

The effect of deposit insurance on banks' risk taking*

Iljoong Kim^{}, Inbae Kim^{***}, and Yoonseon Han^{****}**

<ABSTRACT>

This paper analyzes the effect of ‘deposit insurance (DI)’ on banks’ risk-taking for the ASEAN countries and Korea. Previous studies focused primarily on developed countries or used mixed samples. The utilization of a panel dataset consisting of 406 banks across our sample countries reveals that banks engaged more actively in risk-taking in the presence of DI, that the adverse impact of DI was aggravated with extensive coverage, and that DI-related moral hazard was curbed through better regulatory quality. Particularly, risk-taking was relatively higher in Korea, but no difference was detected in the stabilizing effect of the regulatory quality. Relevant policy implications are offered.

JEL Classification: G21

Key Words: deposit insurance, moral hazard, risk-taking, regulatory quality

*. This version is prepared for the presentation at the 2014 conference of Korea Money & Finance Association, Daegu.

**. Professor of Economics, SungKyunKwan University (SKKU), Seoul, Korea.
ijkim@skku.edu

***. (corresponding author) Professor of Economics, Ewha Womans University, Seoul, Korea. ibkim@ewha.ac.kr

****. Ph.D student of Economics, University of Oregon, Eugene, USA.
Yoonseon87@naver.com

I. Introduction

According to the classic work by Friedman and Schwartz (1963), the adoption of federal deposit insurance in 1934 in the U.S. was a prominent decision. By eliminating, at the outset, the loss of confidence by the public in convertibility of deposits into currency, it removed the threat of banking panic that the Federal Reserve Bank had failed to prevent. Depositors know that their funds will be protected even in the face of a bank failure, so bank runs become unnecessary.

However, deposit insurance is not without blemish. The existence of a deposit insurance system deprives depositors of incentives to monitor banks and encourages them to take on excessive risk. This gives rise to the moral hazard problem of deposit insurance (Hutchison and McDill, 1999; Barth et al., 2004). In fact, the savings and loan crises of the 1980s in the U.S. which resulted in numerous bank failures are viewed by many to have occurred due to excessive risk-taking of banks in the presence of deposit insurance (Kane, 1989; McKenzie et al., 1992). In short, despite the meritorious functions of deposit insurance, this moral hazard problem may threaten the stability of the banking system.

Empirical studies offer diverse results in this regard. For example, Eichengreen and Arteta (2002) and Gropp and Vesala (2004) showed that the introduction of deposit insurance decreases the likelihood of a banking crisis. In contrast, Hutchison and McDill (1999), Demirgüç-Kunt and Detragiache (2002), and Barth et al. (2004) found the opposite. They attributed it to banks' moral hazard. Other researches including Hoggarth et al. (2005) and Angkinand et al. (2007), however, revealed that the relationship between deposit insurance and banking crisis is ambiguous or sensitively changes depending on model specifications, data periods, or definitions of the banking crisis.

This paper adds to the literature by focusing on the experiences of the ten ASEAN member countries and Korea. Specifically, we study the following. First, we examine whether the existence of deposit insurance itself changes an individual bank's behavior

in risk-taking, which might be a possible cause of the financial stability. Many of the previous studies focus directly on whether deposit insurance affects the likelihood of a banking crisis. However, as noted by Klomp and de Haan (2009), there are several drawbacks¹ in using banking crisis as an indicator of financial instability. Second, if banks show such moral hazard, its intensity is expected to increase with the deposit insurance's coverage. We investigate this as an elaboration of testing the bank's moral hazard incentive. Third, we study whether this effect can be curbed by the quality of the regulatory environment. Demirgüç-Kunt and Detragiache (2002) claimed that effective prudential regulation and supervision can reduce a bank's moral hazard.

Previously, the research focus was mainly on developed countries such as the US, EU, and OECD, or a heterogeneous sample including both developed and developing countries.² However, this paper, for the first time, investigates the banks in the ten ASEAN members consisting mostly of developing countries. This exclusive focus on ASEAN countries, as well as the elaborate compilation of dispersed data regarding deposit insurance in these countries, differentiates this paper from previous studies. Furthermore, Korea is subsequently added to the model specification estimated from a rich dataset, the motivation of which mainly stems from the country's distinct and somewhat self-conflicting backgrounds. First, Korea is known to have undergone extensive regulatory reforms for the financial sector since the financial crisis of 1997. Second, many banks in the country have been subject to government-led restructuring since 1996, when deposit insurance was first introduced. Third, among the major

¹ For example, crises are identified only when they are severe enough to trigger market events, whereas crises that are successfully contained by prompt and corrective policies are neglected. Also the identification of the exact timing of crises is rather subjective depending on the researchers.

² Wheelock (1992), Karels and McClatchey (1999), and DeLong and Saunders (2011), for example, examined banks in the entire U.S. or a particular state. Banks in EU member countries were studied by Gropp and Vesala (2004), while those in OECD member countries were examined in Wee, Kim, and Rhee (2007). Demirgüç-Kunt and Detragiache (2002) used a heterogeneous sample of 61 countries worldwide.

economies in Asia that underwent extensive regulatory reform in the 1990s, Korea nonetheless is the only non-ASEAN member country to be severely hit in the wake of the financial crisis in the late 2000s.³ Therefore, it would be interesting to determine whether any systematic differences exist in the degree of moral hazard in association with deposit insurance and in the effects of the quality of regulation and supervision.

This paper is organized as follows: Section II briefly reviews the theoretical and empirical literature related to the effect of deposit insurance. Section III overviews the econometric model and the data. The estimation results are presented in Section IV, followed by conclusions in Section V.

II. The Literature

The benefit of deposit insurance is quite controversial among economists. Diamond and Dybvig (1983) point out that deposit insurance can prevent depositors' self-fulfilling bank runs. However, as is the case for any type of insurance, it is also a source of moral hazard. Merton (1977) views deposit insurance as a put option and theoretically attempts to evaluate the cost of deposit insurance imposed upon the Federal Deposit Insurance Corporation (FDIC).⁴ Keeley (1990) shows that, in a fixed-rate deposit insurance system, banks have incentives to reduce capital and to increase asset risk in an attempt to raise their put value of deposit insurance. Pennacchi (2006) also demonstrates that actuarially fair insurance premiums, even though they are correct assessments for insuring independent risks, encourage banks to amass a systematically risky asset portfolio, which increases the variability of insured loss.

Empirical studies have been undertaken to examine the disputed effect of deposit insurance on banks' behavior. Wheelock (1992) investigates banks in Kansas, where membership in the deposit insurance system was voluntary, and finds that insured banks

³ Refer to the speech by the Fed Chairman Ben S. Bernanke at the Federal Reserve Bank of San Francisco conference on Asia and the Global financial Crisis (Santa Barbara, California, Oct. 19, 2009).

⁴ See Duffie et al. (2003) or Falkenheim and Pennacchi (2003) for discussions on setting fair deposit insurance premiums using an option pricing approach.

engaged more actively in risk-taking and were more prone to bank failures in the 1920s. Demirgüç-Kunt and Detragiache (2002) find evidence that the presence of deposit insurance increases the probability of a banking crisis. The probability rises when the coverage of the deposit insurance system is more extensive. DeLong and Saunders (2011) analyze 60 financial institutions in the US and find that the adoption of fixed-price deposit insurance in 1933 resulted in an increase in the risk-taking of banks and trusts.

However, not all empirical studies support the proposition that the existence of deposit insurance leads to moral hazard. For example, Karels and McClatchey (1999) conclude that there is no evidence that the credit unions in the U.S. assumed more risk after the introduction of deposit insurance. Gropp and Vesala (2004) even suggest that the adoption of deposit insurance has in fact reduced the risk-taking behavior of banks. This is because all creditors were perceived to be insured through a set of implicit government guarantees prior to the introduction of deposit insurance. However, since the deposit insurance system specified the type of creditors and deposit products covered in the scheme, those with deposits beyond the coverage limit or depositors of uninsured products were now left without the benefit of deposit insurance, giving them incentives to monitor banks. As a result, the authors conclude that the risk-taking of banks decreased.

Besides the presence of deposit insurance itself, the specific design features of the deposit insurance scheme also have an influence on banks' behavior. For example, Wee et al. (2007) examined banks in OECD member countries and found evidence that *ex ante* funding (compared with *ex post* funding) for deposit insurance and also risk-adjusted premiums (compared with fixed-rate deposit premiums) lower the banks' risk-taking. Demirgüç-Kunt and Detragiache (2002) discovered that the probability of a banking crisis increases when the deposit insurance is funded by the government rather than the banks and when it is managed by public officials rather than the private sector.

For the role of regulatory systems, according to Fernandez and Gonzalez (2005) and

Nier and Baumann (2006), if a bank's disclosure or transparency increases, the bank's risk-taking decreases as market discipline strengthens. In this context, the bank's moral hazard can be restrained through effective prudential regulation and supervision of banks. Demirgüç-Kunt and Detragiache (2002) found that, while there is a higher likelihood of banking crisis with deposit insurance of greater coverage, in countries with well-established supervisory and legal systems, such effect noticeably declines.

III. The Econometric Model and the Data

1. The Model

The basic model to be estimated is as follows:

$$Leverage_{jt} = b_0 + b_1 INSURANCE_{it} + b_2 Bankspecific_{jt} + b_3 Countryspecific_{it} + b_4 D_{crisis} + u_j + \varepsilon_{jt} \quad (1).$$

$Leverage_{jt}$ represents the risk-taking of bank j at time t , and $INSURANCE_{it}$ denotes the variables related to the deposit insurance of a country i . $Bankspecific_{jt}$ and $Countryspecific_{it}$ refer to bank-specific control variables for bank j , and the country-specific control variables for country i , respectively. The crisis dummy, D_{crisis} , is used to take the Asian financial crisis of 1997-1998 into consideration. u_j is the bank-specific fixed or random effect (depending on the model selection), and ε_{jt} is the random error of the bank j .

We measure the leverage risk, $Leverage_{jt}$, as $Total\ liabilities_{jt} / Total\ assets_{jt}$.⁵ An increase in the portion of total liabilities out of total assets implies a decrease in the bank's capital to total assets because total assets consist of total liabilities and capital. Since capital serves as a cushion in the face of losses, an increase in the proportion of liabilities (compared with that of capital) implies an increase in the risk-taking of banks.

As for the variables related to the deposit insurance ($INSURANCE_{it}$), the variable of

⁵ See Gropp and Vesala (2004) for other measures of banks' risk-taking such as leverage risk, asset risk, and overall risk.

immediate interest, $Exist_{it}$, is a dummy that takes the value of 1 if there exists deposit insurance (i.e., $Exist_{it} = 1$ if $t \geq \hat{t}_i$, where \hat{t}_i represents the year in which deposit insurance was adopted in the country i), and 0 otherwise. It is expected that the existence of a government safety net would encourage banks to take on higher risk. It thus follows that banks should also engage more actively in risk-taking as the coverage of deposit insurance becomes extended, such as to foreign currency deposits or interbank deposits. In this context, we first categorize banks into three groups. Specifically, we define the corresponding indicator variable based on the insurance system adopted by the country: $CoverF_{it}$ is valued as 0 if no deposit insurance exists, 1 if deposit insurance exists but it does not cover foreign currency deposits, and 2 if foreign currency deposits are also covered. Similarly, we adopt another indicator variable to account for the extent of the insurance coverage. $CoverI_{it}$ is valued as 0 if no deposit insurance exists, 1 if deposit insurance exists but it does not cover interbank deposits, and 2 if the insurance also covers interbank deposits.

$CoverF_{it}$ and $CoverI_{it}$ are an elaboration on the previous categorization of banks by the mere existence of a deposit insurance system, $Exist_{it}$. We intend to further consider the extent of the coverage of deposits by the deposit insurance. These three variables of $INSURANCE_{it}$ (i.e., $Exist_{it}$, $CoverF_{it}$, and $CoverI_{it}$) will be alternatively used to verify the moral hazard behavior of banks.

In order to incorporate factors influencing the risk-taking of banks other than deposit insurance, a number of control variables, bank-specific ($Bankspecific_{jt}$) as well as country-specific ($Countryspecific_{it}$) variables, are used. Three bank-specific control variables are used to account for the difference among banks: the demand deposit share ($Deposit_{jt}$), share of customer loans ($Loan_{jt}$), and size ($Size_{jt}$). First, demand deposits are a relatively inexpensive means of raising funds for banks. As a result, the higher the share of demand deposits in total liabilities, the less incentive banks have to invest in high-risk assets (Gropp and Vesala, 2004). Therefore, the expected sign of the coefficient is negative. Second, making loans is a standard bank business. The share of

customer loans in total assets may thus represent the portion of conventional bank activities *vis-à-vis* non-conventional activities (Gropp and Vesala, 2004). Hence, the higher the share of customer loans, the less risk-taking of banks is expected. Third, the size of banks, measured as the share of the total assets of a bank in the entire banking system, is considered. According to the too-big-to-fail attitude, larger banks would show a higher predisposition towards risk-taking (Houston et al., 2010), which leads to an anticipation of a positive coefficient.

Next, three country-specific control variables are used: real GDP growth rate ($Income_{it}$), inflation ($Inflation_{it}$), and regulatory quality ($Regulation_{it}$). An increase in $Income_{it}$ implies that the economy is in prosperity, making banks invest in more risky assets (Angkinand and Wihlborg, 2010). A higher level of $Inflation_{it}$, as it is casually perceived as an indicator of policy failures of government, would discourage banks from taking risks (Demirgüç-Kunt and Detragiache, 2002). Finally, $Regulation_{it}$ is intended to measure an institutional feature of countries for which we will use ‘Regulatory Quality’ index from the Worldwide Governance Indicators (WGI) in the World Bank Database. It is used as a proxy for the bank prudential regulation and supervision.⁶ The effect of regulatory quality on banks’ risk-taking is, however, worth a more careful explanation. Firstly, most of the countries with high regulatory quality are advanced countries where their financial markets are well-developed. Therefore, banks in these countries can access a wider variety of financial products which may lead to banks’ higher leverage risk. That is, the regulatory quality on its own will also represent the extent of financial development. However, when the regulatory index interacts with the variables of $INSURANCE_{it}$, it will work as a control variable to test whether the effective prudential regulation and supervision can curb the adverse incentive created by

⁶ ‘Regulatory Quality’ captures perceptions concerning the ability of the government to formulate and implement sound policies and regulations that promote private sector development. Demirgüç-Kunt and Detragiache (2002) used similar indices such as the degree to which the rule of law prevails, the quality of contract enforcement, the quality of the bureaucracy, etc., all of which are very highly correlated with our regulatory quality index.

deposit insurance. Then, the coefficient estimates for the interactions are expected to be negative. Lastly, D_{crisis} is anticipated to have a negative sign because banks would become less aggressive in risk-taking during a crisis.

2. The Data

The sample we analyze is the annual panel data for the banks from the ten ASEAN countries and Korea from 1990 to 2011, which is the most recent one available at present. Information on the deposit insurance systems for each country was obtained from various sources. The two main sources were (i) the Bank Regulation and Supervision Survey (BRSS) 2011 (Part 8: depositor (savings) protection schemes) conducted by the World Bank and (ii) the 2011 International Association of Deposit Insurers (IADI) Annual Survey.⁷ The main information of interest was the existence of deposit insurance and the type of deposit products covered including foreign currency and interbank deposits. Information on the year when deposit insurance was adopted was mainly obtained from Demirgüç-Kunt et al. (2005), complemented by other sources such as the 2011 IADI Annual Survey and presentation material produced by a public official for countries not included in Demirgüç-Kunt et al. (2005).

Data for the dependent variables as well as the bank-specific control variables were all derived from the Fitch-IBCA Bankscope database.⁸ The type of banks was restricted to commercial and Islamic banks, and consolidated financial statements were used for banks with consolidated companions.⁹ The number of banks in each country included

⁷ The 2011 BRSS was used when there were inconsistencies between the two sources. In the case of Lao People's Democratic Republic (PDR), the year of establishment was stated in a presentation material produced by the Deputy Managing Director of the Depositors Protection Fund in 2009 (*Overview of Depositors Protection Fund in Lao PDR*), and the other data of interest was obtained from the Bank of the Lao PDR (*Charter of Depositor Protection Fund*, dated December 27th, 1999).

⁸ There is an exception: when we calculate the variable, *Size*, its denominator, which is the total assets in the entire banking system, is proxied by the sum of banks' claims on central bank (IFS code 20) and banks' claims on nonresidents (IFS code 21).

⁹ All data was reported in the company's fiscal year-end format. Bank-related data reported until the last

in our data and the characteristics of deposit insurance along with the year of adoption are presented in <Table 1>.

Lastly, data on macroeconomic variables such as real GDP growth and inflation were obtained from the *International Financial Statistics* (IFS) published by the International Monetary Fund. The missing values in IFS were retrieved from the Key Indicators for Asia and the Pacific 2012 published by the Asian Development Bank. The basic statistics on the key variables are shown in <Table 2> across countries.

<Table 1> Deposit insurance systems of ASEAN countries and Korea

Country	No. of banks	Existence of deposit insurance	Year of adoption	Foreign currency deposits covered	Interbank deposits covered
Brunei	4	Yes	2011	Yes	Yes
Cambodia	18	No	-	-	-
Indonesia	124	Yes	1998	Yes	Yes
Korea	32	Yes	1996	No	No
Lao PDR	6	Yes	2000	Yes	No
Malaysia	65	Yes	1998	Yes	No
Myanmar	6	No	-	-	-
Philippines	45	Yes	1963	Yes	Yes
Singapore	32	Yes	2006	No	No
Thailand	25	Yes	1997	No	No
Vietnam	49	Yes	2000	No	No

day of June was treated as that reported at the end of the previous year, and data reported from the first day of July onwards was treated as that reported at the end of the current year.

<Table 2> Basic statistics on the key variables across countries

		<i>Leverage</i>	<i>Deposit</i>	<i>Loan</i>	<i>Size</i>	<i>Income</i>	<i>Inflation</i>	<i>Regulation</i>	<i>Exist</i>	<i>CoverF</i>	<i>CoverI</i>
Brunei	obs	43	26	43	31	43	43	41	43	43	43
	mean	0.842	0.188	0.622	0.282	0.015	0.008	1.056	0.047	0.093	0.093
	st.dev	0.147	0.301	0.165	0.117	0.023	0.014	0.207	0.213	0.426	0.426
Cambodia	obs	84	68	83	83	84	84	84	84	84	84
	mean	0.691	0.299	0.422	0.126	0.075	0.066	-0.472	0.000	0.000	0.000
	st.dev	0.246	0.240	0.168	0.127	0.038	0.073	0.074	0.000	0.000	0.000
Indonesia	obs	1081	1070	1080	551	1081	1081	874	1081	1081	1081
	mean	0.889	0.166	0.607	0.065	0.045	0.117	-0.286	0.677	1.354	1.354
	st.dev	0.149	0.119	0.264	0.135	0.047	0.121	0.268	0.468	0.936	0.936
Lao PDR	obs	25	18	25	24	25	25	25	25	25	25
	mean	0.899	0.438	0.370	0.482	0.074	0.139	-1.161	0.880	1.760	0.880
	st.dev	0.243	0.247	0.190	0.372	0.014	0.239	0.127	0.332	0.663	0.332
Malaysia	obs	566	536	560	420	567	567	529	567	567	567
	mean	0.896	0.160	0.559	0.149	0.050	0.027	0.548	0.806	1.612	0.806
	st.dev	0.089	0.155	0.201	0.240	0.042	0.014	0.104	0.396	0.792	0.396
Myanmar	obs	40	24	40	24	40	40	35	40	40	40
	mean	0.945	0.277	0.371	0.797	0.099	0.176	-2.116	0.000	0.000	0.000
	st.dev	0.048	0.147	0.196	1.553	0.028	0.124	0.189	0.000	0.000	0.000
Philippines	obs	250	247	248	189	250	250	224	250	250	250
	mean	0.842	0.134	0.465	0.125	0.045	0.058	-0.091	1.000	2.000	2.000
	st.dev	0.124	0.128	0.150	0.154	0.022	0.025	0.182	0.000	0.000	0.000
Korea	obs	152	74	152	152	152	152	102	152	152	152
	mean	0.947	0.187	0.536	0.616	0.055	0.044	0.705	0.671	0.671	0.671
	st.dev	0.028	0.199	0.153	0.576	0.034	0.015	0.228	0.471	0.471	0.471
Singapore	obs	185	144	173	185	185	185	140	185	185	185
	mean	0.801	0.571	0.508	0.181	0.069	0.021	1.955	0.384	0.384	0.384
	st.dev	0.194	0.305	0.200	0.324	0.044	0.017	0.184	0.488	0.488	0.488
Thailand	obs	279	110	278	196	279	279	255	279	279	279
	mean	0.887	0.028	0.736	0.259	0.037	0.032	0.270	0.889	0.889	0.889
	st.dev	0.116	0.023	0.167	0.266	0.043	0.022	0.118	0.315	0.315	0.315
Vietnam	obs	303	234	300	303	303	303	303	303	303	303
	mean	0.840	0.216	0.521	0.211	0.069	0.096	-0.591	0.927	0.927	0.927
	st.dev	0.151	0.199	0.170	0.365	0.012	0.064	0.058	0.260	0.260	0.260

IV. Estimation and the Main Findings

Equation (1) is estimated using the random effects model that allowed the individual bank-specific constant terms to be randomly distributed.¹⁰ The estimation results are presented in <Table 3>. *Eq 1* is the basic model with only the control variables (*Bankspecific*, *Countryspecific* and *D_{crisis}*) included. *Eq 2*, *Eq 3*, and *Eq 4* show the results when the variables related to deposit insurance (i.e., *Exist*, *CoverF*, and *CoverI*) were added, respectively. In *Eq 5*, *Eq 6*, and *Eq 7*, the interaction terms of *Regulation_{it}* with *Exist*, *CoverF*, and *CoverI* are included in *Eq 2*, *Eq 3* and *Eq 4*, respectively, to test whether the effective regulation and supervision can contain the banks' moral hazard behavior.

Eq 8 to *Eq 13* are parallel to *Eq 2* to *Eq 7*, respectively. Through these six specifications we intend to examine whether differences exist for Korea in the degree of moral hazard and in the effects of the quality of regulation and supervision. Throughout the estimation, the bank-specific control variables (*Deposit*, *Loan*, and *Size*) are instrumented with their own lags and the other exogenous variables to take into account the possible endogeneity problem.

In *Eq 1* all coefficient estimates for the explanatory variables conform to expectations when they are significant. First, for bank-specific control variables, the coefficients of *Deposit* and *Loan* are negative, while that of *Size* is positive. It is noted that the positive estimate for *Size* might imply the too-big-to-fail attitude prevails among banks. Second, the coefficient of *Income*(-1) is positive. The estimate for *Regulation* turns out to be positive as expected. Lastly, *D_{crisis}* shows a negative coefficient estimate as anticipated. In sum, the coefficient estimates for control variables show the expected signs. More importantly, their estimates keep showing consistent

¹⁰ The Hausman test was conducted on the basic model (*Eq 1*) to determine which method to use for estimation: the fixed effects or the random effects model. The test statistic was $\chi^2_{df=9} = 14.86$ with p value = 9.5%. At the 10% significance level, therefore, the random effects model was not rejected. This model has an additional advantage of allowing us to use bank dummies in an attempt to test the moral hazard of banks.

signs and significance in all specifications from *Eq 1* through *Eq 13* except that for D_{crisis} .¹¹

With respect to the effect of the deposit insurance on banks' risk-taking, which is the main concern of this paper, we found that the deposit insurance resulted in the moral hazard of the bank. First, the coefficient estimate of *Exist* in *Eq 2* is significantly positive, which gives support to the argument that banks tend to increase their risk-taking in response to the adoption of deposit insurance. Furthermore, the coefficients of *CoverF* and *CoverI* are estimated to be also significantly positive in *Eq 3* and *Eq 4*, respectively. Therefore, we are led to conclude that the risk-taking behavior of banks is further encouraged as the coverage of the deposit insurance scheme becomes extended. This clearly reinforces the proposition of the bank's moral hazard from deposit insurance.

In *Eq 5* to *Eq 7*, the coefficient estimates for the interactions of *Regulation* with *Exist*, *CoverF* and *CoverI*, respectively, are significantly negative. It is interpreted as *Regulation* as a proxy of the bank prudential regulation and supervision is reducing the 'excessive' risk-taking of the bank, i.e., curbing the moral hazard related to deposit insurance. In *Eq 5* through *Eq 7*, not only the coefficient estimate for each of *Exist*, *CoverF*, and *CoverI*, but also that for *Regulation* were positive. Nevertheless, the coefficient estimates for all of their interactions are now significantly negative. Also, note that the sizes of these estimates for the interactions are relatively large in absolute terms, ranging as much as from about a half to two thirds of the estimates for *Exist*, *CoverF*, and *CoverI*, respectively. This indicates that good regulation and supervision can contain banks' risk-taking to a non-trivial extent.

Finally, interaction terms of D_{korea} and *INSURANCE* variables are included in *Eq 8* through *Eq 10* in order to diagnose any peculiarity of Korea. In *Eq 8*, the

¹¹ The significance of the D_{crisis} coefficient in *Eq 1* disappears in the remaining models. We suspect that this is due to sizable correlation between *INSURANCE* variables (i.e., *Exist*, *CoverF*, and *CoverI*) and D_{crisis} , because several countries introduced deposit insurance at about the same time during the late-1990s Asian financial crisis.

coefficient estimate for $Exist * D_{korea}$ is positive but with its significance slightly less than the customary level. In Eq 9 and Eq 10, the coefficient estimates for $CoverF * D_{korea}$ and $CoverI * D_{korea}$, respectively, are significantly positive. This implies that banks in Korea participate more actively in risk-taking in association with deposit insurance *vis-à-vis* other countries. Thus, the incentive of moral hazard appears to be stronger.

Also, in Eq 11 to Eq 13, we interacted with the Korea dummy the earlier terms which were expected to capture the effect of more effective financial regulation and supervision on the moral hazard incentive. That is, in order to determine if there is a systematic Korea-specific difference, we incorporate $Exist * Regulation * D_{korea}$, $CoverF * Regulation * D_{korea}$, and $CoverI * Regulation * D_{korea}$ into Eq 11 to Eq 13, respectively. The estimation hardly uncovered any difference.

<Table 3> Regression results for the risk-taking of the banks

<i>Variable</i>	<i>Eq 1</i>	<i>Eq 2</i>	<i>Eq 3</i>	<i>Eq 4</i>	<i>Eq 5</i>	<i>Eq 6</i>	<i>Eq 7</i>
<i>Constant</i>	0.902*** (0.014)	0.861*** (0.016)	0.863*** (0.016)	0.870*** (0.016)	0.848*** (0.016)	0.850*** (0.017)	0.863*** (0.016)
<i>Deposit</i>	-0.041** (0.020)	-0.035* (0.020)	-0.035* (0.020)	-0.034* (0.020)	-0.038** (0.020)	-0.040** (0.020)	-0.038** (0.020)
<i>Loan</i>	-0.069*** (0.020)	-0.072*** (0.020)	-0.070*** (0.020)	-0.072*** (0.020)	-0.073*** (0.020)	-0.068*** (0.020)	-0.071*** (0.020)
<i>Size</i>	0.052*** (0.017)	0.056*** (0.017)	0.060*** (0.017)	0.058*** (0.017)	0.058*** (0.017)	0.061*** (0.017)	0.059*** (0.017)
<i>Income</i>	-0.013 (0.050)	0.041 (0.051)	0.041 (0.052)	0.014 (0.050)	0.046 (0.050)	0.052 (0.051)	0.015 (0.050)
<i>Income(- 1)</i>	0.103** (0.047)	0.133*** (0.047)	0.134*** (0.047)	0.118*** (0.047)	0.126*** (0.047)	0.133*** (0.046)	0.121** (0.047)
<i>Inflation</i>	-0.004 (0.030)	-0.014 (0.030)	-0.006 (0.030)	-0.011 (0.030)	-0.007 (0.030)	0.004 (0.030)	-0.007 (0.030)
<i>Inflation(- 1)</i>	-0.036 (0.034)	-0.025 (0.033)	-0.020 (0.034)	-0.031 (0.034)	-0.027 (0.033)	-0.018 (0.034)	-0.031 (0.033)
<i>Regulation</i>	0.015*** (0.006)	0.017*** (0.005)	0.018*** (0.006)	0.020*** (0.006)	0.040*** (0.008)	0.036*** (0.009)	0.034*** (0.009)
<i>D_{crisis}</i>	-0.014* (0.008)	0.032 (0.009)	-0.000 (0.009)	-0.004 (0.009)	0.008 (0.009)	0.002 (0.009)	-0.003 (0.009)
<i>Exist</i>		0.040*** (0.008)			0.053*** (0.009)		
<i>Exist * D_{korea}</i>							
<i>Exist * Regulation</i>					-0.031*** (0.007)		
<i>Exist * Regulation * D_{korea}</i>							
<i>CoverF</i>			0.022*** (0.005)			0.028*** (0.005)	
<i>CoverF * D_{korea}</i>							
<i>CoverF * Regulation</i>						-0.015*** (0.005)	
<i>CoverF * Regulation * D_{korea}</i>							
<i>CoverI</i>				0.023*** (0.006)			0.026*** (0.006)
<i>CoverI * D_{korea}</i>							
<i>CoverI * Regulation</i>							-0.013** (0.006)
<i>CoverI * Regulation * D_{korea}</i>							
<i>#Wald c²</i>	31.54***	52.60***	46.85***	42.57***	69.69***	54.86***	48.14***
<i># no. of obs.</i>	1,430	1,430	1,430	1,430	1,430	1,430	1,430

(continued)

<Table 3> Regression results for the risk-taking of the banks (continued)

<i>Variable</i>	<i>Eq 8</i>	<i>Eq 9</i>	<i>Eq 10</i>	<i>Eq 11</i>	<i>Eq 12</i>	<i>Eq 13</i>
<i>Constant</i>	0.861 ^{***} (0.016)	0.859 ^{***} (0.016)	0.868 ^{***} (0.016)	0.847 ^{***} (0.016)	0.845 ^{***} (0.017)	0.859 ^{***} (0.017)
<i>Deposit</i>	-0.035 [*] (0.020)	-0.034 [*] (0.020)	-0.034 [*] (0.020)	-0.038 ^{**} (0.020)	-0.038 ^{**} (0.020)	-0.037 [*] (0.020)
<i>Loan</i>	-0.072 ^{***} (0.020)	-0.070 ^{***} (0.020)	-0.072 ^{***} (0.020)	-0.073 ^{***} (0.020)	-0.067 ^{***} (0.020)	-0.070 ^{***} (0.020)
<i>Size</i>	0.053 ^{***} (0.018)	0.055 ^{***} (0.018)	0.054 ^{***} (0.018)	0.055 ^{***} (0.018)	0.057 ^{***} (0.018)	0.055 ^{***} (0.019)
<i>Income</i>	0.043 (0.051)	0.047 (0.051)	0.018 (0.050)	0.048 (0.051)	0.059 (0.051)	0.019 (0.050)
<i>Income</i> (- 1)	0.134 ^{***} (0.047)	0.138 ^{***} (0.047)	0.121 ^{***} (0.047)	0.130 ^{***} (0.047)	0.140 ^{***} (0.047)	0.127 ^{***} (0.047)
<i>Inflation</i>	-0.013 (0.030)	-0.005 (0.030)	-0.010 (0.030)	-0.006 (0.030)	0.005 (0.030)	-0.005 (0.030)
<i>Inflation</i> (- 1)	-0.025 (0.034)	-0.018 (0.034)	-0.030 (0.033)	-0.027 (0.033)	-0.016 (0.034)	-0.030 (0.033)
<i>Regulation</i>	0.015 ^{***} (0.006)	0.016 ^{***} (0.006)	0.018 ^{***} (0.006)	0.039 ^{***} (0.008)	0.035 ^{***} (0.009)	0.033 ^{***} (0.008)
<i>D_{crisis}</i>	0.003 (0.009)	0.000 (0.009)	-0.004 (0.009)	0.007 (0.009)	0.001 (0.009)	-0.005 (0.009)
<i>Exist</i>	0.039 ^{***} (0.008)			0.052 ^{***} (0.009)		
<i>Exist * D_{korea}</i>	0.029 (0.023)			0.073 [†] (0.052)		
<i>Exist * Regulation</i>				-0.032 ^{***} (0.008)		
<i>Exist * Regulation * D_{korea}</i>				-0.046 (0.059)		
<i>CoverF</i>		0.022 ^{***} (0.005)			0.029 ^{***} (0.005)	
<i>CoverF * D_{korea}</i>		0.044 ^{**} (0.023)			0.100 ^{**} (0.052)	
<i>CoverF * Regulation</i>					-0.015 ^{***} (0.005)	
<i>CoverF * Regulation * D_{korea}</i>					-0.067 (0.059)	
<i>CoverI</i>			0.022 ^{***} (0.006)			0.026 ^{***} (0.006)
<i>CoverI * D_{korea}</i>			0.038 [*] (0.023)			0.097 [*] (0.052)
<i>CoverI * Regulation</i>						-0.013 ^{**} (0.006)
<i>CoverI * Regulation * D_{korea}</i>						-0.069 (0.060)
<i>Wald c²</i>	57.95 ^{***}	55.70 ^{***}	49.86 ^{***}	77.18 ^{***}	65.31 ^{***}	57.19 ^{***}
<i>no. of obs.</i>	1,430	1,430	1,430	1,430	1,430	1,430

Notes: ^{***}, ^{**}, and ^{*} indicate statistical significance at the 1%, 5%, and 10% level, respectively, while [†] represents significance slightly over 10% but within 15% level.

V. Conclusions and Policy Implications

This paper has examined commercial and Islamic banks in the ten ASEAN member countries and Korea, focusing on the effect of deposit insurance on the risk-taking behavior of banks and on the role of regulatory quality therein. Risk-taking of banks was measured by the leverage risk. This paper is meaningful in that the sample is composed mostly of developing countries. In previous studies, the focus was more on developed countries or mixed samples of both developed and developing countries. Therefore, the results of this paper provide implications for banks in other developing countries that already have or are considering adopting the deposit insurance system. In short, empirical results provided the following three major findings for our sample.

First, we found that, with the introduction of the deposit insurance system, banks more actively engaged in risk-taking, thus increasing moral hazard. Second, banks assumed higher risks in countries where the deposit insurance scheme was designed to cover foreign currency or interbank deposits. These two findings support the view that the adverse impact of deposit insurance on bank stability tends to be greater as a more extensive coverage is offered to depositors (Demirgüç-Kunt and Detragiache, 2002). Third, we found that such moral hazard tends to be restrained *ceteris paribus* when the regulatory environment (i.e., prudential regulation and supervision for banks) is improved. In other words, better equipped institutions can perform a significant role in curbing the negative effect of deposit insurance on bank stability.

Our special attention on Korea has provided beneficial insight from a public policy perspective. Risk-taking in the presence of deposit insurance was relatively higher in Korea than other countries. We speculate that this was partly due to the active government involvement in bank management during the sample period. Although more research on this is necessary for a decisive conclusion, our tentative suggestion is that the government-led restructuring of many banks in Korea since 1996 might have actually reinforced the moral hazard of these banks.

On the other hand, Korea did not show any marked difference compared to other

countries in the moral-hazard-curbing effect of the regulatory quality variable. This is an interesting discovery considering the casual public announcements that the country was undergoing sweeping regulatory reforms for the financial sector from the late 1990s. However, the fact is that Korea is the only non-ASEAN and major economy in Asia that was severely struck by the financial crisis in the late 2000s despite such comprehensive reforms. Also, several financial institutions, although of small sizes, were bankrupt even in the 2010s. Taken together, these factors suggest that the overall regulatory reforms were not actually effective enough¹² or, at the least, imply a need to improve the regulatory instruments specifically targeting moral hazard related to deposit insurance.

¹² For example, according to the dataset in Kim and Kim (2013, pp. 55-56) which was reconstructed using the existing literature, Korea is located below all of the averages of 55 sample countries in terms of the financial supervisors' independence, accountability, and transparency that are known to primarily constitute the good quality of the so-called 'regulatory governance' of financial supervisory system.

References

- Angkinand, A.; W. Sawangngoeny; and C. Wihlborg. 2007. "Banking crises: definitions and explanations." Claremont Working Paper, Claremont Graduate University, California.
- Barth, J.R.; G. Caprio; and R. Levine. 2004. "The regulation and supervision: what works best?" *Journal of Financial Intermediation* 13, pp. 205–248.
- DeLong, G., and A. Saunders. 2011. "Did the introduction of fixed-rate federal deposit insurance increase long-term bank risk-taking?" *Journal of Financial Stability* 7, no. 1: 19-25.
- Demirgüç-Kunt, A., and E. Detragiache. 2002. "Does deposit insurance increase banking system stability? An empirical investigation." *Journal of Monetary Economics* 49, no. 7: 1373-1406.
- Demirgüç-Kunt A.; B. Karacaovali; and L. Laeven. 2005. "Deposit insurance around the world: A comprehensive database." Policy Research Working Paper no. 3628, World Bank.
- Diamond, D.W., and P.H. Dybvig. 1983. "Bank runs, deposit insurance, and liquidity." *Journal of Political Economy* 91, no. 3: 401-419.
- Duffie, D.; R. Jarrow; A. Purnanandam; and W. Yang. 2003. "Market pricing of deposit insurance." *Journal of Financial Services Research* 24, no. 2: 93-119.
- Eichengreen, B., and C. Arteta. 2002. "Banking crises in emerging markets: presumptions and evidence." In *Financial Policies in Emerging Markets*, ed. M.I. Blejer, and M. Skreb, pp. 47-94. Cambridge: MIT Press.
- Falkenheim, M., and G. Pennacchi. 2003 "The cost of deposit insurance for privately held banks: a market comparable approach," *Journal of Financial Services Research* 24, no. 2: 121-148.
- Fernandez, A., and F. Gonzalez. 2005. "How accounting and auditing systems can counteract risk-shifting of safety-nets in banking: some international evidence." *Journal of Financial Stability* 1, no. 4: 466–500.
- Friedman, M., and A.J. Schwartz. 1963. *A monetary history of the United States, 1867-1960*. NBER Book Series Studies in Business Cycles. Princeton: Princeton University Press.
- Gropp, R., and J. Vesala. 2004. "Deposit insurance, moral hazard and market monitoring." *Review of Finance* 8, no. 4: 571-602.
- Houston, J.F.; C. Lin; P. Lin; and Y. Ma. 2010. "Creditor rights, information sharing, and bank risk taking." *Journal of Financial Economics* 96, no. 3: 485-512.
- Hoggarth, G.; P. Jackson; and E. Nier. 2005. "Banking crises and the design of safety nets." *Journal of Banking and Finance* 29, no. 1: 143–159.
- Hutchison, M., and K. McDill. 1999. "Are all banking crises alike? The Japanese experience in international comparison." *Journal of the Japanese and International Economics* 13, no. 3: 155–180.
- Kane, E.J. 1989. *The S&L insurance mess: How did it happen?* Washington, DC: Urban Institute Press.
- Karels, G.V., and C.A. McClatchey. 1999. "Deposit insurance and risk-taking behavior in the credit union industry." *Journal of Banking & Finance* 23, no. 1: 105-134.
- Keeley, M.C. 1990. "Deposit insurance, risk, and market power in banking." *The American Economic Review* 80, no. 5: 1183-1200.
- Kim, I., and I. Kim. 2013. "Financial supervisory agency's regulatory governance and financial stability." *Journal of Money and Finance* 27, no. 5: 29-69.
- Klomp, J., and J. de Haan. 2009. "Central bank independence and financial instability." *Journal of Financial Stability* 5, no. 4: 321-338.
- Merton, R.C. 1977. "An analytical derivation of the cost of deposit insurance and loan

- guarantees: An application of modern option pricing theory.” *Journal of Banking & Finance* 1, no. 1: 3-11.
- McKenzie, J.A.; R.A. Cole; and R.A. Brown. 1992. “Moral hazard, portfolio allocation, and asset returns for thrift institutions.” *Journal of Financial Services Research* 5, no. 4: 315-339.
- Nier, E., and U. Baumann. 2006. “Market discipline, disclosure and moral hazard in banking.” *Journal of Financial Intermediation* 15, no. 3: 332–361.
- Pennacchi, G. 2006. “Deposit insurance, bank regulation, and financial system risks.” *Journal of Monetary Economics* 53, no. 1: 1-30.
- Wee, K.; C. Kim; and Y. Rhee. 2007. “The effects of the characteristics of deposit insurance system on the behavior and financial performance of the banks: An empirical study on the OECD country banks.” *International Area Studies Review* 16, no. 4: 1-19.
- Wheelock, D.C. 1992. “Deposit insurance and bank failures: New evidence from the 1920s.” *Economic Inquiry* 30, no. 3: 530-543.