)	0.14				0.06					
							91	95	96	97	98	99	01	02	**03**
Regional banks	ASSET1	1.35 (0.04)	1.22 (0.08)	1.01 (0.02)	1.00 (0.06)	0.00									0.99
	ASSET2	0.51 (0.007)	0.55 (0.05)	0.61 (0.006)	0.64 (0.06)	0.00									0.66
	CAP	0.09 (.006)	0.07 (0.008)	0.17 (0.08)	0.56 (0.03)	0.00									0.59
	ME1	--	--	0.06	0.04	--									0.001
	ME2	--	--	3.23	3.70	--									3.17
	ROA	1.92 (0.22)	2.86 (0.30)	2.19 (0.43)	1.34 (0.61)	0.00									0.27
	PM	0.52 (0.08)	0.23 (0.15)	0.39 (0.07)	0.35 (0.15)	0.04									0.45
	LIQ	0.05 (0.00)	0.04 (0.00)	0.03 (0.00)	0.04 (0.00)	0.20									0.03
							91	**95**	**96**	**97**	**98**	**99**	**01**	**02**	03
Regional Tier II	ASSET1	1.30 (0.04)	1.18 (0.06)	1.05 (0.008)	1.03 (0.05)	0.00	0.99	1.07	1.06	1.05	1.04	1.02	1.07	1.03	
	ASSET2	0.52 (0.02)	0.54 (0.03)	0.63 (0.006)	0.70 (0.07)	0.00	0.66	0.70	0.72	0.73	0.73	0.72	0.71	0.69	
	CAP	0.11 (0.01)	0.09 (0.006)	0.19 (0.08)	0.60 (0.06)	0.00	0.61	0.65	0.58	0.60	0.59	0.61	1.00	1.09	
	ME1	--	--	0.06	0.04		0.08	0.02	0.02	0.01	0.01	0.01	0.0	0.0	

	ME2	--	--	3.23	3.70	--	3.5 3.50 3.40 5.2 4.8 4.8 10.0 10.9
	ROA	1.61 (0.20)	2.43 (0.27)	2.0 (0.38)	1.24 (0.62)	0.00	1.79 1.05 0.96 0.62 0.44 0.40 0.42 0.31
	PM	0.30 (0.07)	0.21 (0.16)	0.43 (0.03)	0.33 (0.19)	0.35	-0.03 0.52 0.51 0.44 0.40 0.48 - -
	LIQ	0.05 (0.02)	0.04 (0.00)	0.04 (0.00)	0.02 (0.00)	0.00	0.03 0.02 0.02 0.02 0.02 0.02 0.02 0.04
							91 95 96 97 **98** 99 01 02 03
Long Term Credit Bank	ASSET1	1.35 (0.06)	2.06 (0.37)	1.59 (0.17)	0.90 (0.80)	0.00	0.92
	ASSET2	0.64 (0.01)	0.63 (0.01)	0.63 (0.00)	0.59 (0.03)	0.00	0.59
	CAP	0.06 (0.01)	0.04 (0.01)	0.48 (0.24)	0.79 (0.22)	0.00	0.96
	ME1	--	--	0.13	0.05	--	0.04
	ME2	--	--	12.7	9.02	--	6.5
	ROA	1.35 (0.06)	2.06 (0.37)	1.59 (0.17)	0.90 (0.80)	0.01	0.60
	PM	--	--	--	0.33	--	0.32
	LIQ	0.03 (0.00)	0.03 (0.00)	0.05 (0.00)	0.4 (0.01)	0.82	0.02
							91 95 96 97 98 99 01 02 03
Trust Bank	ASSET1	0.45 (0.02)	0.44 (0.03)	0.43 (0.03)	0.44 (0.07)	0.98	
	ASSET2	0.45 (0.02)	0.47 (0.05)	0.51 (0.03)	0.47 (0.05)	0.53	
	CAP	0.19 (0.02)	0.12 (0.04)	0.60 (0.31)	1.29 (0.29)	0.00	
	ME1	--	--	0.13	0.05	--	
	ME2	--	--	12.17	9.02	--	
	ROA	1.12 (0.19)	1.25 (0.04)	0.77 (0.31)	0.38 (0.38)	0.00	
	PM	--					
	LIQ	0.06 (0.00)	0.07 (0.00)	0.11 (0.01)	0.08 (0.01)	0.50	
							91 95 96 97 98 99 01 02 03
All Banks	ASSET1	1.26 (0.02)	1.16 (0.03)	0.97 (0.03)	1.23 (0.07)	0.35	0.91 1.55 1.50 1.47 1.41 1.37 1.32 1.02 1.00
	ASSET2	0.50 (0.02)	0.54 (0.05)	0.58 (0.03)	0.60 (0.05)	0.00	0.56 0.63 0.63 0.62 0.61 0.61 0.60 0.59 0.57
	ASSET3	0.06 (0.00)	0.07 (0.02)	0.11 (0.00)	0.10 (0.01)		0.11 0.09 0.09 0.10 0.10 0.10 0.12 0.11 -
	CAP	0.08 (0.01)	0.07 (0.01)	0.33 (0.14)	0.87 (0.22)	0.00	0.71 0.77 0.75 0.81 0.81 0.86 1.31 1.15 0.98
	ME1	--	0.08	0.08	0.03	--	
	ME2	--	26.8	20.47	--	--	0.08 0.03 0.02 0.02 0.01 0.01 0.01 0.01 0.00
	ME3	0.002	0.003	0.005	0.004		0.002 0.003 0.003 0.003 0.004 0.003 - - -
	ROA	0.10 (0.01)	0.23 (0.01)	0.30 (0.01)	0.09 (0.10)	0.65	0.15 -0.31 0.00 -0.54 -0.38 0.09 -0.56 0.65 0.8
	PM	--	0.23	0.39	0.34		0.15 -0.51 0.40 0.38 0.39 0.49 0.45 - -
	LIQ	0.06 (0.01)	0.06 (0.00)	0.08 (0.00)	0.06 (0.01)	0.28	0.09 0.06 0.05 0.05 0.03 0.04 0.04 0.04 -

**Standard errors are in parentheses; p-values are based on F-statistics*

Figure 2: Plot of hazard functions (Kaplan-Meier's estimate)

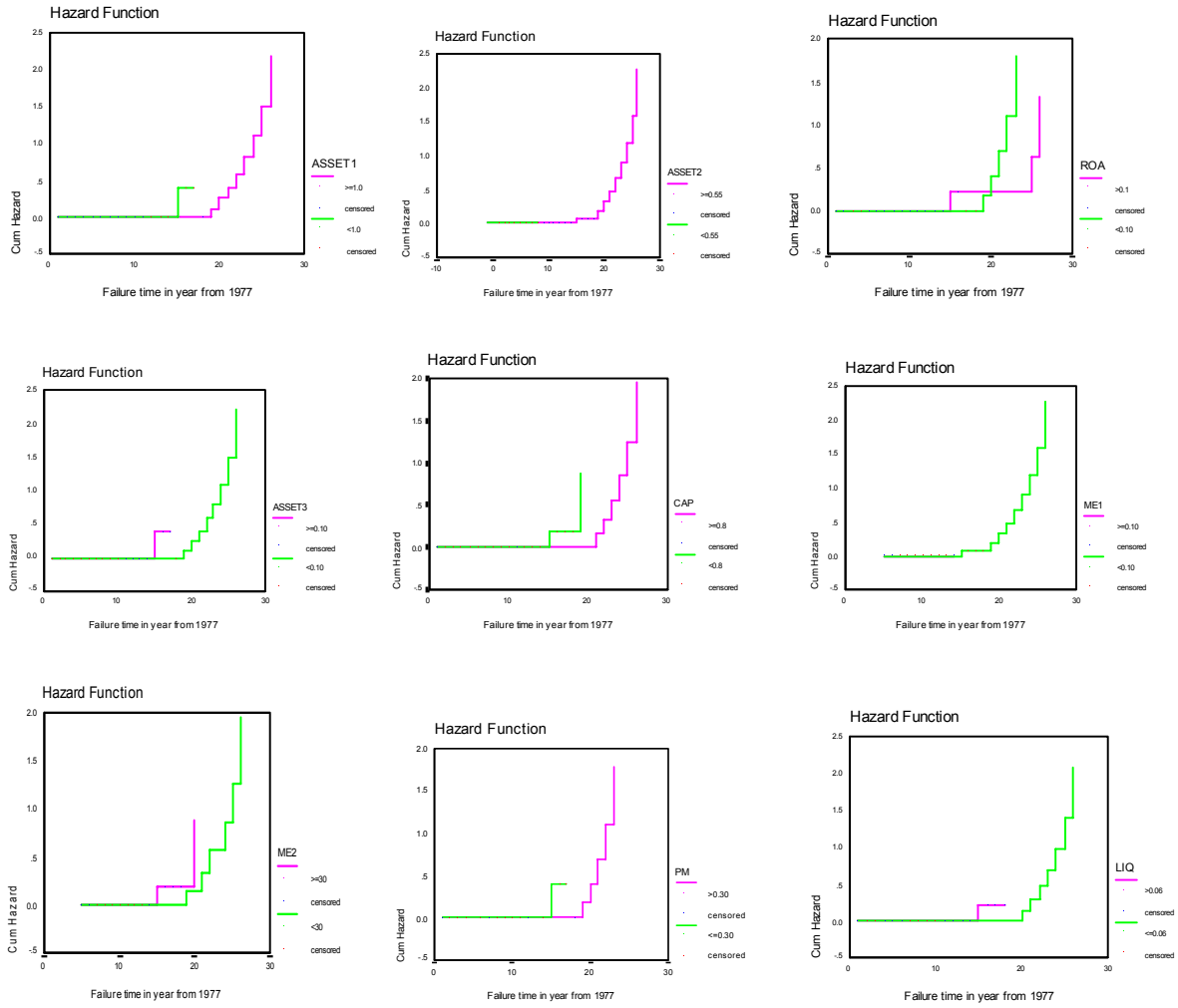


Figure 3: Testing the proportionality of the hazard functions

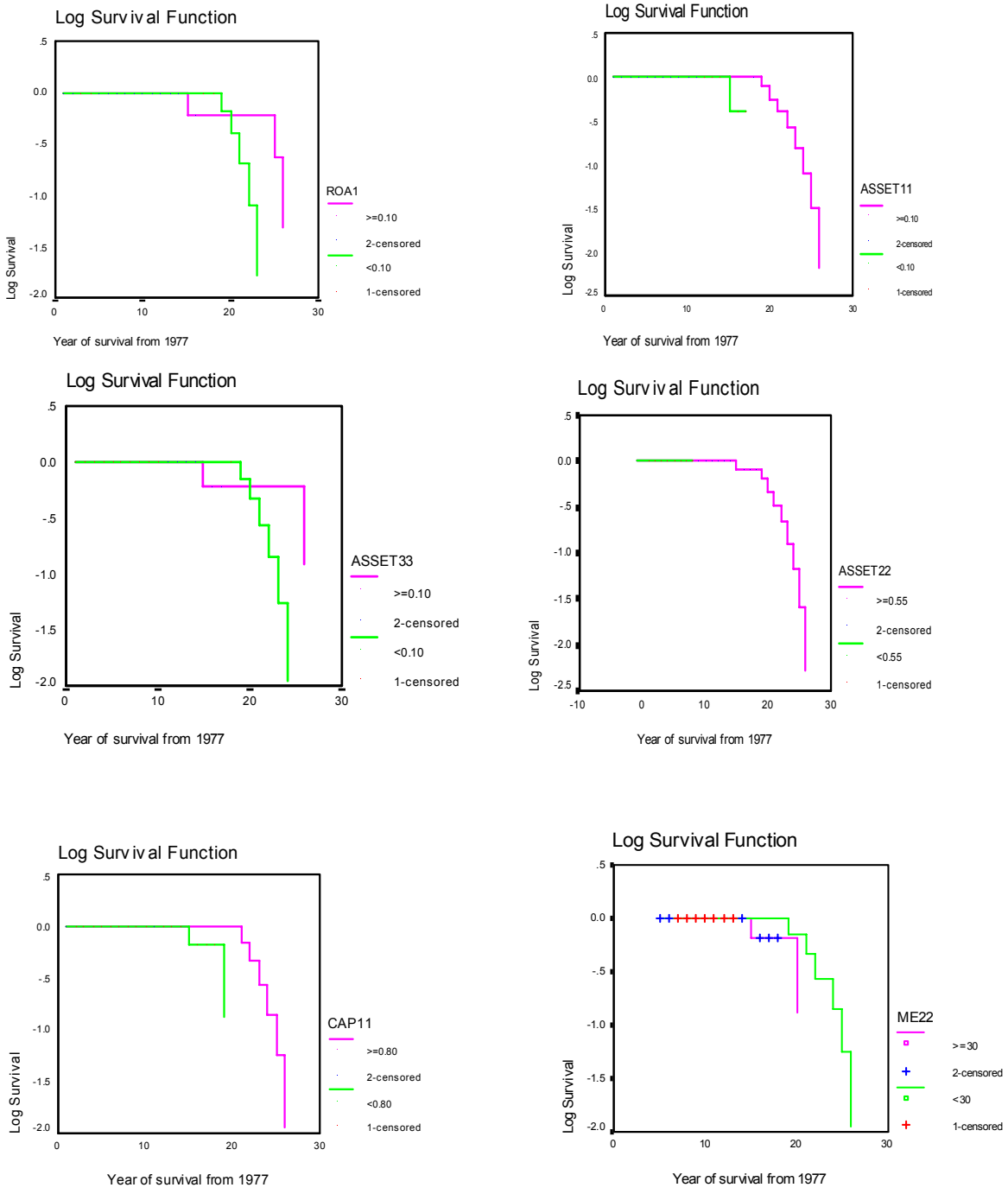
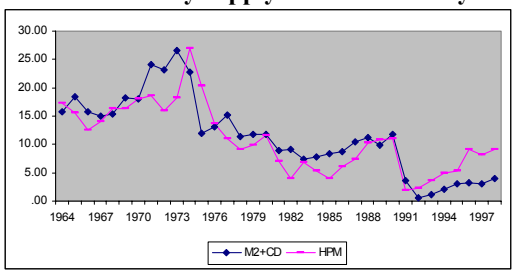
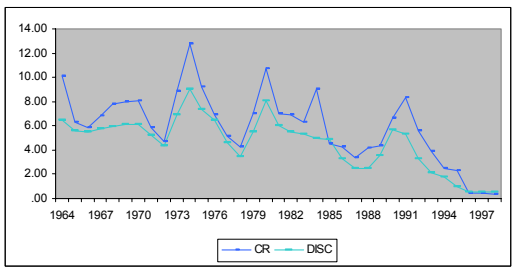


Figure-4: Different indicators of the Japanese economy during 1964-2003

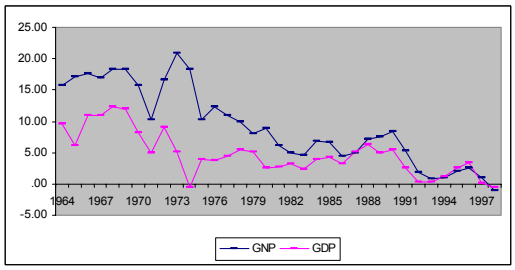
Growth of Money supply and Base money



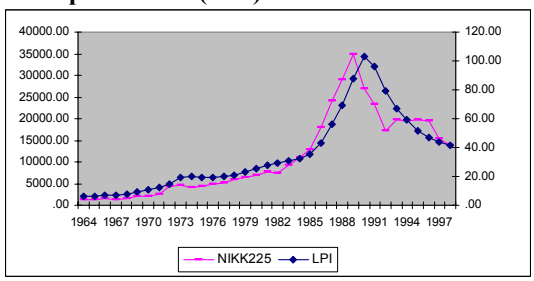
Call rate and Discount rate



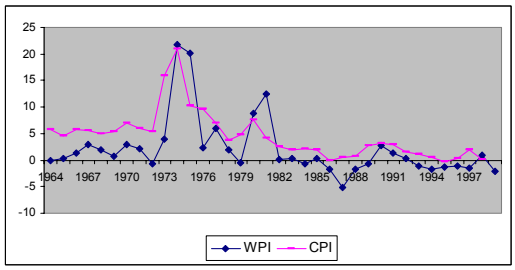
Growth of GDP and GNP



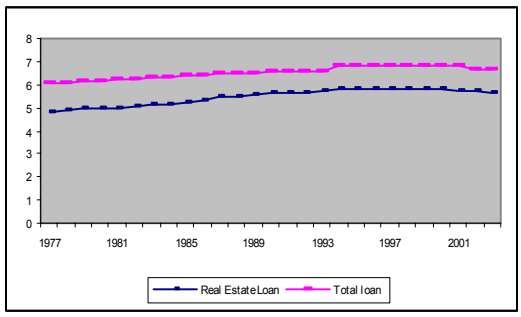
Stock price index (Left) and Land Price index



Growth of WPI and CPI



Growth of banks outstanding total loan and real estate loan



APPENDIX-II

Table C: Indicators of Japanese banking distress, obtained by applying survival methods (Excerpts from Table B of Appendix I).

Variables	City banks		Regional banks		Regional-II		Long Term Credit		Trust
	NF	F	NF	F	NF	F	NF	F	NF
ASSET1[a,b,c]	0.96	>0.96 (p)	1.0	≥1.0 (p)	1.03	≥ 1.03(p)	0.90	>0.90 (p)	0.44
ASSET2[a,b]	0.59	≥0.59 (np)	0.64	>0.64(np)	0.70	≥ 0.70(np)	0.59	0.59 (p)	0.47
CAP[a] (percent)	0.81	≥0.81(np)	0.56	>0.56(np)	0.60	≥ 0.60(np)	0.80	>0.80 (np)	1.29
ROA[a,b,c] (percent	0.36	<0.36(np)	1.34	<1.34(np)	1.24	< 1.24(np)	0.90	<0.90(np)	0.38
ME1[b]	0.09	<0.09(np)	0.04	<0.04(np)	0.04	<0.04(np)	0.05	<0.05(np)	0.05
ME2[b,c]	26.18	>26.18(np)	3.70	<3.70(np)	3.70	≥3.70(np)	9.02	<0.90(np)	9.02
PM[c]	0.33	≤0.33(np)	0.35	>0.35 (p)	0.33	≥0.33(np)	0.33	≥0.33(np)	0.33
LIQ[a]	0.06	0.06	0.04	<0.04	0.02	≥ 0.02	0.40	<0.40	0.08

NF: Non-Failed banks, F: Failed banks; **a, b, c**: significance by PL, PH and AFT model respectively.

(p): comparable to pre-bubble; (np): long-term trend (≤ high to low, or ≥: low to high)

Some analytical points to note:

1. I have used the average ratio of 1990-2003 for all Non-Failed banks, whereas the individual year's ratio for failed banks. This makes it possible to compare the long term trend as it is depicted in the above table.
2. Although it is reasonable to use the initial year's (or end-year) bank-specific ratio as a covariate for PH or AFT model, it would not be possible in that way to compare banks' long term situation, i.e. to capture the bubble period or period before 1980. The use of average ratio has not made any loss of generality since the trend is mostly comparable for specific year too for NF vs. F comparison, shown in the above Table.
3. Moreover, trend in Table C indicates a threshold level for NF banks. This means that increase or decrease from the level may contribute to failure of the banks. Therefore, these variables together can be considered as an indicator to the failure of banks.