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The effect of systemic risk on depositor discipline: evidence from Thailand before the 1997 financial crisis

Abstract

This paper tests the effect of systemic risk on deposit market discipline by interacting systemic risk variables with bank-specific risk variables. Discipline is measured by estimating a supply of deposit funds function at Thai banks from 1992 to 1997. The results show that supply decreases as bank-specific risk increases. Also, the sensitivity of funds to changes in bank-specific risk increases as systemic risk rises. Additionally, depositors decrease their sensitivity to deposit rates, decreasing the ability of banks to offset deposit drains by raising rates. Although banking system risk increases, discipline decreases the share of deposits at the riskiest banks.

Keywords: market discipline, market monitoring, systemic risk, banking and currency crises.
JEL Classifications: E53, E44, G28, G21.

Introduction

Economists often promote the ability of market discipline to mitigate banking system risk. However, as systemic risk rises it can affect the degree of market discipline. Exploring effects of systemic risk on discipline is important to financial stability. As systemic risk rises, one would hope that discipline is maintained. However, there is no evidence on whether discipline changes under this environment. Despite the likelihood of a connection between systemic risk and discipline, systemic risk is usually treated as a control variable in the literature. The present study tests the effect of increasing systemic risk on market discipline at Thai banks before the 1997 currency crisis[1].

This paper emphasizes the risk of withdrawal of short-term deposits from the banking system. The focus on this type of risk follows from the financial crisis literature, which argues that systemic risk arising from heavy short-term borrowing contributed to the financial and currency crises in Latin America and East Asia (Bernard and Bisignano, 2000). Although this borrowing differed among countries in these regions, Thailand is often cited as an example. Thus, this paper's focus on Thai banks is appropriate.

The effect of the withdrawal of short-term funds on any particular bank depends not only on its exposure to those funds, but on its overall condition. Thus, as systemic risk increases depositors have incentives to monitor banks more in an attempt to sort out the effect of this risk on individual banks. Discipline in this environment can take two forms, depending on how systemic risk rises or whether it reaches some critical level. First, depositors might attempt to use bank-specific risk measures to discipline banks more intensely. Second, to gauge bank-specific condition as systemic risk rises, depositors might require more accurate and timelier information. This can lead depositors to increase monitoring of ratios with the highest information content under a high risk environment (Levy-Yeyati, Peria and Schmukler, 2010).

This paper tests the hypothesis that systemic risk affects market discipline using data on the Thai banking system in the pre-crisis period from 1992Q4 to 1997Q2[2]. This paper measures discipline by estimating a supply function for deposit funds. Unlike other discipline studies, estimating a supply function allows a test of the consistency of the results with theoretical models of a deposit market (Park and Peristiani, 1998)[3].

The next section introduces four measures of systemic risk for Thailand. Section 2 presents the econometric model of deposit funds supply, the data and the results. The last section concludes the paper.

1. Systemic risk of withdrawal of short-term funds in Thailand

The adverse effect of short-term funds withdrawal can be measured through the product of exposure to short-term borrowing and the probability of these funds being withdrawn. Exposure can be measured as short-term interbank deposits at each bank. Exposure increased from 4.5% of banking system liabilities in 1992 to 20% in 1997 at 15 Thai banks. To test

[1] Discipline has been traditionally defined as risk pricing of banks by liability holders. Recently discipline has included the quantity responses of the market to bank-specific measures of default risk. At least one of these two concepts of discipline is imbedded into almost every market discipline study (e.g., see Flannery and Nikolova (2004) for reviews of the literature).

[2] While it might be interesting to examine the post-crisis period to see how depositors sorted out bank risk as banks continued to deteriorate, the government gave full guarantees to all banks and some banks were taken over by the government. Consequently, the measurement of discipline would be complicated. See Peria and Schmukler (2001) for a pre-crisis and post-crisis comparison of discipline in three Latin American countries.

[3] Park and Peristiani (1998) argue that risk pricing reflects depositor monitoring responses if information on bank condition is transparent, accurate and timely. If information is not transparent and depositors do not all have equal access to the same information on bank-specific risk, deposit quantities may also reflect default risk. A positive-sloped supply of deposit funds results from this dispersion of information.

the hypothesis that rising systemic risk affected discipline, we interact our four measures of probability of default with bank-specific measures of default risk, including exposure. The first measure of probability of default is a time dummy variable for the last year before the crisis (*DUMYR*). The second indicator is the implicit rate on short-term borrowing for the banking system ($IMPLBORRT_{t\text{-}1}$)[1]. The third indicator is the index of Thai bank stock prices ($SETBANK_t$)[2] Finally, we use the 6-month Thai baht forward rate ($THBFOR_t$) as a fourth indicator of the systemic risk of withdrawal.

2. Empirical model, data and results

2.1. Empirical model. This paper tests whether systemic risk affects depositor discipline. We interact the above-mentioned proxies of systemic risk with indicators of bank-specific default risk. We use a market supply and demand framework specified as follows:

$$(DEPGR_{it})^{supply} = \beta_1 (DEPRATE_{it}) + \gamma_1 (BANK\text{-}SPECIFIC\ RISK_{it\text{-}1}) + \delta_1 (CONTROL_{it\text{-}1,\, i,\, t}) +$$
$$+\beta_2 [(DEPRATE_{it}) \times (SYSTRISK_t)] + \gamma_2 [(BANK\text{-}SPECIFIC\ RISK_{it\text{-}1}) \times (SYSTRISK_t)] +$$
$$+\delta_2 [(CONTROL_{it\text{-}1}) \times (SYSTRISK_t)] + \varepsilon_{it}, \qquad (1)$$

where the four-quarter real growth of deposits ($DEPGR_{it}$) is a function of the rate on deposits of 6-month maturity ($DEPRATE_{it}$) for the i^{th} bank. Deposit growth is also a function of a vector of bank-specific default risk indicators ($BANK\text{-}SPECIFIC\ RISK_{it\text{-}1}$) that are lagged one period to mitigate endogeneity problems. This vector includes a measure of general bank risk (return on equity ($ROE_{it\text{-}1}$)), three measures of asset risk (loan-to-asset ratio ($LNAS_{it\text{-}1}$), foreclosure-to-asset ratio ($FORCLSAS_{it\text{-}1}$), and cash-to-asset ratio ($CAS_{it\text{-}1}$)) and a measure of leverage (a bank's computed franchise value ($FRANK_{it\text{-}1}$)). This vector also includes a measure of bank-specific exposure to short-term funds (the ratio of foreign interbank borrowing-to-liabilities ($EXPOS_{it\text{-}1}$)). We employ a vector of firm-specific and time-specific control variables ($CONTROL_{it\text{-}1,i,t}$). The control variables include the logarithm of real assets ($LOGAS_{it\text{-}1}$), firm-fixed effects dummy variables ($DUMFF_i$) and time fixed-effects dummy variables ($DUMTIME_t$)[3].

To test the hypothesis that discipline changes with changes in systemic risk, the above-mentioned bank-specific measures are interacted with each of the four measures of systemic risk ($SYSTRISK_t$). Since each of these four measures are a proxy for the systemic risk of short-term funds withdrawal, only one measure at a time is included in each of four regression equations. These measures consist of a time-dummy variable for the last year before the crisis (*DUMYR*), the implicit borrowing rate for short-term foreign funds ($IMPLBORRT_{t\text{-}1}$), the stock price index of Thai commercial banks ($SETBANK_t$), and the 6-month forward rate on the Thai baht ($THBFOR_t$)[4].

The deposit supply function is estimated using the two-stage least squares (TSLS) technique. Since all 15 of the Thai banks included in the sample are engaged in a similar business, they are more than likely affected by common shocks. Although several bank-specific and systemic variables are included, it is reasonable to assume that these banks form a set of imperfectly-pooled seemingly unrelated (SUR) regressions. Using the SUR technique should mitigate omitted variable bias and provide more efficient estimates. A test of the correlation matrix of residuals formed from the least squares regressions shows that the assumption of zero contemporaneous cross-correlations among the residuals can be rejected at the 1% level. Consequently, we use cross-section SUR weights in each stage of a TSLS process to estimate the supply of deposit funds.

DEPGR and *DEPRATE* are assumed to be endogenous. All other variables are assumed to be exogenous. Three exogenous bank-specific deposit demand shifters are included. The deviation of a bank's quoted prime loan rate from the industry average ($MLRDEV_{it}$) is a proxy for the bank's loan opportunities. An increase in this rate should increase the demand for deposits. The ratio of non-interest expenses to total assets ($NIEXPAS_{it}$) is a proxy for operating costs of the bank per baht of assets. An increase in this cost decreases the demand for deposits. The share of liabilities that a bank has in deposits ($DEPLIAB_{it}$) is an indicator of a bank's dependence on deposits for funding assets. An increase in this variable should increase the demand for deposits in the current period. Since all three demand shifters are known by banks in the current period, but revealed to the public only in the subsequent period, there is little likelihood that they affect

[1] This is calculated as banking system interest expenses on short-term funds divided by the average value of short-term borrowing in the banking system.

[2] This index is a weighted average of the market capitalization of Thai banks.

[3] The time-fixed effects play an important role. If there are shifts in deposit funds between institutions, time-fixed effects should control for this shift. Thus, even if deposits are not fleeing the banking system as systemic risk increases, estimates of equation (1) should still measure discipline among banks.

[4] The reciprocal of SETBANK is used in regression equation (1).

deposit supply. These three demand shifters are used along with all other exogenous variables as instruments in the first stage of the TSLS/SUR regressions.

2.2. Data. This paper employs a quarterly panel from 1992Q4 to 1997Q2 that includes 15 Thai commercial banks. Real quantities are computed using the CPI for all items. Balance sheet and income statement data for Thai banks and the market capitalization of each bank was used to compute the franchise value and market capital leverage ratio, and were obtained from the Stock Exchange of Thailand. Deposit rates on 6-month savings at commercial banks were obtained from the Bank of Thailand. The Thai bank stock index and the baht/USD 6-month forward rate were obtained from Bloomberg.

2.3. Results. *2.3.1. Systemic risk model: interacting systemic risk with bank risk measures.* Tables 1-4 report the results of the four estimated deposit funds upply functions, where each regression interacts oneof the four measures of systemic risk with bank-specific risk variables. Initially, we focus on the total monitoring response by depositors for evidence of discipline when systemic risk is included in the regressions. The coefficients showing this total effect appear in the last column of Tables 1-4 and are of the correct sign and significant for almost every bank-specific default risk variable. The hypothesis test of whether the bank-specific risk variables are jointly equal to zero, appears at the bottom of each table and is rejected for each of the four regressions. This is evidence of discipline.

Table 1. Supply of deposit funds estimation (TSLS/SUR), dependent variable = *DEPGR*1 *DUMYR* is interacted with bank-specific variables (*DUMYR* = 1 for period 1996Q3-1997Q2 and = 0 otherwise)

Independent variable[a]	Coefficient / (t-statistic) 1st period effect 1993Q1-1996Q2	Coefficient / (t-statistic) Interaction *w* / *DUMYR*	Coefficient / (Chi-square statistic) Total effect
Bank-specific risk variables			
FRANK (t - 1)	63.960* (1.758)	107.749** (2.192)	171.709*** (17.301)
CAS (t - 1)	365.940*** (5.727)	150.218* (1.731)	516.158*** (7.281)
ROE (t - 1)	55.578*** (2.855)	-28.274 (-1.170)	27.304** (4.898)
FORCLSAS (T - 1)	-1586.583*** (-5.351)	1566.881** (2.194)	-19.702 (0.000815)
EXPOS (t - 1)	-134.851*** (-4.518)	-25.677 (-0.565)	-160.528*** (12.894)
LNAS (t - 1)	103.115 (1.150)	-26.666 (-0.220)	76.449 (0.445)
Control variables			
LOGAS (t - 1)	57.964** (2.418)	-1.341 (-0.294)	56.622** (4.316)
Slope of deposit supply			
DEPRATE (t)	28.393** (2.308)	-23.742** (-2.247)	4.651 (0.898)
Hypothesis test[b]			
Null hypothesis: Bank-specific risk variables = 0	(283.788)***	(12.051)*	(66.799)***

Table 2. Supply of deposit funds estimation (*TSLS/SUR*), dependent variable = *DEPGR*1 ($IMPLBORRT_{t-1}$ is interacted with bank-specific variables)

Independent variable[a]	Coefficient / (t-statistic) Own effect	Coefficient / (t-statistic) Interaction *w* / *IMPLBORRT*	Coefficient / (Chi-square statistic) Total effect
Bank-specific risk variables			
FRANK (t - 1)	-111.817*** (-2.808)	74.057*** (5.146)	62.538*** (15.976)
CAS (t - 1)	368.829*** (2.811)	-9.767 (-0.203)	345.835*** (55.447)
ROE (t - 1)	27.585 (0.811)	3.470 (0.248)	35.755*** (22.441)
FORCLSAS (t - 1)	970.983 (1.486)	-782.477*** (-2.927)	-871.245*** (13.960)
EXPOS (t - 1)	-135.239*** (-7.380)	-7.076* (-1.920)	-151.898*** (88.371)
LNAS (t - 1)	130.054 (1.507)	-25.450 (-0.755)	70.136** (5.546)

Table 2 (cont.). Supply of deposit funds estimation (TSLS/SUR), dependent variable = *DEPGR*1 (*IMPLBORRT*$_{t-1}$ is interacted with bank-specific variables)

Independent variable[a]	Coefficient / (*t*-statistic) Own effect	Coefficient / (*t*-statistic) Interaction *w* / *IMPLBORRT*	Coefficient / (Chi-square statistic) Total effect
Control variables			
LOGAS (*t* - 1)	51.643*** (7.079)	-4.112*** (-3.443)	41.960*** (25.071)
Slope of deposit supply			
DEPRATE (*t*)	27.592*** (3.148)	-7.192*** (-3.248)	10.660** (5.357)
Hypothesis test [B]			
Null hypothesis: bank-specific risk variables = 0	-	(56.276)***	(316.315)***

Table 3. Supply of deposit funds estimation (TSLS/SUR), dependent variable = *DEPGR*1 (*SETBANK* $_t$ is interacted with bank-specific variables)

Independent variable[a]	Coefficient / (*t*-statistic) Own effect	Coefficient /(*t*-statistic) Interaction *w* / SETBANK	Coefficient / (Chi-square statistic) total effect
Bank-specific risk variables			
FRANK (*t* - 1)	-136.460*** (-4.051)	187.329*** (5.015)	33.382** (5.361)
CAS (*t* - 1)	-1322.822*** (-11.211)	1970.688*** (14.657)	463.903*** (157.122)
ROE (*t* - 1)	139.799*** (4.990)	-99.166*** (-3.863)	49.890*** (50.482)
FORCLSAS (*t* - 1)	-4205.571*** (-5.577)	3043.040*** (4.230)	-1446.600*** (54.114)
EXPOS (*t* - 1)	-190.263*** (-14.597)	31.686*** (3.251)	-161.535*** (158.304)
LNAS (*t* - 1)	0.239 (0.00363)	25.495 (0.403)	23.353 (0.858)
Control variables			
LOGAS (*t* - 1)	38.092*** (4.254)	-3.841* (-1.826)	34.610*** (15.035)
Slope of deposit supply			
DEPRATE (*t*)	36.112*** (7.272)	-18.791** (-6.992)	19.075*** (36.027)
Hypothesis test [b]			
Null hypothesis: bank-specific risk variables = 0	-	(295.284)***	(569.019)***

Next, we turn to the effect of increasing systemic risk on depositor discipline, which is the main focus of this paper. This effect is measured by observing the coefficients associated with the interaction of our proxies for systemic risk with each bank-specific measure of risk. This marginal effect is reported in the second column of each of Tables 1-4. An increase in systemic risk strengthens the direct relationship between deposit growth and, both the franchise value (FRANK) and the cash-to-asset (CAS) ratios, as indicated by the positive and significant coefficients in each of the four regressions for the proxy for capital and three of the four regressions for the cash ratio. This result is consistent with the often cited expectation that depositors flee to banks with the highest capital and liquidity as systemic risk rises (see e.g., Nier and Baumann, 2003).

Increases in systemic risk weaken the relationship between deposit growth and both foreclosures to assets (FORCLSAS) and the return on equity (ROE). This result is apparent by the positive and significant coefficients on the interaction term of FORCLSAS in two of the four equations, and a negative coefficient for ROE in two of the regressions. It is intuitive that the monitoring of these ratios decreases given that they contain dated information, which probably lacks relevance in an environment of rapidly increasing systemic risk. This result is consistent with other discipline studies (Levy, Peria and Schmukler 2010).This result should not be viewed as a shift in depositor emphasis from variables that have little information content under rising systemic risk to variables that do. In the case of this study, depositors are shifting away from FORCLSAS and ROE and, towards CAS and FRANK. The remaining two bank-specific risk variables (EXPOS and LNAS) show no definite pattern of change as systemic risk rises.

Conclusion

This paper tests the hypothesis that systemic risk affected deposit market discipline at Thai banks in the pre-crisis period from 1992 to 1997. We choose measures of systemic risk that proxy for the probability of the withdrawal of short-term foreign funds from the banking system. In this paper we estimate the effect of systemic risk on discipline by interacting these measures of systemic risk with bank-specific default risk variables. Additionally, market discipline is measured in the context of estimating a function for the supply of deposit funds. This latter approach allows a test of the consistency of the results with theoretical models of a deposit market and facilitates testing the effect of systemic risk on discipline.

The results of this paper show that market discipline existed at banks in pre-crisis Thailand. That is, the supply of deposit funds decreased at the riskiest banks. There is also strong evidence that increases in systemic risk increased the rate at which depositors-pulled funds from the riskiest banks. In particular, as systemic risk increased, depositors moved their funds to banks that had higher net worth and were moreliquid than other banks. Additionally, depositors placed less emphasis on profitability and measures of asset quality – dated measures that often convey little information about bank condition as systemic risk rises. There is no evidence that depositors fled to large banks, which questions the conventional wisdom that depositors perceived increasing government guarantees as the crisis approached. Finally, the sensitivity of deposit growth to deposit rates was positive, but decreased as systemic risk increased. This is a further sign that depositors forced banks to pay higher premia for bank efforts to maintain deposits in the face of deteriorating fundamentals.

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Appendix

Table 4. Supply of deposit funds estimation (TSLS/SUR), dependent variable = $DEPGR_1$ ($THBFOR_t$ is interacted with bank-specific variables)

Independent variable[a]	Coefficient / (*t*-statistic) Own effect	Coefficient / (*t*-statistic) Interaction *w* / THBFOR	Coefficient / (Chi-square statistic) Total effect
Bank-specific risk variables			
FRANK (*t* - 1)	-1515.977** (-2.279)	61.144** (2.371)	63.846*** (28.258)
CAS (*t* - 1)	-4428.854 (-1.456)	184.095* (1.755)	327.710*** (62.895)
ROE (*t* - 1)	1171.797** (2.202)	-43.150** (-2.135)	56.900*** (23.295)
FORCLSAS (*t* - 1)	-21481.130*** (-2.839)	778.623* (1.846)	-1120.126*** (30.293)
EXPOS (*t* - 1)	-337.046** (-2.340)	7.040 (1.272)	-155.151*** (120.870)

Table 4 (cont.). Supply of deposit funds estimation (TSLS/SUR), dependent variable = $DEPGR_1$ ($THBFOR_t$ is interacted with bank-specific variables)

Independent variable[a]	Coefficient / (*t*-statistic) Own effect	Coefficient / (*t*-statistic) Interaction *w* / THBFOR	Coefficient / (Chi-square statistic) Total effect
LNAS (*t* - 1)	2423.655** (2.251)	-93.076** (-2.218)	18.796 (0.547)
Control variables			
LOGAS (*t* - 1)	-6.751 (-0.221)	2.523** (2.127)	58.426*** (15.035)
Slope of deposit supply			
DEPRATE (*t*)	95.410** (2.382)	-3.158** (-2.117)	13.816*** (51.398)
Hypothesis test[b]			
Null hypothesis: bank-specific risk variables = 0	-	(67.635)***	(493.938)***

Note: [a] *t*-statistics are in parentheses in columns 2 and 3. Chi-squared statistics are in parenthesis in column 4. * Significant at 10% level, ** significant at 5% level and *** significant at 1% level. Coefficient estimates on the firm and time-fixed effects regressors are not included in the above table, but are available on request. [b] Chi-squared statistics are in parentheses.