Early Warning System of Forecasting Currency Crisis

The Joint NSC Project

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Abstract

Why the past early warning systems failed to anticipate the Asian crisis, the most serious and challenging economic event of the 1990s? This question has attracted a lot of attention recently. One of the explanations for this question is that the crisis is a new experience. If this is true, the natural next question is "what is the core of this new explanation?" Krugman (1999) suggests that the worsening corporate balance sheet is the core. This paper establishes the testable hypothesis and empirically investigates it.

The testable hypothesis centers on the "continued" corporate distress, which is proxyed by number of the declining return on asset (ROA) and number of the high leverage (debt/equity) of corporate simultaneously. Employing Asian countries as our sample from 1990 to 1997, we find that if a country exhibits a declining ROA over years, then the country is likely to have the crisis even her ROA is high. The situation becomes worse if she has a high debt/equity ratio.

One stronger assertion is that high ROA might be a biased signal of the health of a country if her long term ROA pattern is ignored. A country with high but declining ROA deserves closely watched since the warning voice of declining ROA may be mitigated by the high ROA.

Based on the all evidences obtained, we cannot reject the continued corporate distress.

1 Introduction

The eruption of Asian financial crisis on 1997 has astonished the investors, academics and government. It is astonishing because the eruption comes without any signals. Two international organizations, the Asian Development Bank (ADB) and the International Monetary Fund failed to anticipate even any kind of economic and financial problems. ADB stated that "despite a predictable slowdown in the rate of growth in 1996, over the near term, prospects for growth look good". The IMF also praised "the soundness of the Thailand's and South Korea's macroeconomic polices" before 1997.[1] Academics is eager to know why the crisis occurs and what is missing in the previous early warning models.

Explanations are abound. Two old views on the crises have first been raised. The first is the first generation model, exemplified by Krugman (1979), held that a balance-of-payment crisis was simply the results of bad fundamentals due to fiscal irresponsibility, as the case of Mexico (1973-1982) and Argentina (1978-1981).[2] The second generation model, exemplified by Obstfeld (1994), held that the crisis was mere outcome of a self-fulfilling foreign panic against slowing economics with rising unemployment. The second model is designed to capture features of the speculative attacks in Europe (1992–1993) and in Mexico (1994-1995).[3]

[1] See *Asian Development Outlook 1997* and *IMF Annual Report 1997*, respectively.

[2] See Flood and Marion (1998) for a survey.

[3] The argument between the first and the second generation models has a long history. The more detailed distinguish can be found in Kim and Stone (1999). For example, the origins of the crisis are owing to external shocks (Masson, 1998), cross-country trade and financial market linkages (Glick and Rose, 1998); financial market contagion (Goldstein, 1997; Calvo and Mendoza, 1998); monetary policy that was too tight (e.g. Radelet and Sachs, 1998) or too loose (Lane et al. 1999); tight fiscal policy (Radelet and Sachs, 1998); domestic bank over lending (Corsetti et al, 1998, Krugman 1998 and Dooley, 1997); political risk (Roubini et al, 1998) and excessive corporate leverage via current account adjustment (Krugman, 1999).

Though the two generation models have successfully explained the past currency crises, they fail to render an accurate picture of the causes, consequences and remedies of the Asian crises. One of the reasons is that the causes as well as the backgrounds are not completely the same as those in the past. For example, the fiscal budgets of most Asian countries are in surplus not in deficit, which is against the prediction of the first generation model, see Krugman (1999) or Bustelo (1998). In addition, the Asian countries did not exhibit a particular tradeoff between employment and exchange stability that Britain had faced in 1991, making the second generation model less compelling. Milesi-Ferretti and Razin (1998), therefore, claimed that it is difficult to infer from the data whether the collapse of the peg is a result of deteriorating fundamentals or self-fulfilling prophecies. Coresetti et al. (1998) also pointed out that the usual "suspects" of the currency crises, such as slowing growth, high budget deficits, high inflation and substantial current deficit, were not observed in East Asia in 1990–1996. Frankel (2000) claimed that diagnoses of crises should emphasize a different sort of fundamentals. Krugman (1999), in particular, repelled the use of the conventional views to explain the Asian crisis.

Chang (1999) revitalizes the issue and divides existing many new explanations for the Asian crisis into two categories. One is the bad policy view, the other is the financial panic. The bad policy view stresses the implicit or explicit government guarantees to private debts to borrowing is responsible for the crisis. This view is consistent with the two notable facts, the credit boom and financial liberation preceding the crisis.[4] Advocates of the financial panic view argue that the sudden shifts in market expectations

[4]See McKinnon and Pill (1996), Dooley (1997) for the credit boom, and see Corsetti, Pesenti and Roubini (1999) for the risky project.

and confidence, the financial panic, were the key sources of the financial turmoil. The international or domestic creditors will refuse to roll over credits once they are in panic. Chang and Velasco (1998) argue that a country of international illiquidity is prone to the financial panic, and thus the contagion effect (also see Radelet and Sachs, 1998).[5]

These two revitalized explanations indeed capture some aspects of what happened to Asian, however, as argued by Krugman (1999), are incomplete to the task of explaining the severity of the event. For example, if the implicit guarantees encourages the excessive risk-taking behavior by entrepreneurs, then some investments, such as direct foreign purchases of equity and real estate, which are not guaranteed should be crowed out and decrease. However, as Radelet and Sachs (1998) point out all forms of investment were booming before the eve of the Asian crisis. Thus, only if the Asian crisis is a new experience, it could explain the failure of the past early warning systems to anticipate one of the most serious economic event in 1990s. The third generalization model, suggested by Krugman (1999) and Frankel (2000), is thus called for.[6]

If the Asian crisis is indeed a new experience, then what is the core part of this serious economic event? Though the crony capitalism, fragile financial system, inappropirate sequences of financial liberalization, poor accounting systems, ineffective regulation and corruption etc. are often mentioned, however, they are more like an abstract concept than can be really tested. While Frankel (2000) has mentioned the need of the third generation model, he did not provide any clue regarding the core. Krugman (1999), instead, suggests

[5]They argue that the financial panic view is also consistent with the liberalization and credit boom. Also, it can explain the contagion effect.

[6]Velasco (1998) aruges that the Asian crisis is not new but is owing to the bad policy and financial panics.

that weakening company's balance sheet may be the core and provides a raw theoretical model to demonstrate it. However, he did not test the hypothesis. Since this corporate argument is plausible, it would be interesting to examine his argument empirically.

This paper plans to demonstrates that it is the "continued" corporate distress that is missing in the prediction of the Asian crisis. While the literature of corporate performance and currency crises each is abound, the links of the two are little. (see next section for details). Furthermore, as we stress that it is the on going corporate distress that is ignored, the concept is even less mentioned in the literature. Therefore, the testable hypothesis has to be established.

The continued corporate distress hypothesis argues that the continued declining pattern of the corporate return on asset (ROA) and the persistent high leverage (debt/equity) are the core factors of the third generation model. We count the number of the declining ROA and the number of high leverage to capture the spirit of the on-going worsening process. These two numbers are referred to as the ROA duration and leverage duration, respectively.[7] A high ROA and a persistently declining ROA, ie., the high duration, may coexist.

Employing the concept of the duration, it is found that the high ROA level may not relieve the predicament yielded by the continuingly declining ROA and persistent high leverage. To the opposite, the benefit of the high ROA before the Asian crisis may be overstressed, and even worse, it may mute the warning signal sent by the declining ROA. Our empirical results find countries with the high ROA, which were credited as the good

[7]The concept of the duration here is borrowed from biology study, meaning how long a patient will survive after a special treatment. It is often used in unemployment and on strike studies in economics.

prospects earlier, are fragile if their ROAs decline over years.

We also note that there is another plausible candidate, the weakening banking hypothesis, which is used to account for the Asian crisis (see Kaminsky and Reinhart, 1999; Shen, 2000b). This hypothesis is interesting since it may involve the above mentioned two new views, i.e., the bad policy view and the financial panic view. Because of the implicit government guarantees (the bad policy view), banks balance sheets are mismatched. The assets and liabilities are denominated in local currency and in foreign currency, respectively. Furthermore, the high nonperforming loan increases bank fragility, making banks vulnerable to self-fulfilling panics (the financial panic view). While we recognize that an epidemic of financial distress that cannot be resolved simply by fixing the banks, it is worth trying adding the banking sector into our empirical study and investigating its marginal explanation power.

Two research strategies are suggested to demonstrate our hypothesis. First, we look at the basic statistical data and charts to investigate the performance of corporates in ten Asian countries from 1990–1996. Both corporate and banks data are taken into account. Then, the crisis proxies, the percentage change of exchange rates and of foreign reserves in 1997 and 1998, are calculated. We then examine the relationship between the durations and the crisis. This is close to the lead-lag test since the durations are compiled up to 1996 and the crisis data is compiled starting from 1997. Significant relationship indicates that the continuingly worsening corporates lead the crisis.

Next, the regression-type analysis is provided. This includes the survival test and the tobit model. The survival test, which investigates the probability of the length of time

until failure, plans to answer the question like "given the distress has lasted until time t, what is the probability that it will be exploded in the next short interval of time, say $\triangle$? This test is also conducted based on the durations.

It is worth noting that the continued corporate distress hypothesis does not imply that it is the sole reason for the crisis. It simply argues that it may be the missing part in the previous early warning models. Therefore, the last research examines whether or not the corporate variables add significant marginal explanatory power to account for the eruption of the crisis, given the existing explanations. Tobit regression analysis is conducted to compare the explanatory power of the Asian crisis of the three major hypotheses, fundamental and panic hypothesis, weakening banking hypothesis and our continued distressed corporate hypothesis. We expect corporate variables can add more marginally explanatory power than the banking sector to explain the crisis.

Seven sections are include in this paper. Next section presents the continued corporate distress hypothesis. The third section discusses the variables used in the paper, data source and the basic statistics. Our three research agenda are presented in the sections 4, 5 and 6. Section 7 concludes.

2 Continued Corporate Distress Hypothesis

In the literature, though the discussion of the corporate distress and currency crisis each is abound, the links of the two are few. While many papers have discussed corporate performances after the Asian crisis, the focuses of those papers, however, are on the corporate financing, corporate growth or corporate governance etc., without researching the

impacts of the corporate distress on the Asian crisis.[8] One exception is Kim and Stone's (1999) work, which indeed sheds light on the corporate leverage with the crisis. Their focus, however, is on the bankruptcy and output adjustment after, not the preceding, the Asian crisis.[9]

Alternatively, the literature of the currency crisis also ignores the development of corporate risks. For example, in an excellent currency crisis literature survey by Flood and Marion (1998), the corporate distress is not mentioned. The two strands of literatures appear parallel with the notable exception of Krugman (1999), who strongly proposed the (corporate) balance sheet weakening may be the key reason of the Asian crisis. He provided a "raw" model based on his realistic feel without empirical evidence. Pomerleano (1998) may be the most relevant studies to our research. He argues that the rapid investment in fixed assets financed by excessive borrowing in some Asian countries resulted in the poor profitability. However, neither does his paper provide any empirical studies linking the corporate distress and the currency crisis. Hence, despite a lot of efforts in studying the causes of Asian crisis and in studying the corporate distress, the link between two has been neglected in both literature.

If the continuingly worsening balance sheet of corporations is indeed the core factor of the Asian crisis, the natural next question is why? To answer this "deep" structural reason is beyond the scope of this paper. Further, this question can hardly be answered

[8]For example, see Claessens et al (1999a) for the corporate risk; Clasessens et al (1999b) and Clasessens et al, (1998) for the corporate diversification, Block (1998) for the corporate governance.

[9]This is also true for the studies of the Korean currency crisis. Some studies do mention that the high Korean corporate debt/equity may be the causal factor of the Korean crisis (Joh, 1999), however again, there are no empirical studies between the two fields.

until we have a sounded theoretical model associated with its testable hypothesis.

While no theoretical model is built, an old but still useful structural reason may be used to explain the deterioration. That is, the losing competitiveness may be the main reason of worsening balance sheet of the corporations. If a product is competitive, it can be sold globally, and increase the corporate profit. The high retained earning is then yielded, making the external debt financing less urgent and the resulting debt/equity ratio becomes low. Accordingly, observed high return as well as low leverage ratio imply that the products are competitive. The total factor productivity can hardly be low. A country in this environment is less likely to have the financial crisis.

Three symptoms of corporate performance are suggested here to evaluate the competitiveness. First the return of corporate should be positive. This prerequisite is self-evident. Next, this positive return should not decrease over time. Otherwise, a positive return associated with a negative growth of return imply the decreasing marginal rate of the investment. Third, the financial leverage, the debt/equity ratio, should be persistenly low. The latter two emphasize that the high ROA and the low leverage in one particular year is not free of the threaten of the currency attack. Instead, their long term patterns should be noticed. The two duration measures, counted from the numbers of the declining ROA and the number of the high leverage, are used to proxy the continuing worsening hypothesis.

3 Data Source

Ten Asian countries, Thailand, Indonesia, Korea, Malaysia, Japan, Philipppine, HongKong, Singapore, Taiwan as well as USA are considered. With respect to the corporate data, we use return on asset (ROA) and financial leverage (total debt/equity) to proxy their return and risk, respectively. For banking industry, the return on equity (ROE) and nonperforming loan (NPL) are employed to proxy the return and risk, respectively.

Since we have three sectors, the corporate sector, banking sector and macroeconomic sector, the variables are from three different sources. The data used for conventional international macro explanations are from IMF's *International Financial Statistics* (IFS). Our source of the corporate data is basically from Claessens, Djankov and Lang (1998). However, their data ends at 1996. Hence, we extend their data to 1997 using annual reports of the companies listed on the major stock exchanges in the region and come from *Worldscope*. The corporate data is unbalanced, i.e., the number of observations varies from year to year. Companies report data less than three times are excluded.[10]

The bank data is from the annual reports of banks but compiled by *Bankstat*. See Shen (2000a, 2000b) for the description of the banks data source. The sampling range is from 1991 to 1997. Also, when banking variables are added in, the sample starts from 1993 owing to the data availability. See Table 1 for the description of the variable, sample lengths of each variable and data sources.

[10]Also, see Lim and Woodruff, (1988).

4 Basic Statistical Evidence of the Continuing Corporate Distress

4.1 Two Durations and the Continuing Corporate Distress

With respect to the corporate data, ten countries are first divided into two groups according to their ROA patterns. The first group is referred to as the "ROA declining countries", which are appeared on the left hand side of Figure 1. It includes Thailand, Korea, Indonesia, Malaysia and Japan. The feature of this group is in its continuingly declining ROAs, which generally exhibit downward trends during the periods of our study. Also, the declining ROA implies negative ROA growth rate. Since we are interested in the frequency of declining before the crisis, we count the number of their declining, that is, the duration defined in this paper. During the sample length from 1990 to 1996, the duration of these five countries are 6, 5, 5, 4 and 4, respectively.

The second group is referred to as the "ROA fluctuation countries", which are shown on the right hand side of Figure 1. It contains Philippine, HongKong, Singapore, Taiwan and USA. The ROAs of these five countries fluctuate around time and the numbers of declining ROA are 3 (2), 3, 3, 2 (1) and 2, respectively. Because data of 1990 is nonavailable for Philippine and Taiwan, the growth rates of these two countries in 1991 are unknown. Hence, the numbers in parenthesis indicate the alternative possibility.

Next, ten countries are also arranged in an descending order based on the leverage. Then, letting the top five countries be called the "high leverage countries" and the bottom five the "low leverage countries". The critical value of dividing the two groups is close to 1.2. It is strikingly to find that the ROA declining (fluctuation) countries are

overlapped with the high (low) leverage countries for four out of the five countries. For example, except for Malaysia, ROA declining countries overwhelmingly have high leverages, whereas, except for HongKong, ROA fluctuation countries all have low leverages. Their leverages are plotted in Figure 2 with the same country order appeared in Figure 1.

Our second duration measure is based on the number of the high leverage. The split of the high and low leverages needs to determine the critical value in advance. The unity is selected first simply because a standard corporate finance textbook would suggest that a company financed by the debtor should be no more than that financed by the shareholder. However, in reality, it is common to have ratio higher than unity without arising any immdeiate financial fragility. Thus, critical values of 1.5 and 2 are also attempted alternatively.

Two duration measures counted from 1990 to 1996 are reported in the first two columns of Table 3. Of the two measures, the first measure appears more important as the evidence will show it shortly. Since the two durations are overlapped for eight out of ten countries, we may simply use the duration to describe the both when no confusion is arised. It is found that the high duration is synonymous to the continuingly declining ROA and persistently high leverage.

The above classification is far from perfect and is ad hoc since it is conceivable that a clean cut classification is uneasy owing to the fact that there are nine different countries in the region. However, the implications of dividing countries into two groups based on the declining ROA seems encouraging. Countries which are severely suffered during the

Asian crisis all display high durations and vice versa.

4.2 Country Analysis

4.2.1 Corporate Sector

Unlike time series data of each countries plotted in the figures, Table 2 summarizes the means and standard deviations of ROAs, Leverages, ROEs and NPLs of each country. Macro variables used in the following section are also reported. The ROA declining and fluctuation countries are reported in the upper and lower panel, respectively. The average ROA of the first group is 6.174 and is 5.50 for the second. While the level of ROAs does not differ significantly between the two types of countries, the growth rates of them differ substantially. The ROA growth rate of the ROA declining countries is −4.072, whereas it is 1.728 for the fluctuation countries. Negative ROA growth rate implies the lose of the growing momentum.

The leverage of two groups are also different. The first group has the average leverage of 2.12, which is higher than any critical values set above. The average leverage of the second group is 1.178, only slightly higher than the critical value of one.

The patterns of ROA and the leverage in Thailand are interesting. Its ROA is 11.5% in 1991 and then declines gradually over year to 7.5% in 1996. The high level of ROA in the early 1990s reflects the high return of the corporations. During the time, the international capital flushes into Thailand. If an international organization pays attention only on the level of ROA, it is easily misled to believe the soundness of the economics. In contrast, if the declining pattern of ROA as well as the persistent high leverage, proxyed by the two durations, are taken into account, the conclusion drawn may be totally different. In

Table 3, Thailand's ROA and leverage durations are the highest in the region, ie., 6 and 6, respectively.

Indonesia exhibits the same interesting patterns as those of Thailand. While means of their ROA are the highest, 7.62 and 9.68, respectively, means of their ROA growth rates are the lowest, –5.75 and –7.25, respectively. Their leverages are also high, which are 1.96 and 2.08, respectively. Indonesia's two durations are 6 and 6, if the critical value unity is taken to determine the high/low leverage. Accordingly, simply looking at the ROA level without noticing their long term distress patterns may mislead us to believe the soundness of the countries.

Korea and Japan have the similar patterns. Their ROAs and the ROA growth rates are lower than those of Thailand and Indonesia, but their leverages are the highest among the countries, which are 3.51 and 2.18, respectively. These indicate that the majority of their assets are financed externally. A small shock may make the corporates be illiquid, given the earnings are quickly exhausted to pay the interests.

Malaysia also has downward corporate earning, too. However, her leverage is lower than 1 making her the exception in the first group.

The low durations are the features of the second group. Taiwan, Singapore and (trivially) USA, which belong to the this group, should not be surprising since they are well-known as having more sounded economies than other countries. Taiwan and Singapore which have durations of (2, 0) and (3, 0), repsectively, where the first number in the parenthesis denotes the ROA duration and the second the leverage duration, are less struck during the Asian crisis. Though HongKong also belongs to this group, her

ROA declines for three years and her leverage is more than 1.5, making her vulnerable during the crisis. Some sensitivity tests are also involved via shifting HongKong into the first group. Results, however, do not change significantly.

To our surprise, Philippine also belongs to the second group. Before the crisis, the balance sheet of their corporate do not deteriorate as bad as Thailand. Her bad luck may be from her imbalance macroeconomics.

The problem of the Malaysia and Philippine may not lie in their corporate but in their macro imbalance. The current account ratios are –6.02% and –4.58%, respectively, exceeding the suggested critical value of –4 by Shen (2000a) and (roughly) –5% by Demirgüc-Kunt and Detragiache (1998).

4.2.2 Banking Sector

We now turn our attention to the Banking sector, of which only the return and risk are examined. The return is proxyed by ROE and the risk is proxyed by non-performing loan (NPL). Figure 3 plots the banks' ROE of ten countries. Except for Taiwan, Singapore and US, ROEs in remaining countries decline over time. ROEs of Indonesia and Japan even becomes negative during 1996. These results add credit for the bad banking hypothesis since it could account for why the crisis is less severed in Taiwan and Singapore. The low ROEs of the most Asian's financial institutions add oil on the fire.

The NPL is reported in Figure 4. Results display little significant pattern as that of the leverage. Since we know Thailand and Indonesia are severely struck during the crisis but Taiwan is not, then the increase of the Thailand's and Taiwan's NPLs but slightly decreasing for Indonesia before 1996 make no clue for us. The decrease or increase of

NPL reveals little information about the following crisis. The reasons may be simple. Report of NPLs in many countries is not compulsory but voluntary. The average of NPL may thus be substantially underestimated since only the good banks tend to report their NPLs. Furthermore, the accounting definitions of NPL differ across countries. A higher NPL of a country may be the result of either a poor banking system or the stringent definitions of NPL.[11] These two reasons make the comparisons of NPL across countries uneasy. Thus, the bad banking hypothesis, though is possible in theory, is uneasy to justify in practice internationally owing to the poor quality of data.

Table 2 also reports the statistical data of banking sector. The average of their ROEs of the two kinds of the countries are 3.63 and 10.96, indicating that the banking performance in the ROA declining countries is inferior to that of the ROA fluctuation countries. However, the NPL reveals little information since their respective averages are 4.01 and 6.03, respectively.

5 Does the High Duration Lead the Crisis?

5.1 Research Designs

It is uneasy to demonstrate the cause-and-effect when the event occurs only once in our sample. In particular, our data is cross-section in nature. However, to fulfill our goal to show the continued corporate distress leads the crisis, the two durations are calculated based on the data up to 1996 and the crisis and macro data are calculated based on 1997 and 1998. Hence, the significant correlations suggest the lead of the durations on crisis

[11]For example, in the US, an overdue interest payment of 3 months is classified as NPL, but it is 6 months in Thailand. See Corsetti, et al. (1998) for the same argument.

and economic performance variables.[12]

The severity of the crisis is proxyed by the percentage changes of the exchange rates and of the foreign reserves. Foreign reserves, however, are affected by not only the intervenion of the central bank but also by the borrowing from the IMF and other international organizations. The amount of foreign reserve may therefore be less related to the crisis. In addition, the economic performances are also considered and proxyed by the GDP growth in 1997 and 1998 and the average stock return of 1997 and 1998.

Since the hypothesis of the continued corporate distress downgrades the ROA level but stresses the importance of the two durations, the comparisons between them are conducted. We expect that the two durations, especially the number of the declining ROA, is informative in terms of predicting the future currency crisis. By contrast, the ROA level is not.

5.2 Results of the Leading Effect

Table 4 reports the correlation coefficients, which represent the leading effect. Figure 5 compares the plots of the ROA and the number of declining ROA against each crisis and macro variable.

In Table 4, the correlation coefficients between the ROA duration and the percentage of exchange rate in 1997 and 1998 are found to be –0.824 and –0.530, respectively . Both coefficients are significantly at the 1% level, suggesting that the two events are strongly correlated. Namely, the more declining number of ROA, the more likely the exchange rate depreciates. In sharp contrast, the correlation coefficients become insignificantly

[12]Because of the cross section data, we cannot perform the Granger causality.

negative when the ROA is substituted for the ROA duration. Result implies that the level of ROA before the 1997 is irrelevant to the exchange rate depreciations in 1997 and 1998. The contrast evidences are consistent with the continued distress hypothesis which argues the continuingly declining ROA before 1997 is "responsible" for the Asian crisis, whereas the ROA level may be less relevant to the crisis. The stronger assertion would be that the high ROA may mitigate the warning singal sent by the decling ROA.

The signs are mixed when the foreign reserves are considered. It is negative in 1997 but positive in 1998 for the number of declining ROA but remains insignificant for the ROA level. In fact, none of the variables considered in Table 4 are correlated significantly with ROA, suggesting that high ROA reveals little information regarding the soundness of a country. The number of declining ROA, in contrast, is informative since it is significantly related with all variables on the table, including GDP grwoth rates and stock returns.

Mixed results are yielded using the leverage duration measure. The correlation coefficients are overwhelmingly insignificant when the critical values of 1 and 1.5 are adopted to determine the high and low leverages. The correlation becomes significant when the critical value of 2 is taken. It suggests that the separation of the high and low leverage countries would be more informative if the critical value is 2.

Of the two durations, the ROA duration appears better than the leverage duration since the former display stronger and more significant correlations with crisis and macro data.

6 Survival Test

The correlation coefficients above demonstrate that the continuing corporate distress is informative in advance, however, it is interesting to know what the probability of the declining ROA will end (shift to another state) given the current 6, say, periods decline. This section plans to investigate this issue using the nonparametric method.

6.1 Survival Function and Hazard Function

The survival test investigates the length of time until failure, which is similar to one of our question: the probability of the Asian crisis will occur given the continuing distress corporate balance of sheet? The survival test typically consists of a cross section of durations, $t_1, t_2, \ldots, t_n$ where t is the duration and subscript n is the number of cross section. The duration, which is often used in the unemployment theory, is also referred to "spell". See Greene (2000) or Kiefer (1988) for details.

The rationale of matching our durations with that in unemployment theory can be illustrated as follows. If the maximum spell of unemployed is six months, academics is interesting to know whether or not the regime of the unemployed will shift to another regime in the next period. The probability can be estimated via the survival theory in general. The estimation takes into account the maximum spell of six being censored since it is unknown the current state will continue or stop. Our durations have the same meaning. First, it is the length of the event before eruption considered. Next, if Thailand's ROA duration measure is six, meaning that the ROA has declined six times over the periods 1990 to 1996, then, the probability of shifting to the the other regime is

our interest.

The estimation of the above probability is based on the survival and hazard functions. The survival function denotes the probability that the spell is of length at least t, which is given by the survival function.

$$S(t) = \text{Prob}(T \geq t), \tag{1}$$

where T is the random variable that has a continuous probability distribution $f(t)$ and t is a realization of T.

Employing the survival test, we can answer the question of "given the distress has lasted until time t, what is the probability that it will be exploded in the next short interval of time, say Δ? This can be calculated by hazard rate λ, which is roughly the rate at which spells are completed after duration t, given that they last at least until t.

$$\begin{aligned} \lambda(t) &= \lim_{\Delta \to 0} \frac{Prob(t \leq T \leq t + \Delta | T \geq t)}{\Delta} \\ &= \lim_{\Delta \to 0} \frac{F(t+\Delta) - F(t)}{\Delta S(t)} \\ &= f(t)/S(t) \end{aligned} \tag{2}$$

The intuitions of and the difference between S and λ can be accounted for as follows or see Kiefer (1988). Assume that we only observe data up to 1996 and would like to conjecture the probability of the crisis in the next year. Also, we know that Thailand's ROA has declined for 6 years. Hence, the probability of a spell lasting 6 periods or more is S, while the probability that a spell ends between 6 and 6+Δ conditional on having lasted 6 periods is $\lambda\Delta$.

When there is no explanatory variables, both nonparametric and parametric methods can be employed but the former is often used for its simplicity. We also use nonparametric method. The duration data is first split into several fixed intervals. A survival rate is then calculated for each interval. The hazard $\lambda(t_j)$ is the probability of completing a spell at duration t_j, conditional upon the spell's reaching duration t_j. The survival is then the product of $(1 - \lambda_i)$ across the intervals. We skip the detailed estimation procedure but it can be found in Kiefer (1988) or econometric software LIMDEP version 7.

6.2 Results of Survival Testing

Table 5 shows the estimated survival and hazard rates, survival ranges and the corresponding country names. Also, the two rates are plotted in Figure 6 to offer trend patterns. Note that the horizontal axis in Figures 6 and 7 denotes the rank of cell instead of duration ranges shown on the first column in Table 5.

The estimation based on the ROA duration yields a downward stepping survival function, meaning that the probability of the current event will continue is decreasing. By contrast, the hazard rate function is stepping upward, indicating that given the current duration, the probability of the new event will burst is increasing as duration increases. The hazard function, shown on the top panel in Table 5, indicate that the probability for Thailand, Indonesia and Korea to have a crisis is 0.667, whereas the probability is only 0.1 for Taiwan. Results demonstrate that the higher the duration, the higher the probability the crisis will occur in the next period.

The leverage durations considers the number of the leverage being greater than unity,

given the negative ROA growth rate. Similar to the ROA duration measure, the survival rate function is stepping downward. Different from the ROA duration measure, the hazard rates function is not monotonically stepping upward. Higher leverage does not ensure the higher probability of crisis. The probability to have the crisis for the Thailand, Indonesia and Korea is again 0.667 and is 0.2 for Taiwan. Probabilities for other countries also change, but the trend does not alter. This again justifies that ROA duration is more informative in predicting the crisis.

We re-estimate the survival and hazard rates based on the ROA duration, however, using the leverage as the stratification. That is, we estimate the two rates in high and low regimes, respectively. We do not tabulate the results but plot the results shown in Figure 7. The ROA declining countries with the high leverage have the higher hazard rates than those of their counterparts. The difference is significant using log Rank and generalized Wilcoxon tests.[13] The former is 4.093 and the latter 3.807 and both are significant at the 10 level. The more declining ROA and the high leverage suggest the higher probability of current regime to change.

7 Corporate Sector or Banking Sector?

Will corporate or banking sectors improve the conventional fitting significantly? If the answer is yes, which sector increases more? This section pursues this issue.

[13]See LIMDEP version 7.

7.1 Currency Crisis Proxy and Estimation Model

This section follows the literature of currency crisis to implement the regression analysis. First, the exchange market pressure (EMP) is defined as[14]

$$\begin{aligned} \text{EMP}_{it} &= w1_{it}\%\text{exchange rate}_{it} + w2_{it}\%\text{foreign reserve}_{it} \qquad (3) \\ & t = 1, 2, \ldots, T; \;\; i = 1, 2, \ldots, N \end{aligned}$$

where the weight $w1$ and $w2$ are the inverses of standard deviations of percentage changes of the exchange rate (% exchange rate) and the foreign reserve (% foreign reserve), respectively at time t for country i. The subscripts i and t may be occasionally depressed for simplicity if no confusion is created. The percentage of the exchange rate is calculated first by converting each local currency into the indirect quotation system and then it follows the conventional approach for calculating growth rate. Therefore, the negative sign of the percentage change of exchange rate means depreciation. The larger the negative EMP found, the higher will be the probability of exchange rate depreciation and hence, the crisis.

The conventional currency crisis index is equal to 1 when the EMP is less than the mean minus a percentage of the standard deviation of the EMP; otherwise it is equal to zero. Since the index is the binary number, the logit or probit method is typically

[14]Defining the currency crisis is not an easy task. It is generally taken to be synonymous with "speculative attack" or external pressure on the exchange rate. In consequence, four definitions of currency crisis have arisen based on identifying sufficiently sharp changes either in the exchange rate alone (Frankel and Rose, 1996), weighted averages of exchange rates and foreign reserves (Kaminsky and Reinhart, 1999), weighted averages of exchange rates, reserves, and interest rates (Eichengreen, Rose and Wyplose, 1996) and a decline in imports (Kamin and Babson, 1999). The Kaminsky and Reinhart (1999) approach is taken as the benchmark for computing the EMP since the interest rate data used are not available in many developing countries.

employed for the estimation.

We do not use currency crisis index for one estimation reason. Since only Asian data is considered and since the sampling period starts from 1993 and ends at 1997 when banking data is considered, the indexes are almost zero except for the crisis date of 1997. Thus, the extremely unbalanced combination of 0s and 1s makes the convergence of the logit/probit method difficult. To overcome this problem, we create another crisis measure EMP*, which are defined as

$$\text{EMP}^*_{it} = \begin{cases} \text{EMP} & \text{if EMP}_{it} < \mu_i - 1.65 * \sigma_{EMP_i}; \\ 0 & \text{otherwise} \end{cases} \tag{4}$$

This new variable EMP* is not observed until the crisis occurs. Namely, EMP* is a censored data; above the threshold, the EMP* is equal to the actual EMP; below the threshold, the EMP* is censored to be zero. EMP* is not observed until the crisis occurs. Equation (4) is estimated by Tobit model.

We next investigate which sector, corproate or banking, adds more marginal contribution to the benchmark model (Model 1 below). given the fundamental and panic variables. To be more specific, the specification is

$$\text{Model 1: EMP}^* = \alpha_0 + \alpha_1 \text{Fundament} + \alpha_2 \text{Panic} \tag{5}$$

$$\text{Model 2: EMP}^* = \alpha_0 + \alpha_1 \text{Fundament} + \alpha_2 \text{Panic} + \alpha_3 \text{Banking} \tag{6}$$

$$\text{Model 3: EMP}^* = \alpha_0 + \alpha_1 \text{Fundament} + \alpha_2 \text{Panic} + \alpha_4 \text{Corporate} \tag{7}$$

$$\text{Model 4: EMP}^* = \alpha_0 + \alpha_1 \text{Fundament} + \alpha_2 \text{Panic} + \alpha_3 \text{Banking} + \alpha_4 \text{Corporate} \tag{8}$$

where the fundamental and panic variables, as suggested by Radelet and Sachs (1998), are current account/GDP (CA/GDP), foreign reserve/import (FR/Import), credit to the

private sector/GDP (Credit/GDP) and short debt/foreign reserve (SR-Debt/FR). The corporate variables include ROA and leverage and the banking variables include ROE and NPL, respectively. Also, because of data availability,[15] only Thailand, Malaysia, Indonesia, Philippine, Korea and Taiwan are considered. Since the banking data started from 1993, the estimated sample period is 1993–1997.

7.2 Estimation Results of Partial Sum ROA

Our estimation results are put in Table 6. In Model 1, except for CA/GDP, all coefficients are significantly different from zero with the expected signs.[16] Adding two banking variables in the model becomes our Model 2. The first banking variable ROE is significant but the second banking variable NPL is not. The insignificant NPL is probably owing to the reasons of poor quality of data mentioned above. The log-likelihood function value only increases slightly from –69.11 to –67.03, which is not significant based on the chi square test. Employing corporate variables instead of banking variable is the Model 3, which increases the marginal explanatory power substantially since the log-likelihood function increases from –69.11 to –61.46. Also, both corporate variables are significant at the 1% level. The log-likelihood function value becomes –58.75 when both sector variables are considered in Model 4. Again, except for the NPL, ROE, ROA and leverage remain significant.

The use of the level of the corporate ROA in the above four models may not match the spirit of our continuous corporate distress. We, therefore, consider a new measure of

[15]IFS does not provide short term debt data for developed countries.

[16]Note that EMP* is negative when reserve is going to deplete out and the exchange is depreciated.

return, which is referred to as the partial sum ROA, PS_ROA_t, to replace the ROA in level. This partial sum, which describes the accumulation effect of the ROA, is

$$\text{PS\_ROA}_t = \sum_{t=1}^{\tau} \text{ROA}_t \quad \tau = 1, \ldots, T$$

where each PS_ROA_t, accumulating the past ROA up to the current ROA. A country with a positive but decreasing ROA, its PS_ROA_t has positive slop with slightly hump upward. A country with a positive but increasing ROA, its PS_ROA_t also has positive slope but is inverse-hump upward. Hence, the accumulation of ROA is taken into account.

The results of using the partial sum ROA are reported under the column Model 6 in Table 6. The partial sum of ROA further increases the log-likelihood function value from −58.75 of its ROA level counterpart to the −49.07, which is the highest level among the all models. The increased explanatory power is highly significant based on the Chi-square test. Also, the previous insignificant CA/GDP becomes significant at the even 1% level.

The ROA growth is also considered and is reported under the column Model 5 in Table 6. The results turn out to be less satisfactory than using ROA form since its likelihood value decreases.

Based on Table 6, the use of the corporate sector adds more marginal explanatory power than that of the banking sector. Furthermore, PS_ROA_t, which reflects the continued corporate distress, adds even more explanatory power.

8 Conclusion

Why the past early warning systems failed to anticipate the Asian crisis, the most serious and challenging economic event of the 1990s? This question has attracted a lot of

attention recently. One of the plausible explanation for this question is that the crisis is a new experience. Since it is new, the previous model based on the old experience failed to foresee it. If this is true, the natural next question is "what is the core of this new explanation?" Krugman (1999) suggests that the worsening corporate balance sheet is the core and dub it as the third generation model. This paper designs the testable hypothesis and empirically investigates it.

The testable hypothesis centers on the "continued" corporate distress, which is proxyed by number of the declining return on asset (ROA) and number of the high leverage (debt/equity) of corporate simultaneously. Employing Asian countries as our sample from 1990 to 1997, we find that if a country exhibits a declining ROA over years, then the country is likely to have the crisis even her ROA is high. The situation becomes worse if she has a persistent high debt/equity ratio.

Our correlation coefficient testing suggests that the number of declining ROA strongly leads the crisis (in particular, leads the percentage change of the exchange rate). In contrast, ROA level shows no relation with the crisis. Our survival tests also demonstrate that number of declining ROA and the number of the high leverage increase the probability of the crisis. Thus, a country is fragile if her corporate's ROA is declining over years and her leverage is high.

One even stronger assertion is that high ROA might be a biased signal of the health of a country if the long term ROA pattern is ignored. Thailand, the root of the Asian currency crisis, provides a good example of this argument. Indonesia, too.

Our regression results also suggest that the corporate sector adds more explanatory

power than those of the banking sector. Among three corporate ROA measures, the partial sum ROA, which reflects the accumulation effects of ROA, increases the likelihood significantly.

Based on the all evidences obtained, we cannot reject the continued corporate distress.

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Figure 1:

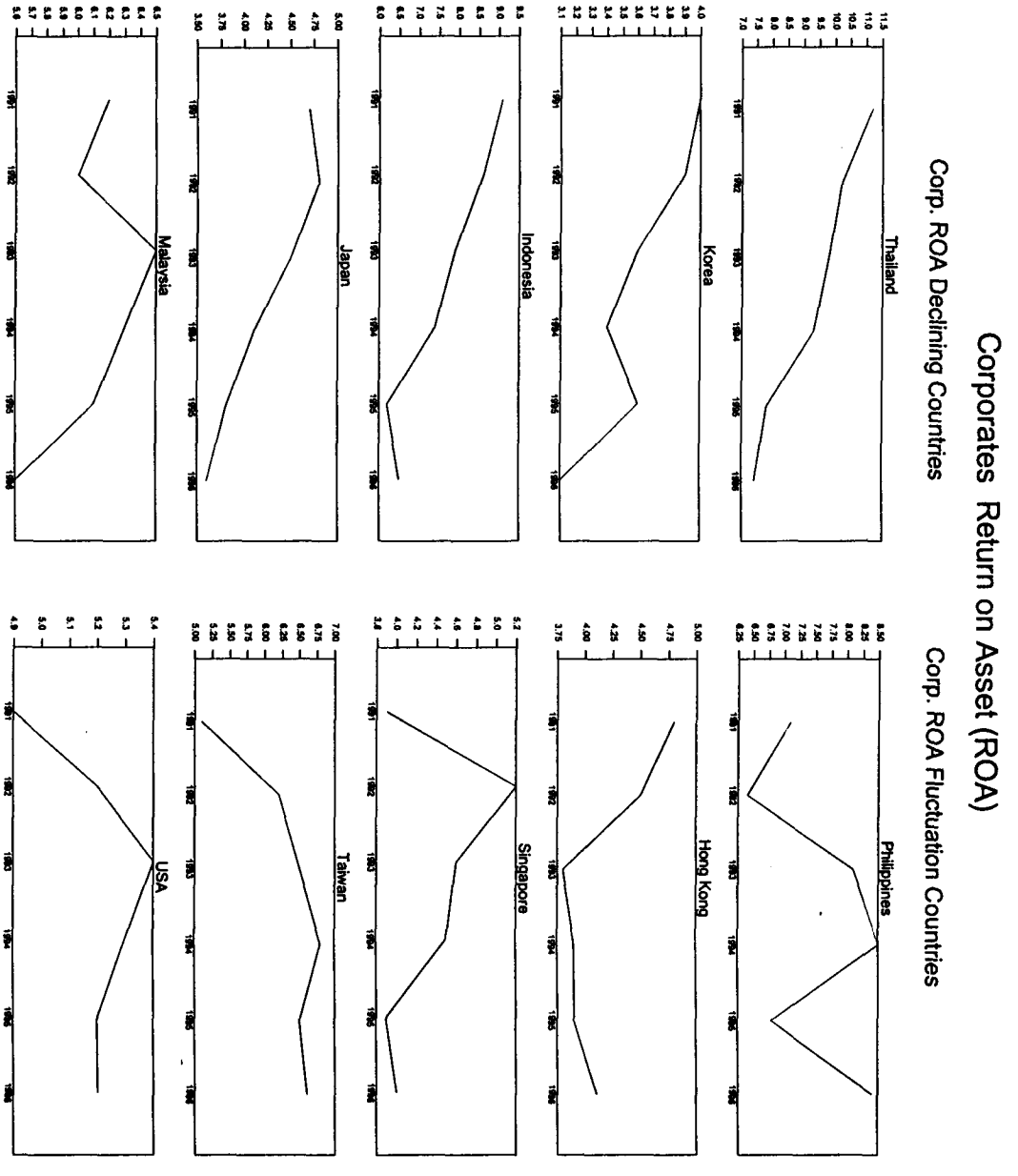
Corporates Return on Asset (ROA)
Corp. ROA Declining Countries
Corp. ROA Fluctuation Countries
Thailand
Korea
Indonesia
Japan
Malaysia
Philippines
Hong Kong
Singapore
Taiwan
USA

Figure 2:

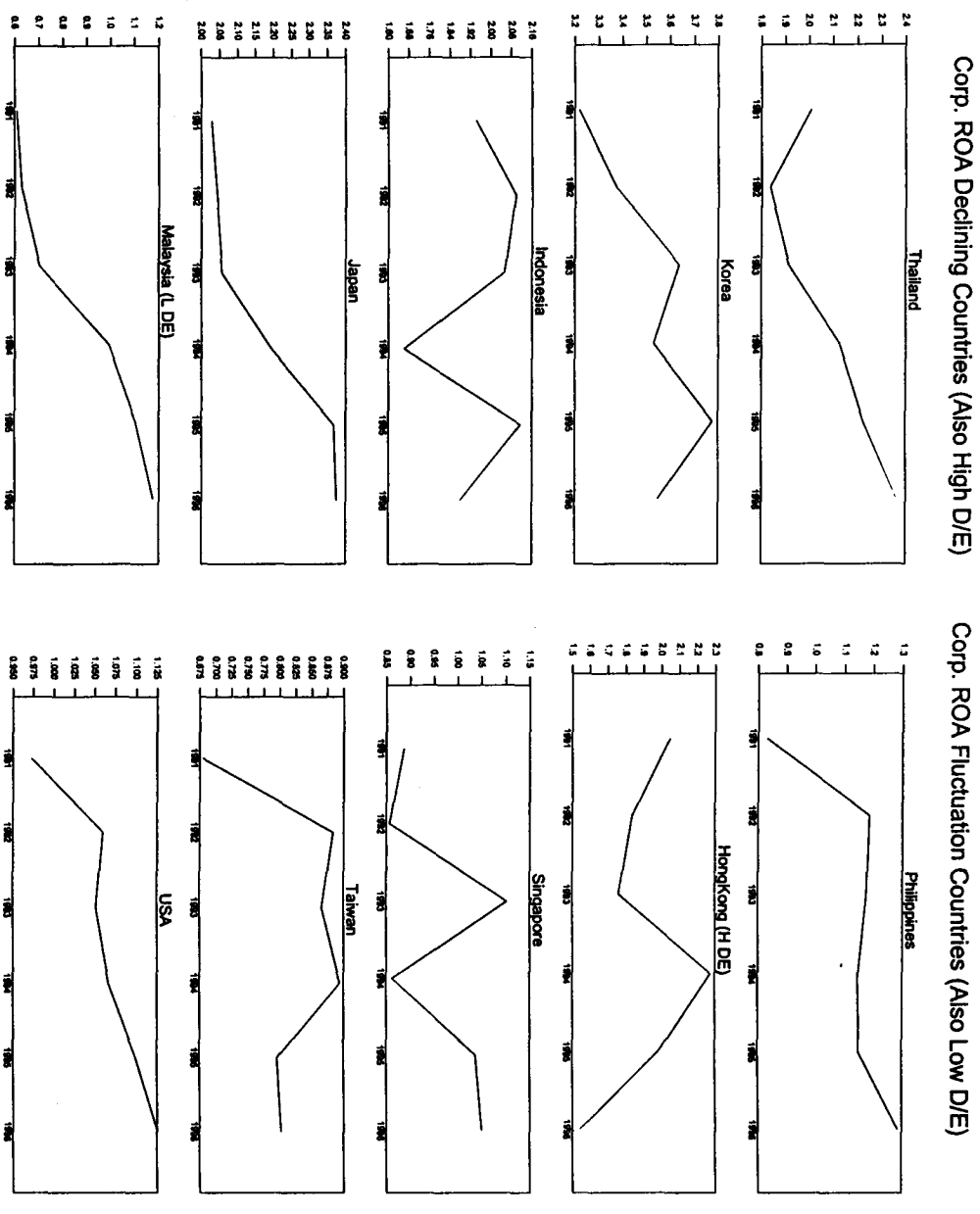
Corporates LEVERAGE (Debt/Equity)
Corp. ROA Declining Countries (Also High D/E)
Corp. ROA Fluctuation Countries (Also Low D/E)
Thailand
Korea
Indonesia
Japan
Malaysia (L DE)
Philippines
HongKong (H DE)
Singapore
Taiwan
USA

Figure 3:

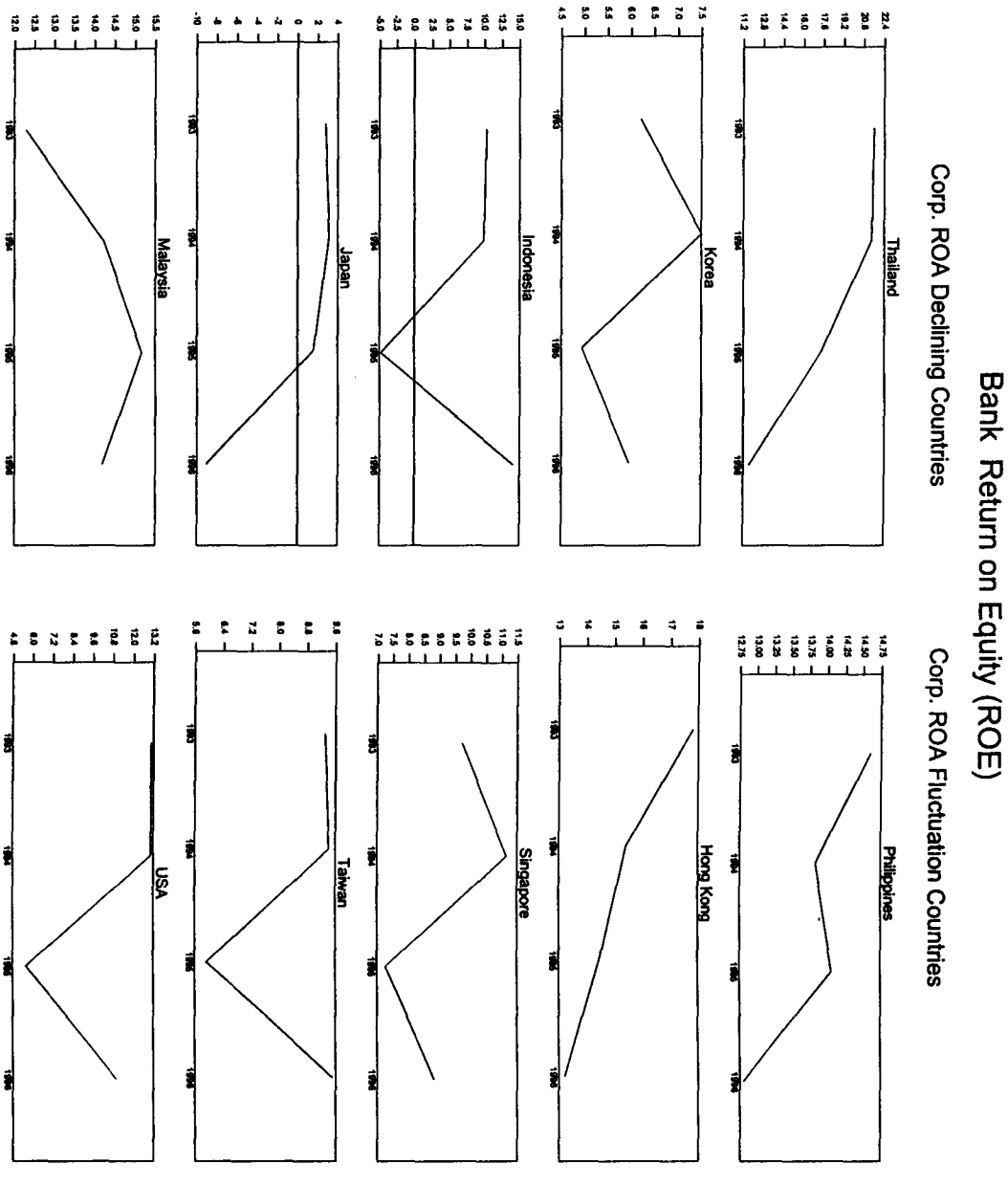
Bank Return on Equity (ROE)
Corp. ROA Declining Countries
Corp. ROA Fluctuation Countries
Thailand
Korea
Indonesia
Japan
Malaysia
Philippines
Hong Kong
Singapore
Taiwan
USA

Figure 4:

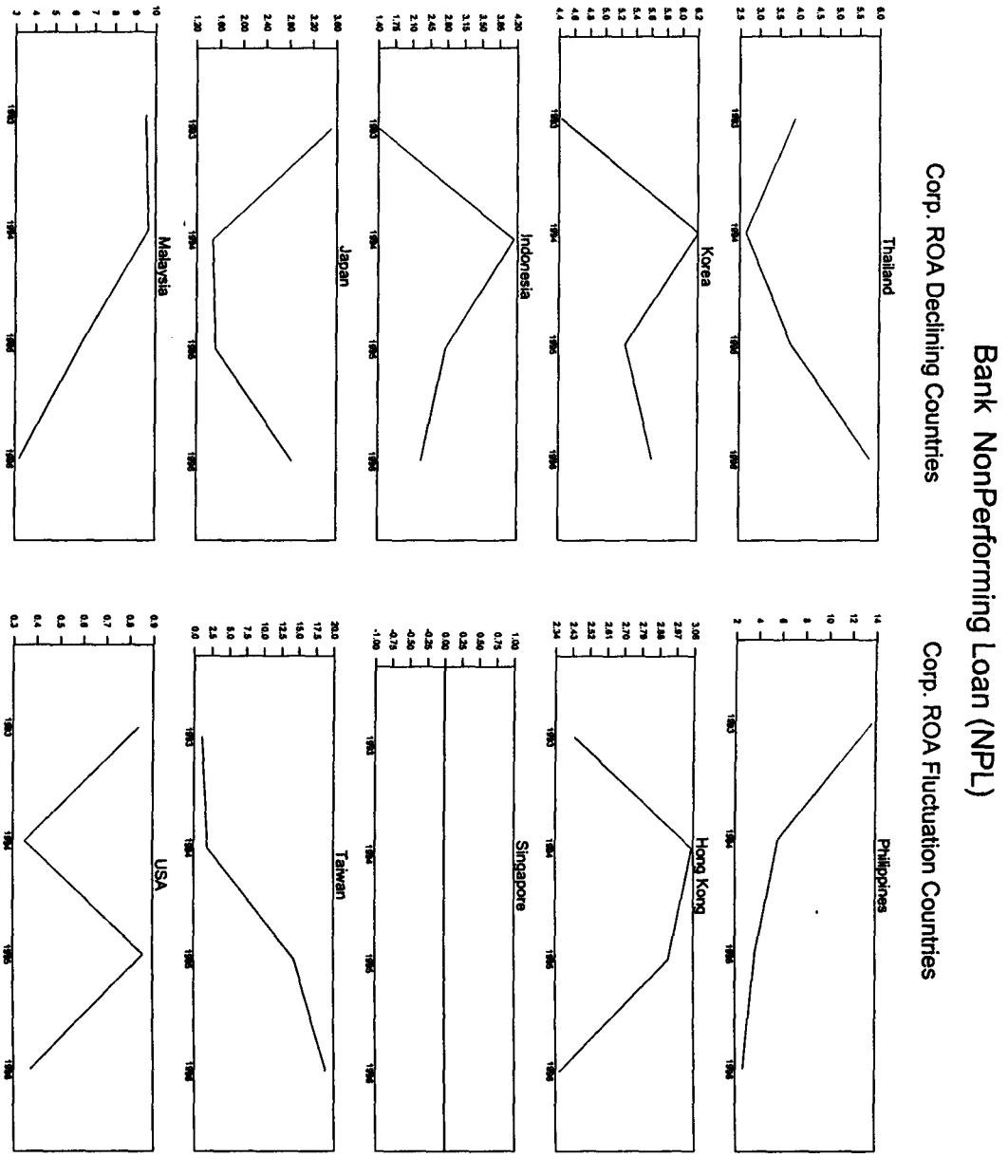
Bank NonPerforming Loan (NPL)
Corp. ROA Declining Countries
Corp. ROA Fluctuation Countries
Thailand
Korea
Indonesia
Japan
Malaysia
Philippines
Hong Kong
Singapore
Taiwan
USA

Figure 5:

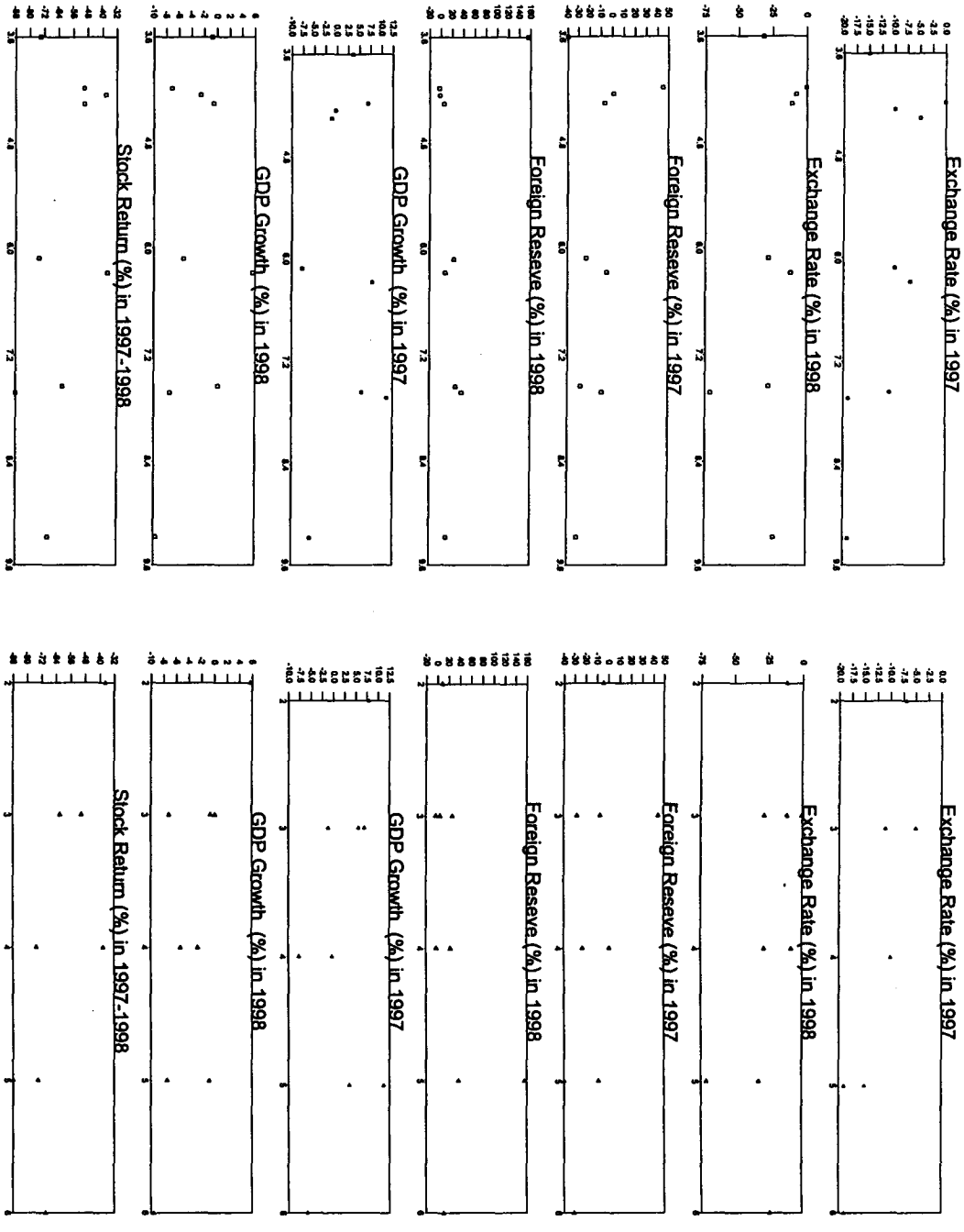
Comparisons of Two ROAs with Crisis Variables
ROA (Horizontal Axis)
NO. of Declining ROA (Horizontal Axis)
Exchange Rate (%) in 1997
Exchange Rate (%) in 1998
Foreign Reseve (%) in 1997
Foreign Reseve (%) in 1998
GDP Growth (%) in 1997
GDP Growth (%) in 1998
Stock Return (%) in 1997-1998

Figure 6:

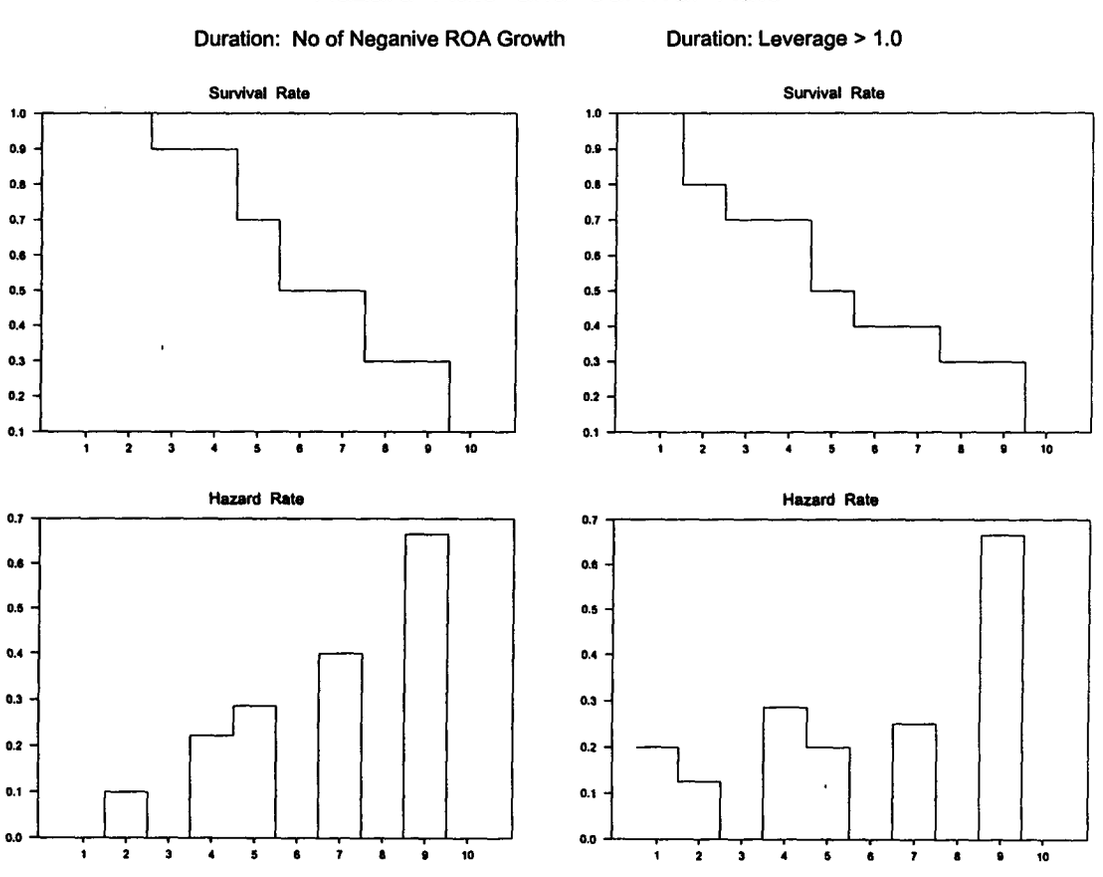
Hazard Rate and Survival Rate
Duration: No of Neganive ROA Growth
Duration: Leverage > 1.0
Survival Rate
Survival Rate
Hazard Rate
Hazard Rate

Figure 7:

Hazard Rate and Survival Rate, (Stratification by Leverage)

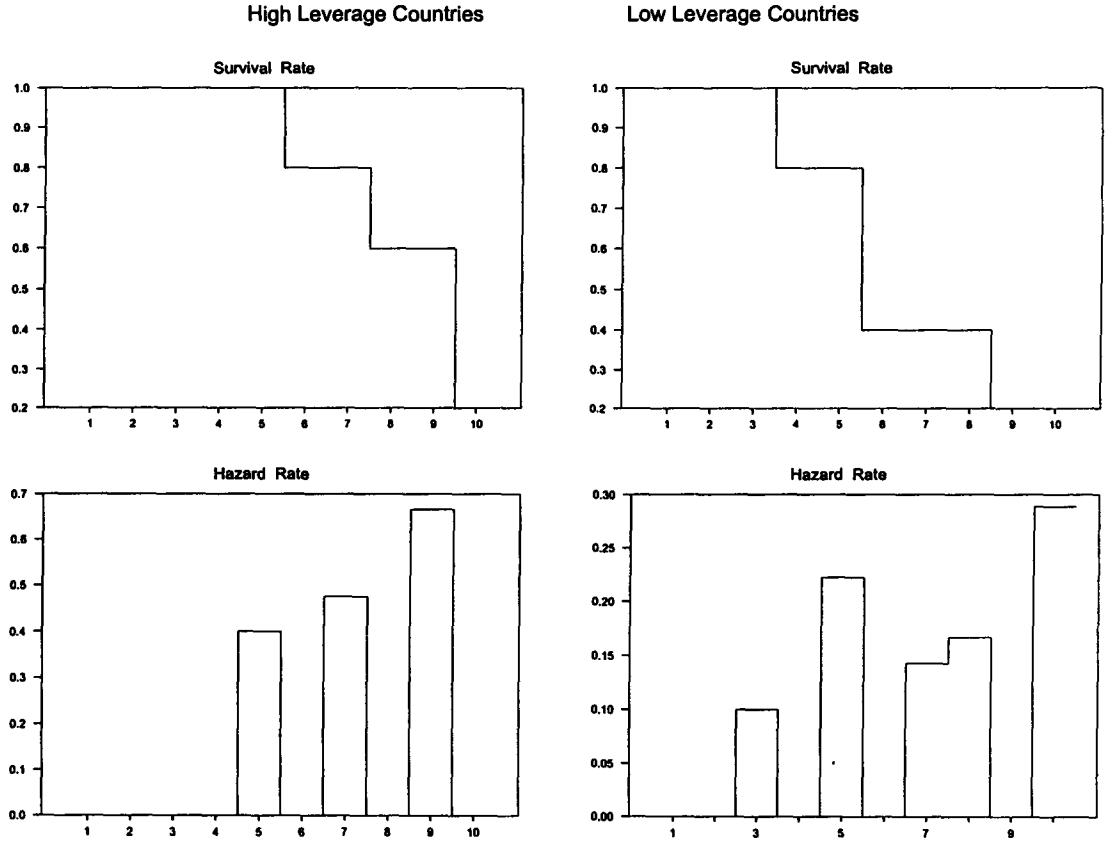

Table 1: Data Definition and Sources

Variable Names	Definition	Sample Period	Sources
Corp. ROA	Corporate's Return on Asset	1990–1997	WorldScope and Claessen et al. (1998)
Corp. Leverage	Corporate's Debt/Equity	1990–1997	WorldScope and Claessen et al. (1998)
Bank ROE	Bank's Return on Equity	1993–1997	BankStat
Bank NPL	Bank's Non Performing Loan	1993–1997	BankStat
Cred/GDP	Bank Credit to the Private Sector/GDP	1993–1997	BankStat
		1991–1997	IFS
CA/GDP	Current Account/GDP	1991–1997	IFS
FR/Import	Foreign Reserve/Import	1991–1997	IFS
SRDEBT/FR	Short-term Debt/Foreign Reserve	1991–1997	IFS

Corporate' and Banks' data are weighted by their assets
IFS: International Financial Statistics

Table 2: Basic Statistics Before the Asian Crisis: Mean and Standard Deviation

	A. ROA Declining Countries					
	THAILAND	KOREA	INDONESIA	MALAYSIA	JAPAN	Average c 5 Countrie
Corp. ROA	9.28	3.60	7.62	6.12	4.25	6.174
LEVEL	(1.45)	(0.32)	(1.14)	(0.31)	(0.49)	(2.35)
Corp. ROA	–7.25	–4.37	–5.75	0.91	–3.90	–4.072
Growth	(4.71)	(6.56)	(6.85)	(8.73)	(4.84)	(3.06)
Corp.	2.08	3.51	1.96	0.87	2.18	2.12
LEVERAGE	(0.20)	(0.20)	(0.17)	(0.25)	(0.16)	(0.94)
BANK ROE	16.64	-0.95	-10.28	13.32	-1.23	3.50
	(5.04)	(15.89)	(40.13)	(1.78)	(5.40)	(11.19)
BANK NPL	6.79	5.71	2.49	6.69	2.45	4.826
	(6.28)	(0.99)	(1.04)	(2.86)	(0.91)	(2.19)
CRED_GDP	98.14	63.63	54.10	86.38	116.30	83.71
	(15.73)	(6.15)	(4.45)	(12.45)	(1.56)	(25.29)
CA_GDP	-5.74	-1.84	-2.35	-6.02	0.002	–3.1896
	(2.47)	(1.85)	(0.92)	(2.15)	(0.0006)	(2.61)
FR_IMPOT	6.04	2.64	4.65	4.65	6.43	4.882
	(0.60)	(0.54)	(0.39)	(1.58)	(1.24)	(1.49)
SRDEBT_FR	113.60	198.57	183.65	40.38	NA	134.05
	(28.27)	(74.01)	(29.81)	(23.35)	NA	(72.61)

	B. ROA Fluctuation Countries					
	PHILIPPINE	HONGKONG	SINGAPORE	TAIWAN	USA	Average c 5 Countrie
Corp. ROA	7.55	4.17	4.35	6.28	5.20	5.51
LEVEL	(0.90)	(0.40)	(0.52)	(0.61)	(0.17)	(1.41)
Corp. ROA	5.03	–2.68	0.28	5.63	0.38	1.728
Growth	(20.3)	(7.42)	(17.2)	(9.66)	(3.84)	(3.52)
Corp.	1.13	1.91	0.97	0.82	1.06	1.178
LEVERAGE	(0.15)	(0.25)	(0.11)	(0.08)	(0.05)	(0.43)
BANK ROE	13.10	13.98	8.52	8.85	10.99	11.088
	(1.73)	(3.25)	(2.15)	(1.67)	(3.15)	(2.45)
BANK NPL	6.13	2.59	6.68	11.44	0.57	5.482
	(4.38)	(0.38)	(0.00)	(9.38)	(0.26)	(4.18)
CRED/GDP	39.71	155.90	90.08	145.12	64.57	99.076
	(12.87)	(12.59)	(6.75)	(4.64)	(2.01)	(50.36)
CA/GDP	-4.58	NA	14.09	2.88	-0.002	3.097
	(1.13)	NA	(3.94)	(0.72)	(0.00)	(7.95)
FR/IMPOT	2.94	4.00	6.74	11.13	1.05	5.172
	(0.48)	(0.76)	(0.21)	(1.82)	(0.18)	(3.91)
SRDEBT/FR	110.68	NA	NA	23.22	NA	66.95
	(44.86)	NA	NA	(2.70)	NA	(61.84)

Corporate data: 1991–1996, Bank Data: 1993–1996
Other Macro Data: 1991–1996

Table 3: Two Durations, Currency Crises and Economic Performances

	Duration		Exchange Rate (Period of Avg)		Foreign Reserve		GDP Growth		Stock Return
	NO. of Declining ROA	NO. of High Leverage	%	%	%	%	%	%	%
			1997	1998	1997	1998	1997	1998	1997
Country		critical values 1, 1.5, 2							
Thailand	6	6, 6, 4	−19	−24	−31	10	−5.91	−9.59	−70
Korea	5	6, 6, 6	−15	−32	−40	155	3.56	−0.73	−74
Indonesia	5	6, 6, 3	−19	−71	−9	37	11.13	−7.43	−88
Japan	4	6, 6, 6	−10	−8	1	−2	−0.29	−2.58	−38
Malaysia	4	2, 0, 0	−10	−28	−23	23	−7.71	−5.27	−75
Philippine	3 (2)	5, 0, 0	−11	−28	−28	27	5.65	0.15	−62
HongKong	3	6, 6, 2	−0.1	−0.1	45	−3	6.93	−7.16	−50
Singapore	3	3, 0, 0	−5	−11	−7	5	−1.22	−0.52	−50
Taiwan	2 (1)	0, 0, 0	−7	−12	−5	8	7.93	5.64	−37

ROA data is nonavailable in 1990 for Philippine and Taiwan, hence, the number denotes the alternative possibility. We try three different debt/equity ratio to count the number of high leverage. The three critical values are 1, 1.5 and 2.

Table 4: Correlation Between Durations, Currency Crisis and Economic Performances

Crisis and Economic Performances	ROA Level before '97	Durations: NO. of Declining ROA before '97	Durations: No of High Leverage cri. = 1 before '97	Durations: No of High Leverage cri. = 1.5 before '97	Durations: No of High Leverage cri. = 2 before '97
Exchange Rate (%) '97	–0.368	–0.824*	–0.367	–0.460	–0.606
	(1.047)	(3.848)	(1.042)	(1.371)	(0.017)
Exchange Rate (%) '98	–0.237	–0.530*	–0.185	–0.117	–0.471***
	(1.002)	(2.571)	(0.987)	(1.226)	(1.819)
Foreign Reserve (%) '97	0.045	–0.479*	0.189	–0.135	–0.379***
	(0.975)	(2.484)	(0.987)	(1.228)	(1.734)
Foreign Reserve (%) '98	0.252	0.392*	0.253	0.455	–0.271***
	(1.006)	(2.370)	(1.003)	(1.367)	(1.667)
GDP Growth (%) '97	0.108	–0.339*	0.158	–0.027	–0.082
	(0.980)	(2.317)	(0.982)	(1.218)	(1.609)
GDP Growth (%) '98	–0.633	–0.706*	–0.608	–0.316	–0.328***
	(1.258)	(3.078)	(1.222)	(1.283)	(1.698)
Stock Return '97-'98	–0.352	–0.702*	–0.238	–0.129	–0.419***
	(1.041)	(3.059)	(0.998)	(1.228)	(1.767)

t-value in parenthesis. All numbers are in percentage.
*, ** and *** denote the significant level at 1 5 and 10% level, respectively.
Leverages using the critical value D/E ratio 1, 1.5 and 2, respectively.

Table 5: Survival and Hazard Rate Function

A. Duration: No of Negative ROA Growth				
Cell Rank	Duration Range	Countries Belong to This Range	Survival Rate Function	Hazard Rate Function
1	0.0– 0.6		1.0000 (0.000)	0.0000 (0.000)
2	0.6– 1.2	Taiwan	1.0000 (0.000)	0.1000 (0.175)
3	1.2– 1.8		0.9000 (0.095)	0.0000 (0.000)
4	1.8– 2.4	Philippine, USA	0.9000 (0.095)	0.2222 (0.292)
5	2.4– 3.0		0.7000 (0.145)	0.2857 (0.387)
6	3.0– 3.6	HongKong, Singapore	0.5000 (0.158)	0.0000 (0.000)
7	3.6– 4.2	Malaysia, Japan	0.5000 (0.158)	0.4000 (0.571)
8	4.2– 4.8		0.3000 (0.145)	0.0000 (0.000)
9	4.8– 5.4	Indonesia, Korea	0.3000 (0.145)	0.6667 (1.021)
10	5.4 –6.0	Thailand	0.1000 (0.095)	0.0000 (0.000)

B. Duration: No. of Leverage ≥ 1				
Cell Rank	Duration Range	Countries Belong to This Range	Survival Rate Function	Hazard Rate Function
1	0.0 –0.6	Taiwan, USA	1.0000 (0.000)	0.2000 (0.260)
2	0.6– 1.2	Singapore	0.8000 (0.126)	0.1255 (0.222)
3	1.2– 1.8		0.7000 (0.145)	0.0000 (0.000)
4	1.8– 2.4	Philippine, Malaysia	0.7000 (0.145)	0.2857 (0.387)
5	2.4– 3.0		0.5000 (0.158)	0.2000 (0.368)
6	3.0– 3.6	HongKong	0.4000 (0.155)	0.0000 (0.000)
7	3.6– 4.2	Japan	0.4000 (0.155)	0.2500 (0.471)
8	4.2– 4.8		0.3000 (0.145)	0.0000 (0.000)
9	4.8– 5.4	Indonesia, Korea	0.3000 (0.145)	0.6667 (1.021)
10	5.4– 6.0	Thailand	0.1000 (0.095)	0.0000 (0.000)

Philippine's and Taiwan's ROAs are NA during 1990. In this Table, both their growth rates in 1991 are assumed to be positive. Standard errors are in parenthesis.

Table 6: Tobit Regression Analysis
Dependent variable: EMP*

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
				Corporate ROA using Level	Corporate ROA using Growth	Corporate ROA using Accummul.
constant	14.291*	17.187*	4.711*	8.097*	17.33*	9.713*
	(11.76)	(13.86)	(3.87)	(7.809)	(13.14)	(12.51)
Credit/GDP	-0.179*	-0.127*	-0163*	-0.114*	-0.127*	-0.114*
	(11.91)	(8.57)	(4.576)	(10.17)	(7.97)	(11.81)
CA/GDP	-0.010	0.293*	0.081	0.361	0.413	0.443*
	(-0.03)	(0.968)	(0.294)	(1.34)	(1.28)	(2.51)
FR/Import	1.176*	0.582*	0.928*	0.305***	0.484***	0.259
	(4.50)	(2.44)	(4.765)	(1.71)	(1.84)	(1.404)
SR-Debt/FR	-0.086*	-0.088*	-0.112*	-0.119*	-0.088*	-0.118*
	(11.99)	(12.12)	(19.83)	(16.62)	(11.38)	(18.89)
Bank ROE		-0.485*		-0.449*	-0.460*	-0.281*
		(3.079)		(4.42)	(2.67)	(2.53)
Bank NPL		0.054		0.0239	0.050	-0.036
		(0.593)		(0.34)	(0.87)	(0.60)
Corporate ROA			0.697*	0.772*	-5.903	0.116*
			(4.067)	(4.42)	(1.26)	(4.91)
Corporate Leverage			4.481*	4.378*	-1.201	0.858*
			(9.87)	(9.30)	(0.29)	(7.50)
Log-Likelihood	-69.11	-67.03	-61.46	-58.75	-66.16	-49.07

H_0 : Model 1 vs 2: $\chi^2 = 4.160$ [0.1249].
H_0 : Model 1 vs 3: $\chi^2 = 15.29$ [0.0004].
H_0 : Model 2 vs 3: $\chi^2 = 11.13$ [0.0038].
H_0 : Model 3 vs 4: $\chi^2 = 5.43$ [0.0661].
H_0 : Model 2 vs 4: $\chi^2 = 16.57$ [0.0003].
H_0 : Model 5 vs 4: $\chi^2 = 14.82$ [0.0006].
H_0 : Model 5 vs 6: $\chi^2 = 34.18$ [4×10^{-8}.]

Six countries are used and samples are 1993–1997.