

Using Index for Predicting Banking Crisis in Asian Countries

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Abstract

This study aims to develop predictive models of the banking crisis in Asia by utilizing methods of measurement indices in the banking crisis. The CD index is used as a measure of the crisis which includes four components, namely liquidity risk, credit, investment, and exchange rates that is combining of BSS index and BSF index. This research used six countries in Asia for a sample and logit analysis during observation period 1997-2012. The results show that the banking crisis in Asia affected by the decline in real GDP and inflation rate, an increase in the capital adequacy ratio, increasing of profitability ratios ROA, ROE and decreasing of ratio of interest income to operating income, decreasing of liquidity ratio, increasing of sensitivity to market ratio, declining in institutional quality, and increasing in US real interest rates.

Keywords: Banking Crisis, CD Index, Internal Bank, Macroeconomic, US Interest Rate

JEL Classification: G21

1. Introduction

A country is said to experience a banking crisis, is still in discussion among the experts (Rojas-Suarez, 1999; Demirguc-Kunt and Detragiache, 1998; Hardy and Pazarbasiglu, 1998; Bussiere and Fratzscher, 2002; Mannaso and Mayes, 2005, and Borio and Drehmann, 2009). Indication of the difference is indicated by Mannasoo and Mayers (2005), who questioned how the measurement can be defined.

Rojas-Suarez (1999) defines a bank in crisis if the ratio of bad loans to total loans experiences a greater standard threshold determination of non-performing loans in the non-crisis period plus two times the standard deviation. Demirguc-Kunt and Detragiache (1998) and Hardy and Pazarbasiglu (1998) define a banking crisis as occurring if one of the conditions (indicators) are met. These indicators include: bad debt which exceeds 10 percent of the total assets in the banking system, the cost of recovery to 2 percent of GDP, the transfer of ownership of the big banks to the government and the occurrence of bank runs. The banking is said to be in crisis if one of the above conditions are met and it measured using a binary approach that is a score of 1 if experiencing a crisis and zero for bad credit sebaliknya. Gonzalez-Hermosillo *et al.* (1997) provide different measurements by stating that the banks is facing crisis if it have nonperforming loans of more than 6-8 percent of total loans. Another opinion expressed by Kaminsky and Reinhart (1999) which defines a bank experiencing distress characterized by a problem with the balance. Banking crisis is preceded with the deregulation which have an impact on credit expansion too fast

Bussiere and Fratzscher (2002) introduced a three-state classification based crisis multinomial logit model to avoid bias resulting post-crisis recovery phase of the assessment were wrong. This concept has some drawbacks that the binary approach and ignore market pressures approaching crisis standards. Reliance on professional judgment has the same drawbacks and also illustrates the ambiguity of some of the operational definition of a systemic crisis.

Further definition of the crisis proposed by Mannaso and Mayes (2005) is classifying the bank experiencing difficulties into two categories that are distress and bankruptcy. Borio and Drehmann (2009) provide two other definitions of crisis. The first definition of a crisis occurs in a country where the

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government had to inject capital into more than one large bank and one or more of the major banks that failed. The second definition gives a more loose sense of crisis that a country is said to experience a crisis if the government did at least two of the following operating policies: wholesale guarantees issued (large trades), purchase of assets, inject capital in at least one major bank, or to announce a large-scale recapitalization program. Illing and Liu (2003, 2006) subsequently developed an index that is used to test the indicators of crisis. This index is used in further studies by Hanschel and Monnin (2005) was used to investigate the systemic risk in Switzerland and Misina and Tkacz (2008) in Canada. Index based on market data (stock price), the data sheet (inter-bank deposits, return on assets), and supervisory information on bank risk.

Bhattacharya and Roy (2009) showed that there are two methods of identifying the banking crisis that event-based method (based on annual data) and the method index (based on a monthly or quarterly). Event-based methods (event-based) identify systemic banking crisis only after the occurrence of certain events such as bank runs, closures, mergers, long vacation out of the ordinary, recapitalization and Non-Performing Assets of significant (NPA) (eg Demirguc Kunt and Detragiache, 1998; Kaminsky and Reinhart, 1999; Caprio and Klingebiel, 2003, and the World Economic Outlook 1998). Criticism of this method of identification based crisis events that may result in delayed recognition on the incidence of crises (Hagen and Ho, 2003; 2006).

The index method has several advantages over approaches based on events. First, this approach does not require a priori knowledge of events to identify banking crises that delay in recognizing the crisis will be lower. Second, various forms of banking disturbance severity can be identified in this method. Third, the index method based on the monthly time series data can imply a more specific timings crisis.

This study aims to develop a predictive model of banking crises by using the index method to measure the banking crisis. The index used is the CD index (Crisis and Default Index) is composed of the merge BSS index and BSF index. Banking crisis prediction model is built based on the theories of the incorporation of the crisis crisis theory first generation, second generation and third. Thus obtained 5 groups ie group of macroeconomic variables, internal bank, institutional, contagion effects and global factors. This paper consists of an introduction, literature review, methodology, discussion, and conclusions.

2. Literature Review

- **Theory of Crisis**

- **First Generation Model**

The first generation model commonly referred to as exogeneous policy model that looked at the financial crisis originated from a currency crisis or balance of payments crises, caused by macroeconomic imbalances due to weak economic fundamentals. Based on this model, the collapse of the fixed exchange rate regime was caused by unsustainable fiscal policies. This model was first proposed by Krugman (1979) and later by Flood and Garber (1984). Empirically first generation models marked with the swelling budget deficit of a country, the excessive growth of the money supply, foreign exchange reserves are getting depleted, high rate of inflation and an over-valued exchange rate of the domestic currency. Empirically, this theory can explain the phenomenon of the crisis in the countries of Latin America in the 1970s and 1980s.

- **Second Generation Model**

The second generation model with endogeneous policy commonly called a model or a self-fulfilling process, is developed based on the weaknesses of the first generation model. This model was first proposed by Obstfeld and Rogoff (1986). Ali (2007) mentions that in the context of the banking crisis means that regardless of the position of sentience (solvent) of a bank (or the banking sector as a whole) if the random events can negatively alter the collective expectations of the depositors (ie, the creditor), it can accelerate the bank run on the banks and the banking system. Thus, even though the economic fundamentals no problem, but this kind of pure liquidity crisis can occur.

○ Third Generation Model

The third generation model commonly referred to by some observers as the Asian crisis. This model emphasizes the role of moral hazard and balance sheet effects. Moral hazard is the result of an implicit government guarantee that ready-bailing out private companies and banks are in trouble and ensure the investor's future revenue. It clearly leads to excessive borrowing and lending which then creates bad loans (Goldstein *et al.*, 2000). The third generation model was put in place mechanisms supervision in the banking sector becomes an important element in the prevention of financial crises.

● Measurement Banking Crisis With Index

Kibritcioglu (2002) developed an index with the name of the BSF index using three important indicators for measuring the fragility of the banking sector, the level of external debt of the banking sector, the credit level, the level of deposits. This is because the three indicators related to foreign exchange risk, credit risk and liquidity risk. The formulation of the index Kibritcioglu (2002) as follows:

$$IK_t = \frac{\left(\frac{(FL_t - \mu_{FL})}{\delta_{FL}}\right) + \left(\frac{(CR_t - \mu_{CR})}{\delta_{CR}}\right) + \left(\frac{(DP_t - \mu_{DP})}{\delta_{DP}}\right)}{3}$$

Where:

FL_t = external debt of the banking sector

CR_t = credit of the banking sector

DP_t = deposit in the banking

Kibritcioglu (2002) explained that the timing of the crisis in the banking sector or the pressure is the pressure when the indices are arranged in period t has a value above the mean plus 3 standard deviations over the last 24 months, the period is considered as a crisis. Bhattacharya and Roy (2009) modify the Banking Sector Fragility Index (BSF Index) developed by Kibritcioglu (2002) to the Banking Sector Soundness Index (Index BSS). BSS index using monthly data on aggregate deposits, loans, and investment banks as a proxy for the monthly general liquidity risk, credit risk and interest rate risk which is the three main risks faced by banks in India. BSS3 defined as the average value of standardized real credit, real deposits and real investment commercial banks of India, built BSS2 excluding bank deposits.

$$\begin{aligned} BSS3_t &= [(Dep_t - \mu_{Dep})/\sigma_{Dep} + (Cred_t - \mu_{Cred})/\sigma_{Cred} + (Inv_t - \mu_{Inv})/\sigma_{Inv}]/3 \\ BSS2_t &= [(Cred_t - \mu_{Cred})/\sigma_{Cred} + (Inv_t - \mu_{Inv})/\sigma_{Inv}]/2 \end{aligned}$$

Where:

$$Dep_t = (rD_t - rD_{t-12})/rD_{t-12}$$

$$Cred_t = (rCr_t - rCr_{t-12})/rCr_{t-12}$$

$$Inv_t = (rI_t - rI_{t-12})/rI_{t-12}$$

Based on the continuum of values assumed by the BSS index, we obtain a binary crisis dummy that assumes the value 1 when there is a crisis ($BSS < 0$) and a value of 0 ($BSS > 0$) when there is no crisis. And the banking system is considered to have fully recovered from the crisis when the value of $BSS = 0$ (Bhattacharya and Roy, 2009). CD index as a measure of the banking crisis is based on a model built by Kibritcioglu (2002) with the BSF index and Bhattacharya and Roy (2009) with BSS index. This CDI (Crisis and Default Index) combines the BSF index and the index BSS. There are two common measurements of BSF and BSS indices namely liquidity and credit risk, however, BSF is using the exchange rate risk but do not use interest rate risk, and vice versa for the BSS index. CD index combining these two measures so that there are 4 main risks are taken into account in the CD index liquidity risk, credit risk, interest rate risk and

exchange rate risk. CD index using four indicators are considered more able to explain the crisis conditions more broadly.

- **Determines of Banking Crisis**

Many factors influence the occurrence of banking crises, among other macroeconomic environment (Demirgüç-Kunt and Detragiache, 1998; Hardy and Pazarbasioglu, 1999; Poghosyan and Cihak, 2008; Wong *et al.*, 2010), banking fundamentals (Gonzalez-Hermosillo, 1997; De Young *et al.*, 1999, Tung *et al.*, 2004; Arena, 2008), institutional (Klomp, 2010; Wong *et al.*, 2010), the effects of contagion (Kaminsky and Reinhart, 2000; Wong *et al.*, 2010) and global factors (Lestano, 2003; Zhuang and Dowling, 2002).

Macroeconomic variables measured by four variables: real GDP growth, inflation, the ratio of M2 to foreign exchange reserves, and real interest rates. Demirguc-Kunt and Detragiache (1998), Eichengreen and Artera (2000), and Beck *et al.* (2006) found that there was a significant negative effect of real GDP growth to the possibility of a crisis, but Domac and Martinez-Peria (2003) and Cihak (2007) found no effect or positive but not significant. Demirguc-Kunt and Detragiache (1998) find that inflation gives positive influence on the probability of a crisis, but on the other hand Komulainen and Lukkarila (2003), shows that inflation is significantly negative, while Glick and Hutchinson (1999) and Beck *et al.* (2006) showed no significant results. For the real interest rate variable Demirguc-Kunt and Detragiache (1998) and Beck *et al.* (2006) proved that there is a significant positive effect on the probability of a crisis, but in contrast to Domac and Martinez-Peria (2003) and Cihak (2007) which shows the negative effect but not significant in real interest rates to the possibility of a crisis.

The second group of variables is an internal group of banks. Based on the results of previous studies such as the Arena (2005), Gonzalez-Hermosillo (1999), Boyacioglu (2009) which indicates that the bank's internal conditions affecting the banking crisis. In this study the internal condition of a bank is measured by the ratio of CAMELS (Capital, Assets, Management, Earnings, Liquidity, and Sensitivity to Market).

Group of institutional variables using three proxy variables: financial liberalization, central bank independence, and institutional quality. Financial liberalization variable is used as a proxy because there are differences in the results, Demirguc-Kunt and Detragiache (1998) and Shehzad and De hann (2009) shows that there is a positive but not significant effect, on the other hand Komulainen and Lukkarila (2003) showed no effect significant negative financial liberalization variable with the possibility of a banking crisis. Institutional quality as measured by real GDP per capita in several studies as Herrero and Del Rio (2003) and Martinez-Peria and Domac (2003) gave a significant negative effect on the probability of a banking crisis, but Demirguc-Kunt and Detragiache (1998) find different results ie no effect of institutional quality with the banking crisis.

Contagion effect was adopted as an explanatory variable banking crisis based on the research results of Wong *et al.* (2010) who showed no effect of inter-country contagion effects to the possibility of a crisis in a country. Global factors measured variables with the variable economic growth, inflation US, US interest rates and world oil prices. The findings of Kamin *et al.* (2001) showed that there is a significant influence of global factors on the exchange rate crisis. Similarly Zhuang (2002) adopted the indicator for the prediction of the Asian financial crisis and the result can be a predictor variable on the financial crisis.

3. Research Methods

This study analyzes the banking crisis in Asian countries comprising India, Japan, South Korea, Indonesia, Malaysia, and Thailand. Selection of the region by the consideration that these countries are among the most open economies of other Asian countries as well as trade and financial ties with the broad other countries in the world, especially the developed countries.

The period of observation in this study is 1997 to 2012 that use annual data. Data were collected by means of data retrieval via the Internet to the website each data source. Sources of data in this study is the data published by the IMF in the form of IFS (IMF Financial Statistics), World Bank, Asian Development

Bank (ADB) and the respective websites of the central bank states the object of research. This study uses logit analysis to develop predictive models of banking crises in Asia.

4. Discussion

• Measurement of the Banking Crisis With CD Index

Measurement of banking crises using binary data-value 1 (CD index > 0) then there is a crisis and be 0 (CD index < 0) then no crisis. Data obtained by calculating the CDI index (Crisis and Default Index) is formulated by combining indices researchers previously created by Kibritcioglu (2002) and Batacharya and Roy (2009). There are four components in the calculation of this index ie deposits, loans, investments and banking sector debt.

Table 1. CD Index

Year	India		Jepang		Korea		Indonesia		Malaysia		Thailand	
	CD Index	Score*	CD Index	Score*	CD Index	Score*	CD Index	Score*	CD Index	Score*	CD Index	Score*
1995	0,306	0	0,587	0	0,098	0	-0,04	1	0,15	0	0,44	0
1996	0,339	0	-0,46	1	0,408	0	0,899	0	0,492	0	0,311	0
1997	0,231	0	0,26	0	0,817	0	1,496	0	1,839	0	0,883	0
1998	0,043	0	-0,767	1	-0,552	1	0,111	0	-1,428	1	-0,726	1
1999	0,151	0	-0,596	1	1,056	0	-1,661	1	-0,746	1	-0,989	1
2000	-1,413	1	-0,8	1	0,396	0	-0,313	1	-0,485	1	-0,593	1
2001	-1,192	1	0,165	0	-0,05	1	0,363	0	-0,891	1	-0,722	1
2002	0,476	0	-0,554	1	0,288	0	-0,504	1	-0,237	1	-0,582	1
2003	0,318	0	-0,329	1	-0,146	1	-0,161	1	0,051	0	-0,261	1
2004	0,555	0	-0,369	1	0,379	0	-0,463	1	1,511	0	-0,228	1
2005	0,574	0	0,195	0	-0,217	1	-0,012	1	0,525	0	0,016	0
2006	0,413	0	-0,462	1	0,176	0	-0,141	1	-0,075	1	-0,213	1
2007	0,47	0	0,648	0	-0,085	1	0,276	0	0,274	0	-0,512	1
2008	0,531	0	0,823	0	0,073	0	0,286	0	-0,301	1	0,411	0
2009	0,282	0	-0,072	1	-0,472	1	-0,434	1	-0,495	1	-0,132	1
2010	0,261	0	-0,144	1	-2,452	1	0,152	0	-0,367	1	0,611	0
2011	0,406	0	0,914	0	0,621	0	0,325	0	0,506	0	-0,01	1
2012	-2,63	1	0,959	0	-0,337	1	-0,179	1	-0,323	1	2,293	0

* Scores obtained if CDI > 0, then given a score of 0 means no crisis, if CDI < 0 then given a score of 1, which means the crisis; ** the data prediction.

Source: Researchers

• Banking Crisis Prediction Model

The results of the logit analysis as seen in table 2, shows the value of Nagelkerke R square of 51% which means that the variability of the dependent variable in the model prediction that the banking crisis can be explained by the variability of the independent variable is equal to 51%. Value describes the overall percentage of classification accuracy of the estimated value of right and wrong. The analysis showed the overall percentage score of 75% which means that the overall classification accuracy of a crisis and no crisis

by 75%. Value Hosmer and Lemeshow test of significance greater than 5% mean prediction model feasible for use.

Table 2: Statistical Analysis Model For Prediction of Crisis

LOGIT ANALYSIS		
Var.	Koef.	Sign
X1	-0,431	0,070
X2	-0,273	0,030
X5	41,924	0,042
X10	0,629	0,100
X11	-0,034	0,077
X13	-7,315	0,028
X15	-6,396	0,012
X16	0,294	0,023
X20	-5,172	0,082
X23	0,432	0,039
Const	11,465	
Nagelkerke R square: 51%		
Overall percentage: 75%		
Hosmer and Lemeshow test:		
Chi-square : 4,305		
Sign: 0,829		

The result of the crisis prediction model parameter estimates indicate that there are ten independent variables that can be used as predictors of crisis. In this model, the independent variables that can be used as predictors of crisis is the growth of real GDP (X1), the inflation rate (X2), car1 (X5), EAR1 (X10), EAR2 (X11), EAR4 (X13), LIQ2 (X15), SEN1 (X16), institutional quality (X20), and real interest rates USA (X23). So that the model predictions can be written:

$$Y = 11,465 - 0,431X1_{t-1} - 0,273 X2_{t-1} + 41,924X5_{t-1} + 0,629X10_{t-1} - 0,034X11_{t-1} - 7,315X13_{t-1} - 6,396X15_{t-1} + 0,294X16_{t-1} - 5,172X20_{t-1} + 0,432X23_{t-1} + e$$

Real GDP growth variable (X1) is negatively affected the banking crisis. This may imply that the current economic growth is represented by the growth of real GDP has decreased the probability of a banking crisis increases. Low economic growth indicate a slowdown in economic activity both real sector and the financial sector, of course this will impact on the banking sector. The results of this study are consistent with findings Demirgüç-Kunt and Detragiache (1998, 2000), Hardy and Pazarbasioglu (1998, 1999), Beck *et al.* (2006), Bhattacharya and Roy (2009), and Wong *et al.* (2010) who showed that banking distress is usually preceded by a slowdown in economic growth.

Inflation rate (X2) negatively affect the probability of a banking crisis. This means that at the time infkasi level is low, the probability of experiencing a crisis of the banking sector is becoming increasingly high. English (1996) in a study in Brazil and Russia found similar results that there is a negative relationship between inflation and banking difficulties. Research Corsetti (1999) also revealed that the same thing during the crisis period, the inflation rate in the sample countries (Asia) has decreased.

Davis and Karim (2008) found the same results that inflation negatively affect the banking crisis, they argue that the other is due to the negative effect of procyclical behavior of asset prices that usually occurs in times of crisis. Booming conditions will lead to asset bubbles that excessive borrowing during the boom conditions lead to unrealistic expectations of earnings and valuation of assets that are not realistic. This is called a procyclical effect. Procyclical behavior of assets may trigger the crisis. The results of this study are consistent with findings Komulainen and Lukkarila (2003) and Zistler (2010).

The capital adequacy ratio (X5) shows the estimation results are positive, meaning that the higher the capital adequacy ratio, the higher the probability of a banking crisis in Asia. Beck et al (2006) revealed that the ratio of capital reserves are large enough to make the bank will be having a stronger buffer in the face of liquidity shocks, but it is also a high burden for the banking sector as it will reduce profitability and increase bank fragility. This study also supports the findings of the Arena (2008) which shows the capital adequacy ratio of a positive effect on the probability of banking crises in East Asia and Africa.

Variable earnings in this study proxied by Return on Assets or ROA (X10). The results showed that there are significant positive ROA on the possibility of a crisis in Asia. Gonzalez-Hermosillo (1999) in a study in Colombia showed the same result that positive effect on the probability of occurrence of a banking crisis, as well as the findings of Arena (2008) who studied in East Asia and Africa. Banking assets are not actually much more liquid than liabilities. Another explanation for the increase in ROA can be associated with moral hazard behavior. The impact of moral hazard leads to excessive borrowing and lending which creates bad loans (Goldstein *et al.*, 2000).

ROA is determined by the amount of net income and assets. The asset composition of 90% is not risk-free because of third party sourced funds and loans, it means that the greater asset in the calculation of ROA, the risk faced by the larger banks. Unlike the case with the ROE calculation, where the denominator is derived from the capital risk is relatively small. The results of this study indicate that the ratio of profitability as measured by ROE (X11) negatively affect the probability of a banking crisis in Asia. This means that the magnitude of profitability with ROE measures will minimize the risk of a crisis. Can be described that the higher ROE, the lower probability of a crisis.

Another profitability variable which have significantly affects the probability of crisis is the ratio of interest income to operating income (X13). The results of this study indicate that the ratio of interest income to operating income negatively affect the probability of banking crises. The results of this study support the findings Bongini *et al.* (2001) who studied in six East Asian countries. Research of Demircug-Kunt (2006) also supports the result that states there is a negative effect on the interest margin of the banking crisis prediction. According to Demircug-Kunt *et al.* (2006) banking crisis is always followed by a decrease in profitability and asset quality. However, in this study the variable quality of the asset does not affect the prediction of the crisis in Asia.

Variable liquidity as measured by the ratio of loan to deposit ratio, or LDR (X15) negatively affects the probability of a banking crisis. The results of this study support the research and Budnevich Ahumada (2001), the findings and Budnevich Ahumada (2001) revealed that the higher the LDR ratio indicates high liquidity. In the short term this will reduce the percentage of non-performing loans, which means the risk of bank failure is low, in other words, the more liquid a bank indicating that the bank is risk averse. A similar sentiment was expressed by Barrell et al (2010) shows that the higher the ratio the lower the possibility of a liquidity crisis in OECD countries.

The ratio of assets to liabilities of banks in foreign currency (X16) is used as a proxy for the sensitivity of banks to the financial markets primarily to exchange rate fluctuations. The results showed that the ratio of assets to liabilities of banks in foreign currencies positive effect on the probability of the crisis in Asia. The results of this study support the findings of De Young (1999) that there is a positive effect of the ratio of assets to liabilities in foreign currencies with the probability of a banking crisis.

The quality of institutional (X20) as measured by the index of corruption have a negative impact on the probability of occurrence of a crisis. The higher (lower) value of the index indicates the smaller (larger) the level of corruption in a country, this affects the lower (higher) the possibility of a crisis, this study supports the results of a study conducted Demircug-Kunt and Detragiache (1998), which describes more conducive or strong institutional environment of a country is reflected in the low levels of corruption will decrease the chances of a financial crisis. The findings Angkinand (2009) also corroborate the results of this research that there is a negative effect on the probability of institutional quality banking crisis. Findings Byström (2003) also supports the results of this research to the scope of research in Asia in 1994-2002 that showed lack of corruption negatively affects the possibility of a banking crisis.

United States real interest rates (X23) as part of a group of global factors, turned out to provide a positive influence on the probability of banking crises. This means that the higher real interest rates in the United States will encourage the transfer of funds or outflows (capital outflow) from domestic to foreign, so that the domestic economy will experience liquidity problems. The results of this study are consistent with the findings of Calvo *et al.* (1993) which used indicators US real interest rates as a proxy for global shocks on the economy of Latin America. Eichengreen and Rose (1998) research revealed that the real interest rates of industrialized countries affect the probability of banking crises in developing countries. Lestano (2003) in his study found no significant effect of US real interest rates to the Asian banking crisis in 1970-2001.

5. Conclusion

Based on the background and purpose of the study, it can be concluded that the first, the CD index can be used to measure the banking crisis based on four components, namely liquidity risk, credit, investment, and exchange rates. It can be used as an alternative method of calculating the banking crisis. CD index is a measurement of crisis index, which develop from the BSS index and BSF index. CD index can be used as an early warning system for banks to detect the possibility of a crisis. Secondly, the banking crisis prediction model is built based on three approaches crisis theory shows that the banking crisis in Asia is determined by a decrease in real GDP, inflation rate, an increase in the capital adequacy ratio, increase profitability ratios ROA, ROE and profitability ratios decrease the ratio of interest income to operating income, a decrease in the liquidity ratio, the increase in the ratio of sensitivity to market, decrease in institutional quality, as well as an increase in real interest rates USA.

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APPENDIX

Table 3. Operational Definition of Variables

No	Variable	Description	Literature Source	Data Source
1	Y	$CDI = \left[\frac{(Dep_t - \mu_{Dep})}{\sigma_{Dep}} + \frac{(Cred_t - \mu_{Cred})}{\sigma_{Dep}} + \frac{(Inv_t - \mu_{Inv})}{\sigma_{Inv}} + \frac{(LF_t - \mu_{LF})}{\sigma_{LF}} \right] / 4$ Where: $Dep_t = (rD_t - rD_{t-12})/rD_{t-12}$ $Cred_t = (rCr_t - rCr_{t-12})/rCr_{t-12}$ $Inv_t = (rI_t - rI_{t-12})/rI_{t-12}$ $LF_t = (rLF_t - rLF_{t-12})/rLF_{t-12}$	Kibritcioglu (2002); Batacharya and Roy (2009)	Each central bank data
2	X1	Growth GDP real (%)	Demirguc-Kunt and Detragiache (1998, 1999, 2000, 2002) and Wong <i>et al.</i> (2010)	Asian Development Bank (ADB statistic)
3	X2	Inflation measured by Consumer Price Index (%)	Demirguc-Kunt and Detragiache (1998, 1999, 2000, 2002), Barrel <i>et al.</i> (2010) and Wong <i>et al.</i> (2010)	Asian Development Bank (ADB statistic)
4	X3	Ratio (M2 _t /central bank reserve _t) x 100%	Demirguc-Kunt and Detragiache (1998, 1999, 2000, 2002), Barrel <i>et al.</i> (2010) and Wong <i>et al.</i> (2010)	Asian Development Bank (ADB statistic)
5	X4	Real interest rate (%) measured by $[(1+r_t)/(1+\pi_{t+1})] - 1$, where r_t is 3 month nominal interest rate and π_{t+1} is inflation in period $t + 1$.	Wong <i>et al.</i> (2010)	Asian Development Bank (ADB statistic)
6	X5	CAR1 (capital Adequacy Ratio) = share holder equity _t /total asset _t	Poghosyan and Čihák (2008) and Boyacioglu <i>et al.</i> (2009)	Each central bank data
7	X6	CAR2 (capital Adequacy Ratio) = share holder equity _t /total loan _t	Poghosyan and Čihák (2008) and Boyacioglu <i>et al.</i> (2009)	Each central bank data
8	X7	AQ1 (Asset Quality) = fixed asset _t /total asset _t	Poghosyan and Čihák (2008) and Boyacioglu <i>et al.</i> (2009)	Each central bank data
9	X8	AQ2 (Asset Quality) = total loan _t /total asset _t	Poghosyan and Čihák (2008) and Boyacioglu <i>et al.</i> (2009)	Each central bank data

10	X9	MGT(management) = labor cost _t /average total asset _t	Poghosyan and Čihák (2008) and Boyacioglu <i>et al.</i> (2009)	Each central bank data
11	X10	EAR1 (earning) = net income _t /average asset _t	Poghosyan and Čihák (2008) and Boyacioglu <i>et al.</i> (2009)	Each central bank data
12	X11	EAR2 (earning)= net income _t /average share holder equity _t	Poghosyan and Čihák (2008) and Boyacioglu <i>et al.</i> (2009)	Each central bank data
13	X12	EAR3 (Earning) = earning before tax _t /average asset _t	Poghosyan and Čihák (2008) and Boyacioglu <i>et al.</i> (2009)	Each central bank data
14	X13	EAR4 (Earning) = interest income _t /total operational revenue _t	Poghosyan and Čihák (2008) and Boyacioglu <i>et al.</i> (2009)	Each central bank data
15	X14	LIQ1(Liquidity) = liquid asset _t /total asset _t	Poghosyan and Čihák (2008) and Boyacioglu <i>et al.</i> (2009)	Each central bank data
16	X15	LIQ2 (liquidity)= total loan _t /total saving _t	Poghosyan and Čihák (2008) and Boyacioglu <i>et al.</i> (2009)	Each central bank data
17	X16	SEN1 (sensitivity to market)= FX assets _t /FX liabilities _t	Poghosyan and Čihák (2008) and Boyacioglu <i>et al.</i> (2009)	Each central bank data
18	X17	SEN2 (sensitivity to market)= interest income _t /average asset _t	Poghosyan and Čihák (2008) and Boyacioglu <i>et al.</i> (2009)	Each central bank data
19	X18	Financial liberalization = (domestic credit to private sector/GDP) x 100%	Wong <i>et al.</i> (2010)	Asian Development Bank (ADB statistic)
20	X19	Central Bank Independency	Klomp (2010)	Each central bank data
21	X20	Institutional quality, measure with <i>index the lack of corruption</i> 1-6 scale	Angkinand (2009)	Worldwide Governance Indicator (Bank Dunia)
22	X21	contagion effect measure with: $Contagion_{i,t} = \sum_{j \neq i} Distress_{j,t} W_{ij,t}$ Distress _{j,t} equal 1, if economic j facing	Wong <i>et al.</i> (2010)	Asian Development Bank (ADB statistic)

		distress in year t and equal 0, if otherwise $W_{ij,t} = (1 - \left\{ \phi \left[\frac{(X_{j,t} - \mu_j)}{\sigma_j} \right] - \phi \left[\frac{(X_{i,t} - \mu_i)}{\sigma_i} \right] \right\})$ Where: $X_{i,j,t}$ = GDP economic i dan j at time t σ = standard deviation μ = mean ϕ =cumulative distribution function from standardized normal function		
23	X22	World oil price = % change of world oil price	Eichengreen and Arteta (2000)	World bank (World Development Indicator)
24	X23	US real interest rate (%) = $[(1 + r_t)/(1 + \pi_{t+1})] - 1$, where r_t is 3 month US nominal interest rate , π_{t+1} is US inflation rate t + 1.	Eichengreen dan Arteta (2000)	World bank (World Development Indicator)
25	X24	US real economic growth (%)	Zhuang (2002)	World bank (World Development Indicator)
26	X25	US inflation rate measure with Consumer Price Index (%)	Lestano (2003)	World bank (World Development Indicator)