Depositor Discipline in the East Asian Banking System

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Abstract: This paper analyses the effectiveness of depositor discipline in the East Asian banking system during the time surrounding the 1997 crisis period. Firstly, the paper investigates the 'wake-up call' hypothesis, to find out whether depositor responses are higher during the post-crisis period. Secondly, the paper analyses the possible non-linear relationship between price elasticity and bank quality by separately analysing depositors' reaction to the price offered by both weak and healthy banks. Thirdly, this paper analyses the weakening effect of the depositor protection scheme. Analyses were carried out on a total of 193 banks in the East Asian banking system during the period from 1995 to 2005. The findings confirm that depositors do discipline banks and provide support for the 'wake-up call' hypotheses. The analysis, which was done by subdividing the sample of banks based on their quality, shows that depositors did not discipline weaker banks by demanding higher premiums. The findings also confirm the weakening effect of the depositor protection schemes.

Keywords: Banks, depositor discipline, East Asia, instrumental variable estimations, panel data analysis
JEL classification: G21, G28 and N25

1. Introduction

The East Asian crisis brought forward the discussion about the need for reform in the banking industry. Traditionally, regulation in the banking industry has been prescribed as the solution to market failure that arises as a result of a banking crisis. Nevertheless, existing literature suggests that deriving optimal regulation in the banking industry is not a very easy task since regulators may act in the interest of the government (i.e. Central Banks are not very independent) or in the interest of the industry (i.e. when regulatory capture happens) (Freixas and Rochet 2008). Regulation can also be costly (supervisory and administrative costs, dead weight taxation cost and indirect costs arising from the distortion it generates). In light of these considerations, market discipline is highlighted as one of the key areas of reform policy.

The third pillar of the Basel II highlights the role of market discipline in easing the existing pressure on traditional monitoring measures like capital requirement and government supervision that are emphasised in the first and the second pillars of Basel II.[1,2] In line with this, the present paper will examine the effectiveness of market discipline in the East Asian banking system. Market discipline is the tool through which stakeholders can monitor and discipline banks that have engaged in high risk taking activities by making them pay for the actual cost of their risk taking. Existing empirical

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  This study is part of the author's PhD thesis which was supervised by Dr. Surajeet Chakravarty and Professor James Davidson from the Department of Economics, University of Exeter, UK.
[1] Basel II is the second of the Basel Accords. It is an official effort aimed at preventing crises through the formation of international standards on bank regulation and supervision.
[2] See Basel Committee on Banking Supervision (June 2006) for details.

evidence shows that market discipline can be signalled by all three groups of banks' shareholders; depositors, debt holders and equity holders in developed countries.[3]

This paper will focus on analysing the existence of depositor discipline in the East Asian banking system. Banks in East Asia recorded high deposits and short-term funding growth before the crisis.[4] The onset of the crisis reduced depositor confidence. This caused a massive outflow of deposits from the banking sector during the crisis as shown in Figure 1.[5] A large outflow of deposits triggered a liquidity crisis in the banking system and subsequently caused declines in equity, property prices and widespread bank failures. Total deposits only started to increase in all five countries after the crisis period.

The present study aims to find if depositor discipline was present in East Asia. This will be done by assessing whether depositors withdrew their funds from weaker banks and demanded higher returns from weaker banks. More specifically, in ascertaining if banks in East Asia are able to attract higher deposits by offering higher interest rates, this study will take into account the simultaneity that exists in the depositor discipline model. By doing so, this paper aims to find out if banks in East Asia are able to attract more deposits for a given price once the simultaneous relationship between price and quantity of deposits is controlled for.

This paper also aims to analyse the possible non-linear relationship between price elasticity and bank quality. This will be done by separately analysing depositors' reaction to the price offered by the weak and healthy banks. The banking sector in East Asia underwent a substantial amount of restructuring as a result of the crisis. Hence, this
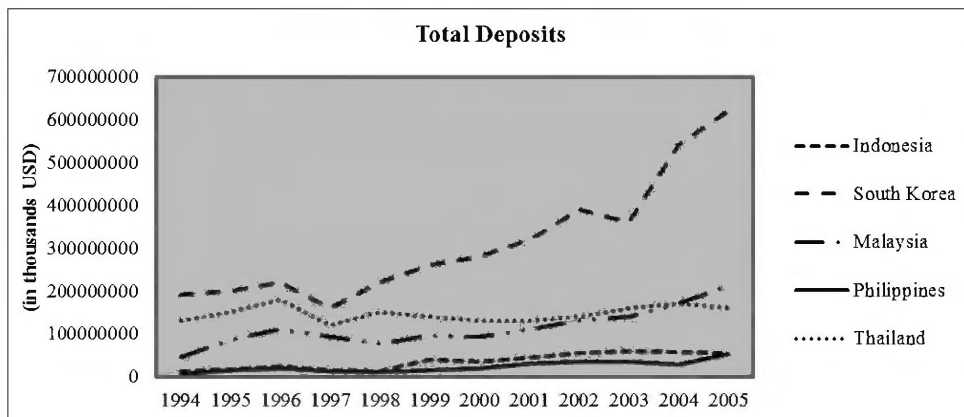
Figure 1. Movements in total deposits for commercial banks in East Asia*
*(only includes banks that are covered by Bankscope)

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[3] Depositors can discipline banks either by demanding a higher return (price effect) or withdrawing their deposit (quantity effect); debt-holders can discipline banks by demanding a higher yield on the bank's debt for the riskier institutions, while equity holders can do so by selling their shares and exerting downward pressure on share prices.

[4] For example, in 1995 the total growth of the short-term fund was 46.32% while the total growth of total deposits was 24.36% in the five countries.

[5] Only includes banks that are covered by Bankscope.

criterion will be used to subdivide the sample of banks. Restructured banks are classified as weak while Non-Restructured banks are classified as strong. Since depositors respond to ex-ante weaknesses in an individual bank's fundamentals, they may react differently to weak banks compared to healthy ones. This paper also intends to examine the effectiveness of depositor discipline in the presence of a deposit insurance scheme that was introduced in most of the countries after the crisis. The extent of depositor discipline will also be examined by taking into account cross-country differences in banking sector reform.

The findings confirm that depositors in East Asia do discipline the banks. More specifically, the findings show that depositors prefer banks that have higher equity ratio and are bigger in size. The results for the whole sample period (1995 - 2005) also show that deposit growth is not driven by price signals. In line with the 'wake-up call' hypothesis, depositors were more responsive to bank fundamentals during the post-crisis period. They also responded to the prices offered by banks during this time. However, this study found that weaker banks' depositors were not more sensitive and did not require a higher price premium than healthy banks' depositors. The results also confirm the weakening effect of depositor protection schemes. This suggests that depositor discipline is not very effective in East Asia.

The rest of the paper is organised as follows: Section 2 describes the concept of market discipline, and briefly reviews the theoretical and empirical literature relating to depositor discipline. In Section 3, the empirical methodology is described by emphasising the dynamic relationship between price and quantity of deposits, and the non-linear relationship between price elasticity and bank quality. This section also discusses the data. Section 4 discusses the results and Section 5 concludes.

2. Literature Review

Market discipline allows stakeholders to safeguard their interest. The threat of action by the stakeholders puts the management under heightened scrutiny and enables suppliers of funds to exert market influence (Flannery, 2001). Diamond and Rajan (2001) assert that the monitoring feature of the demand deposit contract is desirable even though higher reliance on demand deposits causes the capital structure of banks to be inherently fragile. Calomiris and Kahn (1991) model the interim market discipline using the demand deposit contract. The informed depositors are able to observe an interim signal about banks' return, and as a result are able to 'vote with their feet' if the observed signal indicates that the return is low. In this case, depositors are able to increase their utility and payoff by prematurely withdrawing their funds from weaker banks. Depositors' risk aversion drives their withdrawal behaviour and allows them to reward fundamentally sound banks for their prudence and penalise weak banks for engaging in higher-risk taking activities.[6] Signals sent by depositors provide incentives for banks to reduce their excessive risk taking activities. This encourages greater prudence and efficiency among bank managers and enables problems in a particular bank to be contained before they spread to the entire banking sector.

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[6] Information-based bank run models were also propagated by Bryant (1980), Jacklin and Bhattacharya (1988), Chari and Jagannathan (1988), Gorton (1988) and Allen and Gale (1998).

Existing empirical literature in banking shows that depositors do discipline banks. Depositors discipline banks using two approaches: a price-based approach and a quantity-based approach. Under the first approach, banks that engage in higher-risk taking are required to pay a higher return as compensation. Studies by Baer and Brewer (1986), Ellis and Flannery (1992) and Cook and Spellman (1994) found a positive relationship between the rate of large uninsured CDs of US banks, and the riskiness of the banks. The second approach looks at depositors' withdrawal actions or 'flight to quality'[7]. Among the studies that found a positive relationship between banks' risk and deposit withdrawals were that of Kane (1987), Goldberg and Hudgins (1996) and Martinez Peria and Schmukler (1999). Researchers who looked at both approaches were Maechler and McDill (2006), Ghosh and Das (2006) and Ungan *et al.* (2008).

Earlier studies on depositor discipline have focused more on the United States.[8] These studies confirm that depositors do distinguish between weak and strong depository institutions. Similar studies have been carried out on Latin American countries that have experienced crises. Using both pooled panel and fixed-effect panel models for each country, Martínez Pería and Schmukler (2001) found that both insured and uninsured depositors withdrew their funds and required higher returns from banks that engaged in higher risk taking activities in Argentina, Chile, and Mexico during the 1980s and 1990s. They also found that market discipline is weaker during a crisis and stronger after a crisis. Barajas and Steiner (2000) found that depositors in Colombian banks withdrew their funds from weaker banks even after controlling for the return offered by these banks and the deposit insurance scheme that was in place.

Studies by Arena (2004) and Hosono *et al.* (2005) have looked at depositor discipline in East Asia. Arena (2004) analysed deposit growth in the crisis-led East Asian countries during crisis and non-crisis periods by using a cross-country fixed-effect method. This study confirms the importance of bank-specific factors in explaining depositor withdrawal action declines during a crisis period but did not take into account the price mechanism. Hosono *et al.* (2005) use pooled OLS regression of deposit growth and interest rate in analysing depositor discipline in four countries, namely Indonesia, Korea, Malaysia and Thailand. Their findings confirmed that banks that take higher risk have lower deposit growth and offer a higher interest rate. Nevertheless, their study did not take into account the bank-specific effect and the panel structure of the data.

The present study aims to analyse the effectiveness of depositor discipline in the East Asian banking system by taking into account the simultaneous relationship between price and quantity of deposits as postulated by Maechler and McDill (2006). Their findings confirm the endogenous relationship between price and quantity of deposits and show that banks in the United States are able to raise deposits by raising their interest rates. Similar studies by Karas et al. (2006) and Bowe and Wu (2007) looked at the dynamic relationship between price and quantity of deposits in the Russian and Chinese banking sector.

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[7] Bernanke *et al.* (1996) introduced this term in describing depositors' action of withdrawing funds from the weaker institutions and re-depositing in stronger ones.

[8] Flannery (1998)'s summary of the empirical studies of depositors' discipline in United States provides support for this.

Asset pricing models postulate that banks that take higher risks need to offer depositors higher returns in order to induce them to deposit their funds in the bank. Nevertheless, reformulation of the credit rationing model suggests that the relationship between deposit growth and interest rate is not linear at all times as banks that offer too high an interest rate can be perceived as risky.[9] In line with this, the present study will analyse the possibility of a non-linear relationship between interest elasticity and bank quality. Similar to the study of Maechler and McDill (2006), this study aims to find if healthier banks are able to raise higher deposits compared to the weaker ones once the simultaneity between price and quantity of deposits is taken into account. This study will take into account the restructuring exercise that occurred in the East Asian banking sector in dividing the sample of banks according to their quality.[10] The sample of banks in the study will be divided into weaker (Restructured) and healthier (Non-restructured) ones, and estimations will be undertaken to find out if depositors react differently to the two groups of banks.

3. Methodology and Data Description

This study aims to find out if depositors discipline banks. The null hypothesis is that depositor withdrawals do not respond to ex-ante weaknesses in an individual bank's balance sheet. If there is no depositor discipline, deposits growth should be uncorrelated with a bank's specific variables that reflect the risk characteristics. The following model is used to assess depositor discipline:

$$DEPGR_{i,j,t} = \alpha_i + \delta_j + \lambda_t + \beta' INTRate_{i,j,t} + \mu' RISK_{i,j,t-1} + \mu' MACRO_{j,t} + \varepsilon_{i,j,t} \qquad (1)$$

such that $i = 1,...,N$; $j = 1,...,J$; and $t = 1,...,T$. $DEPGR$ is the growth rate of real deposits for individual bank i at time t in country j.[11] N is the number of banks in each country. J is the number of countries (i.e. 5 countries). T is the number of observations per bank (it varies because the panel is unbalanced). $INTRate$ is the interest rate on the total interest bearing debts (calculated as total interest expenditures over total interest bearing debts).[12,13] This variable captures the funding cost per unit of debt. In addition, the government interest rate is subtracted from the ratio of interest expense to interest-bearing debt of each individual bank to get a cross-sectional measure of bank risk that is adjusted for the nominal risk-free rate as shown by the studies of Demirgüç-Kunt and Huizinga (1999) and Fonseca and González (2010). The government rate is the Treasury bill rate where available, or the discount rate otherwise.[14] $RISK$ is the vector of bank level variables that represents banks' risk characteristics. This vector is included with the lag in order to account for the fact that balance sheet information is available to the public with certain

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[9] Insolvent or near-insolvent banks may wish to follow a risky growth strategy in overcoming their financial troubles. As a result, they may offer a very high interest rate.

[10] CAMEL rating is used to classify banks according to riskiness.

[11] Total deposits is used because data on customer deposits is not available for the Indonesian and Korean banks in some of the years.

[12] Data on the detailed breakdown of interest charged by banks on their deposits is not available in Bankscope.

[13] Studies by Demirgüç-Kunt and Huizinga (1999) and Bowe and Wu (2007) have used this as the interest rate proxy.

[14] Data for the government debt rate is taken from line 60zf of the IFS database. Units are in percentage per annum.

delays. *MACRO* represents country-level banking sector and macroeconomic variables. In the above equation, α accounts for the bank-specific effect, δ accounts for the country effect and λ accounts for the time effect.

This study aims to find if banks are able to attract higher deposits over time by raising interest rates. In doing so, this study also takes into account the possible endogenous relationship that can arise between deposit growth and interest rate variables. Bank managers are able to anticipate that bank fundamentals at time t-1 affect deposits at time t. Hence, they may try to adjust interest rates in order to prevent future deposit withdrawals. The effect of this action on the quantity of deposits will depend on the overall movement in the supply and demand curve of deposits.

Depositors' withdrawals, due to greater risk taking by banks, shifts the supply curve to the left (S') and raises the equilibrium level upward along the demand curve. This lowers the quantity of deposits and raises the price. Banks realise that they will incur shortages in deposits and, as a result, will not have sufficient sources to fund their loan portfolio. Weaker banks may react to this shortfall by offering higher interest rates on a given level of deposits. This action may increase the demand for bank deposits and may shift the demand curve for deposits to the right. The new equilibrium can be either on the left or right-hand side of the original equilibrium. It is very obvious that the interest rate rises from its original level as a result of these shifts. However, concurrent movements in the demand and supply curve of deposits can obscure changes in the quantity of deposits. So, in analysing the effect of changes in the interest rate variables on bank deposits growth, the effect of changes in bank risk profiles on those two variables needs to be controlled for. This will allow us to ascertain whether the positive or negative link between the interest rate variables and deposit growth are signals of depositor discipline.

Estimating the simultaneous relationship between price and quantity of deposits using the FE model can be biased. Hence, to ascertain whether the positive or negative link between the interest rate variables and deposit growth are signals of depositor discipline, this study uses the instrumental variable estimation method for panel data. This estimation is carried out using the xtivreg2 user written command in STATA 11 (Schaffer, 2010).[15]

The following general reduced form equation is used:

$$INTRate_{i,j,t} = \eta_i + \theta_j + \pi_t + \rho'RISK_{i,j,t-1} + \upsilon'MACRO_{j,t} + \omega_{i,j,t} \qquad (2)$$

where *RISK* now includes non-performing loans to gross loans and net loans to customer deposits and short term funds as excluded instruments for interest rate and T-bill rate as an additional excluded instruments for price variables.

3.1 Data

The analysis of this study is carried out using the sample of commercial banks in five East Asian countries, namely Indonesia, Korea, Malaysia, Philippines and Thailand. Bank

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[15] Stata's user written xtivreg2 command does not make degrees-of-freedom adjustment for the number of fixed effects as proposed by Arellano (1987) and Wooldridge (2002). In comparison, Stata's official xtivreg command makes (N-N_g-K) degree of freedom adjustment for the number of fixed effects, which is somewhat conservative in this context.

level data was obtained from Bankscope. The database for each bank was obtained for the period between 1995 and 2005. Country level macroeconomic data was obtained from International Monetary Fund's International Financial Statistics database. Depositor discipline can be weakened by the existence of deposit protection schemes. This study controlled for the existence of a safety net in the banking sector by using a deposit insurance index. This index was based on Demirgüç-Kunt and Huizinga (2004)'s study. The variation in the deposit insurance schemes was measured based on three aspects, which included explicit deposit insurance, unlimited coverage, and inter-bank deposits coverage. The deposits insurance index ranged from 0 to 3.

Abiad *et al.* (2008) provide yearly data on banking sector reform and policy changes along five dimensions: credit controls, interest rate controls, banking sector entry barriers, banking supervision and banking sector privatisation.[16,17] Each country was given a final score on the basis of the extent of liberalisation of the banking sector. In general, a low score suggests that the banking sector is repressed while high scores suggest that the banking sector is liberalised.

All commercial banks' data that available from Bankscope were used for the analysis. This yielded an initial sample of 193 banks. The number of observations available for the regression analysis changed according to the variables used in the regressions.

This paper makes a further contribution by assembling a comprehensive database on bank re-structuring in the five East Asian countries. The information on details of restructuring was gathered from Bankscope, banks and central bank websites, and academic sources.[18] The sample of banks in the study were divided into two different quality categories. A bank was classified as Restructured if it was recapitalised, suspended, closed or taken-over by another bank and Non-Restructured, otherwise. Restructured banks were considered weak banks while Non-Restructured banks were considered healthy banks. If the banks went through a restructuring exercise they were removed from the sample size. For those cases in which a bank merged or was acquired, the resulting larger bank was treated as a 'new' bank in the sample.[19]

In addition to this, depositor discipline is also influenced by the level of competition in the banking industry. Studies by Park and Peristiani (1998) and Ungan *et al.* (2008) have used the Herfindahl–Hirschman Index (HHI) as a proxy for competition in the empirical analysis.[20] HHI gives higher weight to larger banks compared to the smaller ones. A higher

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[16] *http://www.imf.org/external/pubs/cat/longres.cfm?sk=22485.0*

[17] Abiad et al. (2008) provided data on seven dimensions of financial reform. However, only five dimensions, which directly relevant to the banking sector, were used in this study.

[18] The academic sources are Ariff *et al.* (2001), Ito and Hashimoto (2007a), Ito and Hashimoto (2007b), Kawai and Takayasu (1999), Lindgren *et al.* (1999), Num and Lam and Lum (2006), Pangestu and Habir (2002), Park (2005), Polsiri and Wiwattanakantang (2005), Sato (2005) and Soon and Koh (2005).

[19] Eliminating the merged banks from the analysis will create biases given the relatively large number of mergers and acquisitions (around 20) in comparison to the number of banks in the sample (about 150).

[20] HHI is defined as the sum of the squares of market shares of all the banks in a country, where the market shares are expressed as fractions. It has the following form:

$$HHI = \sum_{i=1}^{N} s_i^2$$

where s_i is the market share of bank i and N are the number of banks in the system. Market share of banks was measured using total assets as a proxy for bank size.

HHI is associated with greater concentration in the banking industry while a lower HHI is associated with greater competition in the industry.

4. Results
4.1. Summary Statistics
The results in Table 1 show that there is a great variability in the deposit growth variable. This variable varied more across time than across banks as shown by the standard deviation. Both of the price proxy variables displayed variation across time and banks. Solvency ratio, profitability ratio, liquidity ratio, Costs to Income ratio and provisioning ratio of the banks in the sample displayed greater variation overtime than across banks.

Table 1. Summary statistics

Variables		Mean	Std. deviation	Min	Max	Observation
Deposits growth	Overall	19.21	58.96	-95.96	515.23	1315
	Between		23.77	-21.59	222.55	
	Within		54.56	-136.67	470.77	
Interest rate	Overall	7.43	5.87	0.7	48.5	1018
	Between		4.16	1.68	22.38	
	Within		4.27	-4.57	37.33	
Interest rate ex-Gov. debt rate	Overall	-1.61	5.41	28.94	21.06	1019
	Between		4.52	-14.19	21.06	
	Within		3.37	-20.15	22.09	
Total equity/total assets	Overall	11.03	12.37	-129.21	99.72	1640
	Between		8.75	-11.09	55.15	
	Within		8.92	-107.08	82.2	
Return on equity	Overall	3.22	77.21	-975.36	967.12	1632
	Between		34.95	-242.66	115.08	
	Within		70.48	-789.86	855.25	
Liquid assets/total assets	Overall	22.96	16.87	0.2	96.79	1640
	Between		13.03	1.09	72.01	
	Within		10.4	-20.03	86.83	
Costs to income ratio	Overall	64.33	55.19	2.3	873.58	1575
	Between		31.72	12	236.14	
	Within		45.19	-94.13	742.82	
Loan loss reserve/ gross loans	Overall	6.8	9.46	0	90.19	1575
	Between		6.38	0.84	52.43	
	Within		7.48	-43.24	70.5	
Log size	Overall	14.11	1.95	9.27	19.01	1638
	Between		1.88	9.71	18.06	
	Within		0.41	11.39	16.4	
HHI	Overall	0.13	0.06	0.05	0.35	2364
Deposit insurance	Overall	1.49	0.95	0	3	2364
GDP per capita	Overall	3004.31	3649.1	3	13303.82	2364

Size (log value of Total Assets) varied more across banks than across time, highlighting the heterogeneous nature of banks in East Asia.

The average concentration ratio in the East Asian banking sector, as measured using the HH Index, increased during the post-crisis period as shown in Table 2. It ranged between 0.054 and 0.359. Deposit Insurance coverage averaged 1.485. Average GDP Per Capita is 3004.31. Financial reform variables ranged between 1 to 3.

4.2 Panel Data Analysis

Regression analyses using different assumptions of the error structure of the basic model were carried out. The Hausman specification test confirmed that the random effect

Table 2. Panel data analysis with and without price mechanism

Variables	Dependent variable : growth rate of real deposits					
	(1)	(2)	(3)	(4)	(5)	(6)
Interest rate					0.657	
					(0.526)	
Interest rate ex-gov. debt						3.100***
						(0.787)
Lag (total equity/t. assets)	1.791***	1.776***	1.788***	2.474***	2.769***	2.643***
	(0.292)	(0.272)	(0.239)	(0.460)	(0.597)	(0.652)
Lag (return on equity)	0.0141	0.0177	0.0592	0.0117	0.0142	0.0279
	(0.0198)	(0.0192)	(0.0449)	(0.0220)	(0.0254)	(0.0247)
Lag (liquid assets/t. assets)	0.0315	0.101	0.0488	0.0650	0.0438	0.0469
	(0.145)	(0.156)	(0.153)	(0.265)	(0.243)	(0.246)
Lag (costs to income ratio)	0.0401	0.0307	0.0225	0.0482	0.0800**	0.0476
	(0.0261)	(0.0225)	(0.0420)	(0.0338)	(0.0375)	(0.0316)
Lag (loan loss reserve/g. loans)	0.123	0.160	0.224	0.218	-0.00261	-0.137
	(0.372)	(0.329)	(0.285)	(0.363)	(0.475)	(0.498)
Size	5.302***	4.649***	1.958	29.34***	36.34***	28.30***
	(1.158)	(1.383)	(1.386)	(6.268)	(7.237)	(5.985)
HHI	463.2***	500.9***	317.6***	560.2***	645.9***	558.8***
	(47.01)	(49.89)	(74.13)	(62.78)	(70.71)	(73.12)
Deposit insurance	-9.986***	-9.434***	-1.539	-12.07***	-11.13***	9.273***
	(1.626)	(1.900)	(5.909)	(1.775)	(2.577)	(2.231)
GDP per capita	0.00124**	0.00187***	0.00208***	0.000152	0.000537	0.00104
	(0.000483)	(0.000642)	(0.000730)	(0.00327)	(0.00405)	(0.00395)
Type of estimator	Pooled OLS	Random effect	Between effect	Fixed effect	Fixed effect	Fixed effect
Observations	1,208	1,208	1,208	1,208	800	801
R-squared	0.2298		0.437	0.251	156	157
Number of banks	193	193	193	193	0.294	0.322
F-stat	18.71***		12.75***	20.29***	15.55***	21.17***
Wald Chi-squared		202.13***				

1. *** p<0.01, ** p<0.05, * p<0.1
2. Cluster robust standard errors in parentheses
3. Each regression also contains country and time dummy variables that are not reported

estimates would be subject to unobserved heterogeneity bias. This suggests that the fixed effect estimation should be used. The fixed effect estimator emphasises the variation of dependent and independent variables over time, using deviations from each bank's mean.[21] Robust standard errors that were valid in the presence of non-iid errors were used due to the presence of both heteroscedasticity and autocorrelation in the residuals.

The data on East Asian banks seems to support our general hypothesis that deposit growth is associated with the movements in bank fundamentals. Overall, the findings in Table 2 confirm that depositor discipline exists in the East Asian banking sector. More importantly, the findings show that equity ratio and size have a significant impact on deposit growth in all the estimations. This implies that depositors prefer to bank-in their deposits in solvent and bigger banks. The results also show that consolidation in the banking sector encourages deposit growth while deposit insurance scheme reduces it.

Further analyses were carried out by including interest rate and interest rate ex government debt as price proxies. The results in Table 2 suggest that banks are not able to raise more deposits by offering higher interest rates. However, results in column 6 imply that banks are able to do so by offering higher interest rates above the risk-free rate. The analyses using instrumental variable estimation method in column 1 and 2 of Table 3 show that banks are not able to attract more funds by offering higher prices once the endogeneity between quantity and price of deposits is controlled for.

Depositor discipline analyses were also carried out by focusing only on the post-crisis period. The results in column 3 shows that the coefficient of the solvency variable is almost double compared to that of the whole period. This suggests solvency matters more to depositors after the crisis period. A large number of bank failures that happened in East Asia during the crisis period could be the reason for this. Depositors also prefer larger banks more after the crisis period compared to the whole sample period. This is in line with findings which show that larger banks in East Asia are associated with longer survival and less likely to fail (Arena, 2004). Column 4 of Table 3 shows that banks in East Asia that offers higher interest rate above the risk-free rate are able to attract higher deposits during the post-crisis period. This suggests that a price mechanism is only effective during normal periods as compared to the whole sample period.

Further analyses were carried out in order to ascertain the weakening effect of a depositor protection scheme in a depositor discipline model. The deposit insurance variable was interacted with each bank fundamental in order to find the differentiated effect of bank fundamentals on deposit growth for different levels of deposit protection. Results in column 5 show that solvency increases deposit growth. However, the negative value of the interaction term of solvency and deposit protection implies that solvency reduces deposit growth when deposit protection is higher. The findings also show that profitability raises deposit growth, but this effect reduces when deposit protection is higher. This confirms the weakening effect of the depositor protection scheme.

4.3 Restructured versus Non-Restructured Banks

This section analyses the effectiveness of depositor discipline by examining if depositors in weak banks are more sensitive and require a higher price premium than depositors in healthy banks. If this is true, for every one unit increase in interest rate, healthier banks should be able to raise more deposits compared to the weaker ones. Existing studies by

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[21] It effectively discards the between-person variation and as a result can yield standard errors that are considerably higher than those produced by methods that utilise both within- and between-bank variation.

Table 3. Panel data analysis with endogenous price mechanism

Variables	(1)	(2)	(3)	(4)	(5)	(6)
			Post-crisis	Post-crisis		
Interest rate	-3.076		2.140		5.412	
	(11.34)		(7.837)		(4.032)	
Interest rate ex gov. debt		-4.718		15.10**		-4.966
		(3.358)		(7.296)		(4.055)
Lag (total equity/t. assets)	2.497*	2.811***	4.886***	2.895***	6.502***	6.453***
	(1.336)	(0.810)	(0.859)	(1.001)	(0.769)	(0.804)
Lag (return on equity)	0.0506*	0.0340	0.0371	0.0414	0.0705**	0.0683*
	(0.0266)	(0.0236)	(0.0237)	(0.0278)	(0.0359)	(0.0397)
Lag (liquid assets/t. assets)	-0.231	-0.154	-0.364	-0.561	-0.227	-0.274
	(0.325)	(0.321)	(0.250)	(0.400)	(0.275)	(0.323)
Lag (costs to income ratio)	-0.0400	0.0106	0.0777	-0.0244	0.00515	0.0330
	(0.155)	(0.0735)	(0.0612)	(0.0557)	(0.0527)	(0.0736)
Lag (loan loss reserve/g. loans)	-0.202	0.138	0.123	0.550	-1.336**	-1.966**
	(1.061)	(0.825)	(0.794)	(0.661)	(0.634)	(0.791)
Deposit insurance X EQTA					-1.205**	-1.085
					(0.525)	(0.689)
Deposit insurance X ROA					0.0385*	0.0554
					(0.0227)	(0.0338)
Deposit insurance X LQTA					0.195	0.138
					(0.126)	(0.152)
Deposit insurance X CIR					-0.00628	-0.0325
					(0.0940)	(0.0786)
Deposit insurance X LLRGLOANS					-0.0529	0.233
					(0.330)	(0.295)
Size	81.40**	107.2***	101.1***	46.05*	86.75***	89.22***
	(31.87)	(20.20)	(10.72)	(27.13)	(16.71)	(20.89)
HHI	698.0***	896.8***	1,124***	861.2***	857.2***	1,039***
	(237.3)	(159.7)	(323.8)	(237.3)	(105.9)	(189.0)
Deposit insurance	-18.29	-17.06			4.101	1.765
	(17.75)	(14.45)			(10.51)	(13.09)
GDP per capita	-0.0558*	-0.0630***	-0.0471**	-0.00597	-0.0442***	-0.0670***
	(0.0285)	(0.0165)	(0.0210)	(0.0202)	(0.0107)	(0.0149)
Observations	394	394	327	451	451	451
Number of banks	95	95	82	96	96	96
R-squared	0.340	0.304	0.575	0.440	0.543	0.464
F-Stat	7.46***	9.48***	21.29***	14.46***	14.86***	12.76***
Under identification test (p-value)	0.0092	0.0000	0.0762	0.0000	0.0392	0.0085
Hansen J-test (p-value)	0.456	0.305	0.1677	0.3942	0.9041	0.8823

1. *** $p<0.01$, ** $p<0.05$, * $p<0.1$
2. Robust standard errors in parentheses
3. STATA's user written command xtivreg2 with fixed effect option is used.
4. Excluded instruments: Non-performing loans to gross loans, net loans to customer short term funds and T-bill rate

Bongini *et al.* (2001), Rojas-Suarez (2001) and Sahul Hamid (2012) show that a bank restructuring exercise is a good proxy for the overall quality of a bank in East Asia. Hence, it was used to subdivide the sample of banks in the data set into weak and healthy banks.

Overall, there were 74 banks in the sample that were categorised as healthy while 36 were categorised as weak. A mean comparison test showed a statistical difference in the average interest rate offered by the weak (Restructured) and healthy (Non-restructured) banks. Weak banks offered an interest of 8.33 per cent on average while healthy banks offered 7.10 per cent. Figure 2 shows that weak banks also have lower deposit growth compared to the healthy ones. The latter have an average deposit growth of 21.07 per cent while the former have an average deposit growth of 13.72 per cent. The reduction in deposit growth during crisis time was higher for the weaker banks than the healthy ones

Panel data estimation results for the Restructured and Non-restructured banks are presented in Table 4. By differentiating between different qualities of banks, this study found that depositors preferred healthier banks that were more solvent, profitable and bigger in size. More importantly, the results also show that the healthier banks were not able to raise more deposits by paying higher interest. This suggests that depositors are more interested in the fundamentals of the healthier banks rather than the price. As far as the weaker banks are concerned, the results in columns 3 and 4 show that depositors prefer banks that are more solvent, pay higher interest, are less liquid and are bigger in size. More specifically, the study found the coefficients for the price mechanism to be higher than other variables. This implies that depositors are driven more by the price offered rather than the fundamentals of the banks. The results also show that the coefficient of the interest rate variable is 6.86 while that of the interest rate ex government debt variable is 12.01. These imply that for each percentage increase in interest rate, weaker banks that offer higher interest rate above the risk free rate were able to attract more deposits.

Further analysis was carried out by differentiating the effect of bank fundamentals on deposit growth for the restructured banks compared to the non-restructured ones.
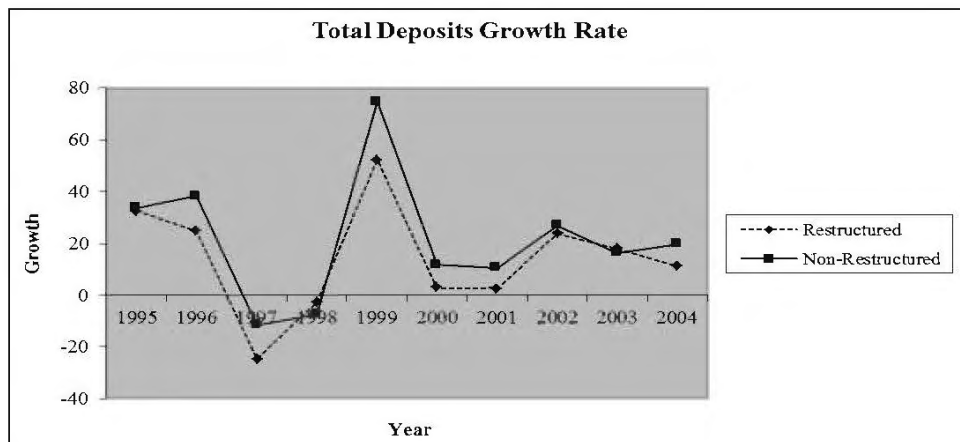

Figure 2. Deposits growth for restructured and non-restructured banks

Table 4. Panel data analysis for non-restructured and restructured banks

Variables	Dependent variable : growth rate of real deposits				
	(1) Non restruc.	(2) Non restruc.	(3) Restructured	(4) Restructured	(5)
Interest rate	-6.868 (11.79)		6.859*** (2.342)		5.368* (2.854)
Interest rate ex gov. debt		-4.184 (3.311)		12.01*** (2.635)	
Lag (total equity/total assets)	2.462* (1.347)	3.072*** (0.895)	4.041*** (1.241)	1.724*** (0.564)	5.867*** (0.825)
Lag (return on equity)	0.0751** (0.0357)	0.0544* (0.0319)	-0.0548 (0.0581)	-0.0333 (0.0473)	0.0658* (0.0387)
Lag (liquid assets/total assets)	-0.162 (0.400)	-0.0991 (0.331)	-1.366** (0.586)	-2.680*** (0.501)	-0.212 (0.265)
Lag (costs to income ratio)	-0.117 (0.156)	-0.0502 (0.105)	0.274* (0.145)	-0.0641 (0.109)	0.0215 (0.0536)
Lag (loan loss reserve/gross loans)	-0.405 (1.157)	0.232 (0.878)	-0.607 (0.859)	2.266** (0.953)	-1.234** (0.617)
Restructure X EQTA					-3.641*** (1.253)
Restructure X ROE					0.171*** (0.0585)
Restructure X LQATA					-0.192 (0.525)
Restructure X CIR					0.357* (0.193)
Restructure X LLRGLOANS					1.419 (0.968)
Size	77.12** (31.62)	111.7*** (21.59)	95.34*** (21.66)	19.72 (16.98)	94.69*** (14.63)
HHI	704.3*** (260.8)	897.7*** (175.6)	1,287*** (231.2)	853.8*** (123.0)	839.5*** (113.8)
Deposit insurance	-25.97 (19.93)	-22.95 (16.49)	27.29*** (5.649)	5.400 (4.048)	-6.659 (6.061)
GDP per capita	-0.0707** (0.0325)	-0.0689*** (0.0180)	-0.00188 (0.0110)	-0.00133 (0.0102)	-0.0457*** (0.00921)
Observations	327	327	67	67	451
Number of banks	72	72	23	23	96
R-squared	0.201	0.300	0.799	0.875	0.546
F-Stat	3.56***	7.34***	7.42***	24.47***	17.45***
Under identification test (p-value)	0.0339	0.0000	0.0455	0.0937	0.0004
Hansen J-test (p-value)	0.4553	0.1885	0.6663	0.2547	0.542

1. *** $p<0.01$, ** $p<0.05$, * $p<0.1$
2. Robust standard errors in parentheses
3. STATA's user written command xtivreg2 with Fixed Effect option is used for all estimations.
4. Excluded instruments: Non-performing Loans to Gross Loans, Net Loans to Customer Short Term Funds and T-Bill Rate

The dummy variable for restructured banks was interacted with all bank fundamentals. The results in column 5 of Table 4 show that higher solvency is associated with lower deposit growth for the Restructured banks compared to the Non-Restructured banks. This provides some evidence that depositors discipline weaker banks more stringently. However, the results also show that higher profitability and cost to income ratio are associated with higher deposit growth for the Restructured banks compared to the Non-Restructured banks. This, on the other hand, suggests that depositors did not discipline weaker banks more stringently.

4.4 Banking Sector Reform

In analysing depositor discipline in the East Asian banking system, this study also took into account the cross-country differences in banking sector regulation. Analyses were carried using five dimensions of banking sector reform as highlighted in Abiad *et al.* (2008). The results in Table 5 show that banks are able to attract more deposits by raising prices. Apart from this, the results also confirm that solvent and profitable banks are able to attract higher deposits. Compared to the results shown in column 1 in Table 3, these findings show that depositors are more responsive to price and bank fundamental variables when the cross-country differences in banking sector regulations are taken into account.

4.5 Robustness

In order to test the robustness of the findings, *Z*-score was used as an alternative index of bank riskiness. The *Z*-score measures a bank's distance from default. It is measured as the sum of the bank's return on assets and equity ratio, divided by the standard deviation of the return on assets. A higher score indicates higher banking stability (lower riskiness). Analysis was carried out to find the differentiated effect of bank fundamentals on deposit growth for different levels of bank stability. The results in Table 6 show that higher solvency is associated with higher deposit growth for the more stable banks. However, lower profitability is associated with higher deposit growth for the more stable banks. In addition, lower cost to income ratio and loan loss provision to gross loans were also associated with higher deposit growth for the more stable banks. Overall, these findings confirm that lower risk profiles are linked to higher deposit growth for banks that are more stable (less risky) compared those that are less stable (risky).

5. Conclusions

This paper analyses depositor discipline in the East Asia banking system. Overall, the empirical findings indicate that depositors behave in a manner that is consistent with depositor discipline. The results suggest higher-quality banks are capable of attracting higher deposit growth. Instrumental variable estimation was used to account for the endogenous relationship between price and quantity of deposits. Initial estimation without the price variable shoed that deposit growth is influenced by equity ratio and size of the banks. In the subsequent analysis, any price effect was controlled for by including the interest rate variables as additional variables in the model. When the endogeneity between the price and quantity of deposits was taken into account, the results showed that deposits growth in the sample banks was driven by bank fundamentals and risk

aversion activities but not by price movements. Lack of responsiveness by depositors to price signal during the whole sample period can be attributable to the large outflow of funds from the banking system that occurred as a result of the 1997 crisis. When

Table 5. Panel data analysis with banking sector regulation variables

Variables	Dependent variable: Growth rate of real Deposits				
	(1)	(2)	(3)	(4)	(5)
Interest rate	4.399**	4.484**	4.222**	7.062	5.512**
	(2.037)	(2.025)	(1.973)	(12.34)	(2.387)
Lag (total equity/total assets)	2.835***	2.899***	3.023***	2.819***	2.601***
	(0.713)	(0.713)	(0.684)	(0.740)	(0.662)
Lag (return on equity)	0.0665***	0.0638***	0.0682***	0.0682***	0.0744***
	(0.0240)	(0.0229)	(0.0225)	(0.0254)	(0.0252)
Lag (liquid assets/total assets)	-0.107	-0.0377	-0.122	-0.110	-0.00485
	(0.275)	(0.286)	(0.287)	(0.303)	(0.279)
Lag (costs to income ratio)	0.0769	0.0911*	0.0811*	0.0768	0.0263
	(0.0484)	(0.0498)	(0.0467)	(0.0508)	(0.0507)
Lag (loan loss reserve/gross loans)	-0.623	-0.571	-0.847	-0.716	-0.820
	(0.610)	(0.606)	(0.596)	(0.642)	(0.607)
Size	94.71***	97.57***	90.56***	97.76***	76.68***
	(13.37)	(14.91)	(14.29)	(31.60)	(10.65)
HHI	852.5***	864.5***	970.7***	767.1**	955.0***
	(110.0)	(104.7)	(100.6)	(304.6)	(117.2)
Deposit insurance	-5.972	-14.55	3.845	-29.13	-13.95**
	(5.984)	(10.09)	(3.944)	(84.08)	(6.762)
GDP per capita	-0.0450***	-0.0452***	-0.0467***	-0.0403**	-0.0483***
	(0.00894)	(0.0103)	(0.00844)	(0.0205)	(0.00876)
Credit control	30.88**				
	(13.04)				
Interest rate control		-22.06			
		(13.86)			
Entry barrier			-126.4***		
			(48.93)		
Supervision				51.96	
				(181.7)	
Privatisation					38.89***
					(13.25)
Observations	464	464	464	464	464
R-squared	0.46	0.469	0.529	0.428	0.503
Number of banks	99	99	99	99	99
F-stat	18.10***	15.85***	16.50***	13.48***	16.00***
Under identification test (p-value)	0.0001	0.0001	0.0000	0.3097	0.0002
Hansen J-test (p-value)	0.8826	0.8604	0.434	0.8951	0.5354

1. *** $p<0.01$, ** $p<0.05$, * $p<0.1$
2. Robust standard errors in parentheses
3. STATA's user written command xtivreg2 with Fixed Effect option is used for all estimations.
4. Excluded instruments: Non-performing loans to gross loans, net loans to customer short term funds and T-bill rate

Table 6. Panel data analysis with Z-score (distant to default) variable

Variables	Growth rate of real deposits	
	(1)	(2)
Interest rate	4.528*	
	(2.387)	
Interest rate ex gov. debt		-7.354**
		(3.506)
Lag (total equity/total assets)	1.926	3.242**
	(1.278)	(1.417)
Lag (return on equity)	0.144***	0.157***
	(0.0446)	(0.0564)
Lag (liquid assets/total assets)	-0.536	-0.474
	(0.435)	(0.471)
Lag (costs to income ratio)	0.0389	0.0665
	(0.0450)	(0.0560)
Lag (loan loss reserve/gross loans)	-0.863	-0.399
	(0.876)	(1.007)
Z-Score X L.EQTA	0.110**	0.0656
	(0.0457)	(0.0507)
Z-Score X L.ROA	-0.0434**	-0.0532**
	(0.0198)	(0.0241)
Z-Score X L.LQTA	0.0167	0.0120
	(0.0139)	(0.0157)
Z-Score X L.CIR	-0.0174*	-0.0323***
	(0.00905)	(0.0102)
Z-Score X L.LLRGLOANS	-0.00961	-0.0830*
	(0.0374)	(0.0452)
Z-Score	-1.086	1.550
	(1.005)	(1.654)
Size	100.7***	109.9***
	(14.94)	(19.23)
HHI	827.1***	1,110***
	(112.4)	(193.3)
Deposit insurance	-8.646	-10.78
	(6.318)	(7.087)
GDP per capita	-0.0503***	-0.0752***
	(0.00859)	(0.0134)
Observations	457	457
Number of banks	97	97
R-squared	0.513	0.383
F-Stat	13.17***	9.4***
Under identification test (p-value)	0.001	0
Hansen J-test (p-value)	0.449	0.859

1. *** $p<0.01$, ** $p<0.05$, * $p<0.1$
2. Robust standard errors in parentheses
3. STATA's user written command xtivreg2 with fixed effect option is used for all estimations.
4. Excluded instruments: non-performing loans to gross loans, net loans to customer short term funds and T-bill rate

the movement in the supply curve of deposits outweighs the movement in the demand curve, banks action of raising price to attract more deposit will have minimal effect on depositors.[22]

Similar to what happened in Chile, Argentina and Mexico during the 1980s and 1990s (Martinez-Peria and Schmukler, 2001), depositors in East Asia were more responsive to bank fundamentals and price after the crisis period. The occurrence of the crisis and the large number of bank failures that occurred as a result of it may have served as a wake-up call for depositors. The findings of this study also confirm the weakening effect of the depositor protection scheme.

However, the findings of this study shows that healthier banks are not able attract more deposits by raising interest rates, while weaker ones are able to do so. Depositors in East Asia also did not discipline weaker banks by demanding higher premiums.

Overall, the findings of this study show that even though depositors in East Asia preferred banks that are fundamentally stronger, they did not use price as a mechanism to discipline weaker banks. This could be due to the existence of implicit and explicit government guarantees to banks that arise as a result of state industrial policy, political connectedness and 'too big to fail' policy as suggested by Chang (2000). Depositors' inability to discipline weaker banks and the weakening effect of depositor protection schemes could also be due to the lack of information disclosure. The World Bank (1998) report identifies 'unreliable financial reporting, lack of adequate disclosure, lax enforcement to ensure compliance, and poor audits' (p.67) as among the weaknesses that existed in the East Asian banking system.

The current study has several policy implications. Firstly, the findings suggest that measures need to be taken to enhance risk-related information disclosure. The bank regulatory authority needs to ensure that the disclosed risk-related information by banks is accurate and it is readily available to the general public. Further to this, regulators could also rate banks according to their quality. This will facilitate depositors in making their investment decisions.

This research can be extended by analysing the extent of depositor discipline that is present in the East Asian banking sytem during the recent global financial crisis and comparing them with these results. Futher analysis can also be performed by examining other determinats of depositor discipline.

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[22] Indonesia, Malaysia and Thailand introduced deposits insurance scheme after the occurrence of the 1997 crisis.

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