



The influence of government intervention on the trajectory of bank performance during the global financial crisis: A comparative study among Asian economies[☆]

Cherng G. Ding^{a,*}, Chiu-Hui Wu^a, Pao-Long Chang^b

^a Institute of Business and Management, National Chiao Tung University, Taipei, Taiwan

^b Department of Business Administration, Feng Chia University, Taichung, Taiwan

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ABSTRACT

The global financial crisis that started from 2007 onwards spread around the world and impacted the performance of banks in major economies. Many governments have used a variety of intervention policies to recover their financial systems. By examining the dynamic changes in bank performance before and after government intervention, this study demonstrates the use of the piecewise latent trajectory model. We used the data collected from Bloomberg for banks of five major Asian economies, Japan, South Korea, Hong Kong, Singapore and Taiwan, over the eleven-quarter period from the 4th quarter of 2007 to the 2nd quarter of 2010 on six financial performance indicators reflecting solvency, credit risk and profitability. The change patterns of bank performance before/after government intervention during the global financial crisis have been compared among the five economies. Our empirical results indicate that, on average, the bank performance in terms of solvency, credit risk, and profitability improves after government intervention. Moreover, the influence of government intervention on bank performance depends on the evaluative financial indicator, the economy, and whether banks are internationalized. South Korea and Hong Kong have been identified to be the economies with stronger bank performance after government intervention. Policies demonstrated useful in South Korea and Hong Kong have been summarized and discussed.

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1. Introduction

In 1929, the U.S. financial system collapsed, the stock market crashed and in less than two weeks, more than 300 billion USD worth of wealth disappeared. This economic crisis quickly spread to other economies also, resulting in the Great Depression. Nearly 80 years later, another financial disaster that began in 2007 because of the U.S. sub-prime mortgage crisis resulted in a snowball effect that has continued to hurt financial markets since then. In 2008, Merrill Lynch was acquired by Bank of America, AIG (American International Group) reported huge losses, the U.S. government took over the management of Fannie Mae and Freddie Mac, and Lehman Brothers Holdings Inc. and Washington Mutual, the largest

savings and loan institution in America, announced bankruptcy, making the Federal Reserve Board provide emergency relief.

The global financial crisis in 2008 was a chain reaction of credit risk inherent in engineered financial instruments. It was the combination of three financial products, Residential Mortgage Backed Securities (RMBSs), Collateralized Debt Obligations (CDOs), and Credit Default Swaps (CDSs), in addition to some other major products, that caused the sub-prime mortgage crisis which later spread across markets. Since many financial products are international and liquid, the American financial crisis had a contagion effect on all economies around the world. The crisis pushed the world economy into a severe recession. It also led to shrinkage of the job market, lack of funds in credit markets, soaring of commercial interest rates, and downturn in the real estate market. American financial institutions reported significant losses in the fourth quarter of 2008 while Europe encountered shortfalls in both domestic and external demands.

The global financial crisis also impacted Japan and the “Four Asian Dragons” (South Korea, Hong Kong, Singapore and Taiwan), which had been rapidly growing export-oriented economies since 1970, until they were hit by the Asian financial crisis of 1997. They were inevitably affected by this global financial crisis as well. Asian banks' earnings suffered from the crisis and their existing financial

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* Corresponding author. Tel.: +886 2 23494932; fax: +886 2 23494922.

E-mail addresses: cding@mail.nctu.edu.tw (C.G. Ding), jessiech.wu@yahoo.com.tw (C.-H. Wu), plchang@fcu.edu.tw (P.-L. Chang).

problems were worsened. They were faced with many unexpected challenges.

At the most critical moment during the financial crisis, nine U.S. financial institutions that were on the verge of collapsing received government's financial aid. They had a combined total loss of close to 100 billion USD in 2008, forcing the U.S. government to inject 175 billion USD into the Troubled Asset Relief Program (TARP), making this a pioneering act of government intervention in an effort to stave off an even more massive financial crisis. Most European bailout programs combined government guaranteed debt issuance programs with direct equity injections. National governments around the world were trying to save stock markets from collapsing, in an effort to resolve the worsening financial crisis. Issues regarding regulation in response to the financial crisis have been discussed (e.g., Goodhart, 2008; Krimminger, 2008; Praet and Nguyen, 2008).

Now that we have faced a global financial crisis not seen in a century, we need to assess whether the Asian governments intervened properly. Since the bank industry, with high financial leverage, is closely connected with the financial system, and bank performance reflects directly financial stability, the bank industry should receive particular attention. Has bank performance improved after intervention during the global financial crisis? The focus of this study is to examine whether government intervention can exert influence on the trajectory of bank performance, and to compare the effects of intervention among different economies. Specifically, there are three research purposes of this study. First, we analyze the changes in bank performance over time for five Asian economies (Japan, South Korea, Hong Kong, Singapore and Taiwan) before and after government intervention during the financial crisis. These five economies are chosen because of their similarities in openness, geography and the preponderance of their financial markets. Second, we compare the differences among these economies. Third, we summarize remedial devices that have been demonstrated useful and discuss some policy implications.

This paper is, to the best of our knowledge, the first study that applies the piecewise latent trajectory model to analyze the change in bank performance over time, before and after government intervention. The model is useful for describing the change of trajectory that occurs after a particular important point in time and conducting comparisons (Flora, 2008). Section 2 reviews related literature. Section 3 presents the method. Section 4 shows the empirical results and discusses some policy implications, and Section 5 gives the conclusion.

2. Related literature and hypotheses

2.1. Financial performance indicators for banks

Mishkin (1999) indicates that a bank is a financial intermediary and makes a profit through transactional processes, such as the selling of debt (accepts customers' deposits) and purchasing of properties (extending loans to customers). When the U.S. Financial Supervisory Authority evaluates the financial position of a bank, it uses the CAMEL standard, which is an internationally recognized rating system for financial institutions, and uses the indicators for capital adequacy, credit risk, management, earnings and liquidity. Solvency is a key factor to financial market efficiency and stability (Barrell et al., 2010; Raddatz, 2006); in the event of the market worsening, the crisis is then attributed to a lack of liquidity and insolvency.

Stojanovic et al. (2008) analyze whether banks underwriting mortgages increase their risk, by using CAMEL financial and economic variables regarding capital adequacy, credit risk,

profitability, liquidity risk, and sensitivity. Arena (2008) find that bank fundamentals significantly affect the likelihood of bank failures for the banks in East Asia and Latin America, based on the indicators of asset quality, solvency, liquidity, return on assets, and interest rates and deposits. Zopounidis (1998) uses the principal component factor analysis to conduct dimension reduction for financial indicators. The resulting factors included solvency, investment activity, capital structure, and profitability. Raveh (2000) uses the co-plot method, a two dimensional graphic display technique, to evaluate a bank's performance by analyzing liquidity, investment activity, capital structure, and profitability of the bank.

2.2. Effects of government intervention

When President Reagan assumed the Presidency in 1981, the U.S. economy was caught in an extremely unusual dilemma comprising severe inflation and rising unemployment. It was in this environment that the economic policies that came to be known as "Reaganomics" were born. At the time, it was considered to be a strategy that actively faced reality and quickly adopted counter measures to address the dilemma. On one hand, the government adopted a fiscal policy of reducing taxes and tax rates while increasing government spending (such as a substantial increase in military spending); on the other hand, the Federal Reserve adopted a policy of reducing interest rates to increase money supply for encouraging investment and stimulating economic development. As a result, there was significant improvement in terms of inflation and the unemployment rate and financial markets were once again active, implying that government intervention can lift economy and financial markets.

Research on changes in performance of the various types of banks has shown differences between public sector and private banks in the Indian commercial banking system, indicating that the average efficiency was higher among public sector banks because of their higher credibility and competitiveness supported by government (Bhattacharyya et al., 1997). Ongena et al. (2003) analyze the Norwegian banking crisis during the period 1988–1991 and find that both Norway and Japan started facing the financial crisis roughly at the same time. However, because of intervention by the government, Norway overcame its financial crisis in four years while Japan continued to suffer. In the 1980s, Japan faced a highly risky mortgage market, endless problems with the financial institutions, and relentless appreciation of the Yen because of foreign pressure. After a couple of failed rescue attempts by the Ministry of Finance, Japan subsequently experienced a financial disaster. During the Asian financial crisis (1997–1999), capital injections by the Japanese government were meant to save the banks. However, the result was ineffective due to insufficient funding. Hoshi and Kashyap (2010) have described in detail the three phases of the Japanese crisis. They also examine major responses by the Japanese government to the financial crisis and show the success or failure of various government interventions. They conclude that government interventions are only partially successful in recapitalizing the banks. The Japanese government intervention seems to be unsatisfactory. The drag the Japanese economy has experienced might be because of improper handling of banks during the entire decade in the 1990s. Drawing some lessons from this, the Taiwanese government started a financial revolution of sorts in 2001 when it aggressively started eliminating idle banking accounts and re-establishing active financial motivations. By joint efforts of all concerned parties, all idle banking accounts were closed and more funds were released into the market, and non-performing loans ratio was significantly reduced. This was taken as a successful effect of the 1st financial reform, but the huge cost was paid by the whole society (Hsiao et al., 2010). South Korea also

experienced the Asian financial crisis and the South Korean government proposed a variety of policies and financial reforms, which led to the revival of its economy after the crisis. The financial crisis prompted the government to initiate a number of reforms in the areas of finance, corporate governance, and the labor market, giving South Korea a brand new opportunity to create a competitive economic environment (Lee and Lee, 2008).

Pasquariello (2007) conducts an empirical investigation of the impact of central bank intervention on the process of price formation in foreign exchange markets and exploits insights from the analysis of market liquidity to explain the effectiveness of the intervention. However, due to the large amount of foreign exchange trades, direct intervention by an individual central bank may produce limited effects unless central banks agree with each other to intervene in currency markets via swap arrangements (Cukierman, 2011).

Goodhart (2008) summarizes the aspects concerning financial regulation to cope with financial crises. They include: (1) deposit insurance; (2) bank solvency regimes ('prompt corrective action'); (3) money market operations by central banks; (4) liquidity risk management; (5) procyclicality in capital adequacy ratios; (6) boundaries of regulation, conduits, SIVs and reputational risk; (7) crisis management. However, it should be cautious to use policies since not all policies are effective. The effects of government intervention vary with economies because the focus of rescue programs proposed by different economies might be quite different.

According to an analysis of performance of domestic and foreign banks by Sabi (1996), the more internationalized the banks are, the more they are affected by a financial crisis. Most of the local banks are less globalized. They have limited involvement in and interface with the global markets. Also, their bonds and securities trading capacity is smaller, and hence, the limited internationalization has resulted in less direct impacts from the global financial crisis. Foreign banks were more efficient than domestic banks, but this higher efficiency was unable to produce higher profits (Sturm and Williams, 2004). Cukierman (2011) mentions that when facing a crisis, larger banks not only do not internalize systemic risks, but also expect to be bailed out by government, which is the "too-big-to-fail" problem. Sohn (2010) indicates that the "too-big-to-fail" expectation makes the market ignore the possibility that four nationwide banks in South Korea might be forced to close. However, larger banks are better able to diversify their loan portfolios, reducing their asset risk, and internationalized banks can have access to parent funding (Arena, 2008; Calomiris and Mason, 2001).

According to the literature review given above, we expect that

H₁. On average, the trajectory of bank performance in terms of solvency, credit risk, and profitability improves after government intervention during the global financial crisis.

H₂. The effects of government intervention on the trajectory of bank performance during the global financial crisis depend on the economy and whether banks are internationalized.

3. Methods

3.1. Data

Six financial indicators for assessing bank performance are used in this study. They include total deposits/total assets (abbreviated as DA in this article), total deposits/total funding (abbreviated as DF), total allowance for bad debt/total loans (abbreviated as ABDL), loan loss reserves/non-performing loans (abbreviated as LRNPL), return on assets (abbreviated as ROA) and growth rate of assets (abbreviated as GRA). DA and DF are solvency-related indicators.

Table 1
Sample characteristics.

Internationalization	Japan	South Korea	Hong Kong	Singapore	Taiwan
With	5	3	7	3	10
Without	5	3	1	0	5

The values in the cells are the numbers of banks. The total number of banks is 42.

ABDL and LRNPL are indicators related to credit risk. ROA and GRA are profitability-related indicators.

The financial data used for this study are obtained from Bloomberg's (a comprehensive financial database for individual banks across the world) quarterly reports during the period from the 4th quarter of 2007 to the 2nd quarter of 2010, in which the 2008 financial crisis occurred. Bloomberg does not report full financial information of banks in Taiwan. As a result, balance sheets and financial statements were gathered separately from reports produced by financial regulatory agencies in Taiwan. By following similar studies (e.g., Hoshi and Kashyap, 2010; Rotheli, 2010), we selected large banks only. The reason is that they suffered much more from the global financial crisis and benefited more by government intervention, and therefore they are representative. The sample consists of 42 banks with complete financial data, selected from Japan, South Korea, Hong Kong, Singapore and Taiwan among the world's top 1000 banks. 10 banks are from Japan, 6 from South Korea, 8 banks are in Hong Kong, 3 banks in Singapore and 15 banks in Taiwan. Of these, 28 are internationalized banks and 14 are non-internationalized banks. Sample characteristics are displayed in Table 1.

3.2. The piecewise latent trajectory model

In order to meet the research objectives and to be in line with the nature of the data, the piecewise latent trajectory model (e.g., Bollen and Curran, 2006, Section 4.3; Flora, 2008; Li et al., 2001) is used in this study. The model is suitable for situations where a fixed transition point during the time period has been determined and different linear trajectories need to be fitted before and after that transition. In this study, government intervention is a particular event during the period of the global financial crisis. Since our purpose is to examine if the change patterns of bank performance before and after intervention (a transition point) are different, in order to see the effects of intervention, the piecewise latent trajectory model is appropriate. The model can not only characterize intra-bank (within-bank) changes in performance over time but also test inter-bank (between-bank) differences in changes.

The piecewise latent trajectory model in this study is given by

$$x_{itk} = \alpha_{ik} + \lambda_{1t}\beta_{1ik} + \lambda_{2t}\beta_{2ik} + \varepsilon_{itk}, \quad i = 1, 2, \dots, 42; \\ t = 1, 2, \dots, 11; \quad k = 1, 2, \dots, 6, \quad (1)$$

where x_{itk} is the value of the trajectory variable x_k (the k th financial performance indicator) for bank i at time t , α_{ik} is the random intercept and β_{1ik} and β_{2ik} are the random slopes before and after government intervention of the trajectory for bank i associated with the k th financial indicator, λ_{1t} and λ_{2t} are fixed loading coefficients, representing the passage of time before and after intervention, and ε_{itk} is the corresponding error, reflecting the departure from the trajectory. Since the transition point (the time point of government intervention) is at $t=4$ (the 3rd quarter of 2008), both λ_{14} and λ_{24} are set as zero. λ_{1t} and λ_{2t} are specified as $[\lambda_{11}, \lambda_{12}, \lambda_{13}, \dots, \lambda_{1,11}] = [-3 -2 -1 0 0 0 0 0 0 0]$ and $[\lambda_{21}, \lambda_{22}, \lambda_{23}, \dots, \lambda_{2,11}] = [0 0 0 1 2 3 4 5 6 7]$. The model in Eq. (1) is referred to as the level-1 model and ε_{itk} the level-1 errors. It is assumed that level-1 errors have zero mean and identical covariance structure Θ_ε for all

Table 2
The mean trajectory of bank performance for each combination of the levels of economy and internationalization.

Economy	With internationalization	Without internationalization
Japan	$\gamma_{00} + \gamma_{01} + (\gamma_{10} + \gamma_{11})\lambda_{1t} + (\gamma_{20} + \gamma_{21})\lambda_{2t}$	$\gamma_{00} + \gamma_{01} + \gamma_{05} + (\gamma_{10} + \gamma_{11} + \gamma_{15})\lambda_{1t} + (\gamma_{20} + \gamma_{21} + \gamma_{25})\lambda_{2t}$
South Korea	$\gamma_{00} + \gamma_{02} + (\gamma_{10} + \gamma_{12})\lambda_{1t} + (\gamma_{20} + \gamma_{22})\lambda_{2t}$	$\gamma_{00} + \gamma_{02} + \gamma_{05} + (\gamma_{10} + \gamma_{12} + \gamma_{15})\lambda_{1t} + (\gamma_{20} + \gamma_{22} + \gamma_{25})\lambda_{2t}$
Hong Kong	$\gamma_{00} + \gamma_{03} + (\gamma_{10} + \gamma_{13})\lambda_{1t} + (\gamma_{20} + \gamma_{23})\lambda_{2t}$	$\gamma_{00} + \gamma_{03} + \gamma_{05} + (\gamma_{10} + \gamma_{13} + \gamma_{15})\lambda_{1t} + (\gamma_{20} + \gamma_{23} + \gamma_{25})\lambda_{2t}$
Singapore	$\gamma_{00} + \gamma_{04} + (\gamma_{10} + \gamma_{14})\lambda_{1t} + (\gamma_{20} + \gamma_{24})\lambda_{2t}$	$\gamma_{00} + \gamma_{04} + \gamma_{05} + (\gamma_{10} + \gamma_{14} + \gamma_{15})\lambda_{1t} + (\gamma_{20} + \gamma_{24} + \gamma_{25})\lambda_{2t}$
Taiwan	$\gamma_{00} + \gamma_{10}\lambda_{1t} + \gamma_{20}\lambda_{2t}$	$\gamma_{00} + \gamma_{05} + (\gamma_{10} + \gamma_{15})\lambda_{1t} + (\gamma_{20} + \gamma_{25})\lambda_{2t}$

banks. A commonly used structure for Θ_ε is AR(1) (the first-order autoregressive) (e.g., Littel et al., 2006, p. 175), given by

$$\Theta_\varepsilon = \begin{bmatrix} \sigma_{\varepsilon_1}^2 & \sigma_{\varepsilon_1\varepsilon_2} & \dots & \sigma_{\varepsilon_1\varepsilon_{11}} \\ \sigma_{\varepsilon_1\varepsilon_2} & \sigma_{\varepsilon_2}^2 & \dots & \sigma_{\varepsilon_2\varepsilon_{11}} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{\varepsilon_1\varepsilon_{11}} & \sigma_{\varepsilon_2\varepsilon_{11}} & \dots & \sigma_{\varepsilon_{11}}^2 \end{bmatrix} = \sigma_\varepsilon^2 \begin{bmatrix} 1 & \rho & \rho^2 & \dots & \rho^{10} \\ \rho & 1 & \rho & \dots & \rho^9 \\ \rho^2 & \rho & 1 & \dots & \rho^8 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \rho^{10} & \rho^9 & \rho^8 & \dots & 1 \end{bmatrix}, \quad (2)$$

where σ_ε^2 is the common variance and ρ is the lag-1 autocorrelation coefficient.

The random intercept and random slopes (also called growth factors) in the level-1 model can be explained by time invariant predictors. The model is referred to as the level-2 model. In this study, two time invariant predictors are used. One is the economy, and the other is internationalization. Since five economies (Japan, South Korea, Hong Kong, Singapore and Taiwan) are to be compared, four dummy variables, DEcon1, DEcon2, DEcon3 and DEcon4 are created for them, defined as follows: DEcon1 = 1 for Japan and = 0 for other economies; DEcon2 = 1 for South Korea and = 0 for other economies; DEcon3 = 1 for Hong Kong and = 0 for other economies; and DEcon4 = 1 for Singapore and = 0 for other economies. There are two levels for internationalization (with/without), and one dummy variable DInt is created. DInt = 1 for banks without internationalization; DInt = 0 for banks with internationalization. Therefore, the level-2 model is given by (subscript k is omitted for simplicity since each indicator is treated individually):

$$\begin{aligned} \alpha_i &= \gamma_{00} + \gamma_{01}DEcon1_i + \gamma_{02}DEcon2_i + \gamma_{03}DEcon3_i + \gamma_{04}DEcon4_i + \gamma_{05}DInt_i + \zeta_{0i}, \\ \beta_{1i} &= \gamma_{10} + \gamma_{11}DEcon1_i + \gamma_{12}DEcon2_i + \gamma_{13}DEcon3_i + \gamma_{14}DEcon4_i + \gamma_{15}DInt_i + \zeta_{1i}, \\ \beta_{2i} &= \gamma_{20} + \gamma_{21}DEcon1_i + \gamma_{22}DEcon2_i + \gamma_{23}DEcon3_i + \gamma_{24}DEcon4_i + \gamma_{25}DInt_i + \zeta_{2i}, \end{aligned} \quad (3)$$

where gamma's are fixed growth parameters to be estimated and ζ_{0i} , ζ_{1i} and ζ_{2i} are level-2 errors, with zero means and the covariance matrix of

$$\Psi_\zeta = \begin{bmatrix} \sigma_{\zeta_0}^2 & \sigma_{\zeta_0\zeta_1} & \sigma_{\zeta_0\zeta_2} \\ \sigma_{\zeta_0\zeta_1} & \sigma_{\zeta_1}^2 & \sigma_{\zeta_1\zeta_2} \\ \sigma_{\zeta_0\zeta_2} & \sigma_{\zeta_1\zeta_2} & \sigma_{\zeta_2}^2 \end{bmatrix}. \quad (4)$$

Combining level-1 and level-2 models leads to (subscript k is omitted):

$$\begin{aligned} x_{it} &= \alpha_i + \lambda_{1t}\beta_{1i} + \lambda_{2t}\beta_{2i} + \varepsilon_{it} \\ &= \gamma_{00} + \gamma_{01}DEcon1_i + \gamma_{02}DEcon2_i + \gamma_{03}DEcon3_i + \gamma_{04}DEcon4_i + \gamma_{05}DInt_i + \gamma_{10}\lambda_{1t} + \\ &\quad \gamma_{11}DEcon1_i\lambda_{1t} + \gamma_{12}DEcon2_i\lambda_{1t} + \gamma_{13}DEcon3_i\lambda_{1t} + \gamma_{14}DEcon4_i\lambda_{1t} + \gamma_{15}DInt_i\lambda_{1t} + \\ &\quad \gamma_{20}\lambda_{2t} + \gamma_{21}DEcon1_i\lambda_{2t} + \gamma_{22}DEcon2_i\lambda_{2t} + \gamma_{23}DEcon3_i\lambda_{2t} + \gamma_{24}DEcon4_i\lambda_{2t} + \\ &\quad \gamma_{25}DInt_i\lambda_{2t} + (\zeta_{0i} + \zeta_{1i}\lambda_{1t} + \zeta_{2i}\lambda_{2t} + \varepsilon_{it}). \end{aligned} \quad (5)$$

The combined model given above involves cross-level interactions ($\gamma_{11}, \dots, \gamma_{15}, \gamma_{21}, \dots, \gamma_{25}$). When their estimates are significant, further comparative analysis of the piecewise linear trajectories needs to be conducted. To facilitate the interpretation of growth

parameters in Eq. (5) and subsequent comparison, we summarize the mean trajectory for each combination of levels of economy and internationalization in Table 2. According to the table, γ_{10} and γ_{20} represent, respectively, the mean slopes of trajectory before and after intervention for internationalized banks in Taiwan. $\gamma_{11}, \gamma_{12}, \gamma_{13}$, and γ_{14} represent, respectively, the differences of the mean slopes of trajectory before intervention between Japan, South Korea, Hong Kong, Singapore, and Taiwan, regardless of internationalized or non-internationalized banks. $\gamma_{21}, \gamma_{22}, \gamma_{23}$, and γ_{24} represent, respectively, those after intervention. γ_{15} denotes the difference of the mean slopes of trajectory between non-internationalized and internationalized banks before intervention, regardless of the economy. γ_{25} denotes that after intervention.

4. Results and discussion

4.1. Test results

Main results of the analysis by the piecewise latent trajectory model for the six financial performance indicators are reported in Table 3. Analysis is conducted with SAS PROC MIXED (SAS Institute Inc., 2010). It appears that some of the estimates of cross-level interactions are significant. In other words, the influence of government intervention on the trajectory of bank performance depends on the evaluative financial indicator, the economy, and whether banks are internationalized. Further comparative analysis

of the piecewise linear trajectories for different groups is needed to obtain more insightful results.

To see how the mean slopes of trajectory before and after intervention differ between internationalized and non-internationalized banks, refer to the results associated with DInt*T1 and DInt*T2 in Table 3. Non-Internationalized banks perform worse than internationalized banks in ABDL before government intervention but better after intervention (the differences of the mean slopes are 6.924 and -0.4908, respectively, both significant at the 0.001 level). Non-internationalized banks perform better in GRA after intervention (the difference of the mean slopes = 1.1912, $p < 0.05$). No significant difference in the mean slopes of trajectory

of solvency was found, regardless of before or after intervention. Since internationalized banks involve financial markets worldwide, they receive more impacts from the global financial crisis. However, they have more sources of funding support, and may

Table 3
Main results of the analysis by the piecewise latent trajectory model for the six financial indicators.

	Solvency		Credit risk		Profitability	
	DA	DF	ABDL	LRNPL	ROA	GRA
Intercept	77.1407***	82.5699***	0.1046	73.6129**	0.2881**	6.6524 [†]
DEcon1	-12.0087 [†]	-7.5608	-1.4289 [†]	10.6806	0.1308	1.0985
DEcon2	-23.5542***	-19.0132***	-1.6280 [†]	88.4864***	0.6004***	12.3588***
DEcon3	-8.9866	2.3150	0.1484	-14.2073	0.1240	3.1258
DEcon4	-18.0160 [†]	-1.2345	0.1070	19.1078	0.7122***	-0.3226
DInt	2.6969	3.1427	2.7846***	-2.2430	-0.2017 [†]	-5.8718 [†]
T1	0.1532	0.0217	-2.3063 [†]	-2.0386	-0.0506	0.4532
DEcon1*T1	-0.6560	-0.7645	-1.2392	-2.1322	0.0122	1.0634
DEcon2*T1	-1.1131 [†]	-1.1297	-2.1251	1.0314	-0.0281	0.7190
DEcon3*T1	-0.0990	0.3571	1.4892	-0.0105	-0.1480*	-3.4275**
DEcon4*T1	0.2243	0.5134	2.3488	-2.4086	-0.0089	-2.7505
DInt*T1	0.0378	0.2507	6.9240***	2.7077	0.0022	-1.3784
T2	0.6482**	-0.8170**	0.1619 [†]	5.6225***	-0.0059	-0.5480
DEcon1*T2	-0.3718	1.0067**	0.1002	-9.6325***	-0.1186***	-0.7483
DEcon2*T2	0.0215	1.7000***	0.1596	-11.4448***	-0.0089	-1.5645 [†]
DEcon3*T2	-0.0743	1.1385**	-0.1566	-2.7545	0.0528	0.4074
DEcon4*T2	-0.1419	1.1462 [†]	-0.1750	-6.1213	-0.0057	0.6689
DInt*T2	0.0785	0.1330	-0.4908***	1.0050	0.0095	1.1912 [†]

DA = total deposits/total assets, DF = total deposits/total funding, ABDL = total allowance for bad debt/total loan, LRNPL = loan loss reserves/non-performing loans, ROA = return on assets, and GRA = growth rate of assets. Dummy variable DInt = 0 for banks with internationalization and 1 for banks without internationalization; Dummy variable DEcon1 = 1 for Japan and 0 otherwise; DEcon2 = 1 for South Korea and 0 otherwise; DEcon3 = 1 for Hong Kong and 0 otherwise; DEcon4 = 1 for Singapore and 0 otherwise. T1 and T2 represent, respectively, λ_{1t} and λ_{2t} . The piecewise latent trajectory model is given in Eq. (5). The values in the table are estimates of the growth parameters.

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

be “too-big-to-fail”. Executives of large internationalized financial institutions expect governments will rescue their institutions when a crisis occurs because governments need to instill confidence by promising to inject additional capital when necessary in order to protect the stability of the financial system. Our results indicate that although non-internationalized banks perform worse in credit risk before government intervention, their recovery speed is faster after intervention. It may take some more time for internationalized banks to improve their credit risk and recover their profitability.

Table 4 displays the mean slopes of trajectory of performance in terms of the six financial indicators across the five economies and internationalized and non-internationalized banks before

Table 4
Comparison between the mean slopes of trajectory of performance before and after government intervention across the five economies and internationalized and non-internationalized banks.

Financial performance indicator	Government intervention		
	Before	After	After – before
Solvency			
DA	-0.1567	0.5742***	0.7309*
DF	-0.0576	0.2478	0.3054
Credit risk			
ABDL	1.2504	-0.0979*	-1.3483
LRNPL	-1.3887	0.1344	1.5231
Profitability			
ROA	-0.0841***	-0.0172	0.0669 [†]
GRA	-1.1151*	-0.1998	0.9153

DA = total deposits/total assets, DF = total deposits/total funding, ABDL = total allowance for bad debt/total loan, LRNPL = loan loss reserves/non-performing loans, ROA = return on assets, and GRA = growth rate of assets. The corresponding statistical null hypotheses for examining the mean slopes of trajectory of performance before and after intervention and their differences are given, respectively, by $H_{0(\text{before})}: \gamma_{10} + (\gamma_{11} + \gamma_{12} + \gamma_{13} + \gamma_{14})/5 + \gamma_{15}/2 = 0$, $H_{0(\text{after})}: \gamma_{20} + (\gamma_{21} + \gamma_{22} + \gamma_{23} + \gamma_{24})/5 + \gamma_{25}/2 = 0$, and $H_{0(\text{after-before})}: [\gamma_{20} + (\gamma_{21} + \gamma_{22} + \gamma_{23} + \gamma_{24})/5 + \gamma_{25}/2] - [\gamma_{10} + (\gamma_{11} + \gamma_{12} + \gamma_{13} + \gamma_{14})/5 + \gamma_{15}/2] = 0$.

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

and after government intervention as well as their differences. By Table 2, the statistical null hypotheses for examining the mean slopes of trajectory of performance in terms of a financial indicator before and after intervention and their difference are given, respectively, by $H_{0(\text{before})}: \gamma_{10} + (\gamma_{11} + \gamma_{12} + \gamma_{13} + \gamma_{14})/5 + \gamma_{15}/2 = 0$, $H_{0(\text{after})}: \gamma_{20} + (\gamma_{21} + \gamma_{22} + \gamma_{23} + \gamma_{24})/5 + \gamma_{25}/2 = 0$, and $H_{0(\text{after-before})}: [\gamma_{20} + (\gamma_{21} + \gamma_{22} + \gamma_{23} + \gamma_{24})/5 + \gamma_{25}/2] - [\gamma_{10} + (\gamma_{11} + \gamma_{12} + \gamma_{13} + \gamma_{14})/5 + \gamma_{15}/2] = 0$. On average, the slopes of trajectory of bank performance in terms of DA, ABDL, ROA, and GRA show improvement after intervention. Although the tests associated with (after – before) for ABDL and GRA are both insignificant, the mean slope associated with ABDL changes from insignificant before intervention to significantly negative (-0.0979 , $p < 0.05$) after intervention and that associated with GRA changes from significantly negative (-1.1151 , $p < 0.05$) before intervention to insignificant after intervention. The former indicates a significant tendency to improve in credit risk, and the latter shows a significant alleviation of the declining profitability after government intervention. Therefore, H_1 is supported.

We summarize the mean slopes of trajectory of bank performance in terms of the six indicators before/after government intervention for different combinations of economies (Japan, South Korea, Hong Kong, Singapore and Taiwan) and internationalization (with and without, denoted by Int0 and Int1, respectively) in Table 5. In addition, the mean slopes before/after government intervention are compared and tested for the significance of the differences. In South Korea, the mean slopes of trajectory of performance in terms of DA and DF are significantly greater (reflecting the improvement of solvency) after intervention than before for internationalized banks (with the estimates of 1.6297 and 1.991) and for non-internationalized banks (with the estimates of 1.6704 and 1.8733). In Taiwan, the mean slope of trajectory of DA is insignificant before intervention but becomes significantly positive after intervention; however, that of DF is insignificant before intervention but becomes significantly negative after intervention, regardless of internationalized or non-internationalized banks. No significant difference was found in other economies for internationalized or non-internationalized banks. It appears

Table 5

The mean slopes of trajectory of performance before/after government intervention by economy and internationalization.

Indicator	Japan		South Korea		Hong Kong		Singapore		Taiwan	
	Int1	Int0	Int1	Int0	Int1	Int0	Int1	Int0	Int1	Int0
Solvency										
<i>DA</i>										
Before	-0.4651	-0.5028	-0.9222 [†]	-0.9599 [†]	0.0919	0.0542	0.4153	0.3775	0.1910	0.1532
After	0.3550	0.2765	0.7483 [†]	0.6698	0.6524	0.5739	0.5848	0.5063	0.7267 [†]	0.6482 ^{**}
After – before	0.8200	0.7793	1.6704 [†]	1.6297 [†]	0.5604	0.5197	0.1695	0.1288	0.5358	0.4950
<i>DF</i>										
Before	-0.4920	0.5250	-0.8572	-1.1080	0.6296	0.3788	0.7859	0.5351	0.2725	0.0217
After	0.3228	0.3364	0.0160 [†]	0.8830 [†]	0.4545	0.3215	0.4623	0.3292	-0.6839 [†]	-0.817 ^{**}
After – before	0.8148	0.9325	1.8733 [†]	1.9910 [†]	-0.1750	-0.0573	-0.3236	-0.2059	-0.9564	-0.8387
Credit risk										
<i>ABDL</i>										
Before	3.3785 ^{**}	-3.5455 ^{**}	2.4926	-4.4314 ^{**}	6.1069 ^{***}	-0.8171	6.9665 ^{***}	0.0425	4.6177 ^{***}	-2.3067 [†]
After	-0.2288 ^{**}	0.2621 ^{**}	-0.1693	0.3215 ^{**}	-0.4855 ^{***}	0.0053	-0.5039 ^{***}	-0.0131	-0.3289 ^{***}	0.1619 [†]
After – before	-3.6072 ^{**}	3.8076 ^{**}	-2.6620	4.7529 ^{**}	-6.5925 ^{***}	0.8224	-7.4704 ^{***}	-0.0556	-4.9466 ^{***}	2.4682 [†]
<i>LRNPL</i>										
Before	-1.4631	-4.1708	1.7006	-1.0071	0.6586	-2.0491	-1.7395	-4.4472	0.6692	-2.0386
After	-3.0050	-4.0101 [†]	-4.8173 [†]	-5.8223 [†]	3.8730	2.8680	0.5062	-0.4989	6.6275 ^{***}	5.6225 ^{***}
After – before	-1.5420	0.1607	-6.5179	-4.8152	3.2144	4.9171	2.2456	3.9483	5.9583	7.6610 [†]
Profitability										
<i>ROA</i>										
Before	-0.0362	-0.0384	-0.0765	-0.0787	-0.1964 ^{***}	-0.1986 ^{***}	-0.0573	-0.0595	-0.0484	-0.0506
After	-0.1150 ^{***}	-0.1245 ^{***}	-0.0053	-0.0148	0.0565	0.0469	-0.0021	-0.0117	0.0036	-0.0059
After – before	-0.0788	-0.0861	0.0712	0.0638	0.2529 ^{**}	0.2455 ^{***}	0.0552	0.0478	0.0521	0.0447
<i>GRA</i>										
Before	0.1382	1.5166	-0.2062 [†]	1.1722	-4.3526 ^{***}	-2.9742 ^{**}	-3.6757 [†]	-2.2973	-0.9252	0.4532
After	-0.1052	-1.2964 [†]	-0.9214	-2.1126 [†]	1.0505	-0.1407	1.3120	0.1208	0.6431	-0.5480
After – before	-0.2434	-2.8130 [†]	-0.7153	-3.2848 [†]	5.4031 ^{**}	2.8336 [†]	4.9877 [†]	2.4181	1.5683	-1.0013

DA = total deposits/total assets, DF = total deposits/total funding, ABDL = total allowance for bad debt/total loan, LRNPL = loan loss reserves/non-performing loans, ROA = return on assets, and GRA = growth rate of assets. Banks with and without internationalization are represented by Int0 and Int1, respectively.

[†] $p < 0.05$.

^{**} $p < 0.01$.

^{***} $p < 0.001$.

that, on average, South Korean banks benefit by government intervention more than other economies in solvency.

The mean slopes of trajectory of ABDL after intervention become significantly less than before (reflecting significant improvement in credit risk) for non-internationalized banks in all economies except South Korea, but become significantly greater (reflecting significant deterioration) for internationalized banks in Japan, South Korea, and Taiwan. Only non-internationalized banks benefits by government intervention in ABDL. Moreover, LRNPL shows significant improvement for internationalized and non-internationalized banks in South Korean but significant deterioration for internationalized and non-internationalized banks in Taiwan.

The mean slopes of trajectory of ROA and GRA are significantly greater (reflecting the improvement of profitability) after intervention than before for internationalized and non-internationalized banks in Hong Kong. The mean slope of trajectory of GRA is significantly greater after intervention than before for non-internationalized banks in Singapore. The performance in terms of ROA of internationalized and non-internationalized banks in Japan becomes worse after intervention.

The results indicate that government intervention may significantly improve bank performance, depending on the evaluative financial indicator, the economy, and whether banks are internationalized. Therefore, H_2 is supported.

4.2. Comparisons among economies

Pairwise comparisons of the mean slopes of linear trajectory of performance in terms of the six financial indicators reflecting

solvency, credit risk and profitability among economies, before and after intervention, based on the results shown in Table 5, are summarized in Table 6. Those before and after government intervention are given in the upper and lower triangular matrices, respectively. In fact, the results can also be obtained based on the mean trajectories shown in Table 2. For example, the differences of the mean slopes of trajectory between Japan and South Korea before and after intervention are given by $\hat{\gamma}_{11} - \hat{\gamma}_{12}$ and $\hat{\gamma}_{21} - \hat{\gamma}_{22}$, respectively. Those between Japan and Hong Kong are given by $\hat{\gamma}_{11} - \hat{\gamma}_{13}$ and $\hat{\gamma}_{21} - \hat{\gamma}_{23}$. For DA, the significant differences exist only between South Korea and other economies before intervention. For DF, the significant differences exist only between Taiwan and others after intervention. The banks in Taiwan perform, on average, the worst in DF. For ABDL and LRNPL, none of the differences among the five economies is significant before intervention. The banks in Japan and South Korea perform best in LRNPL after intervention. The banks in Hong Kong perform better than those in Japan and South Korea in ABDL. It is interesting that the pairwise differences among economies before and after intervention mostly show opposite directions in ROA and GRA, though some of them are insignificant. The results reflect the effects of government intervention on the difference of profitability among economies. Japan performs the worst after intervention in ROA. Government intervention is ineffective for Japan, consistent with Hoshi and Kashyap (2010), who analyze various intervention and bailout programs conducted by the Japanese government at various stages of the financial crisis and conclude that intervention by Japanese government lacks efficiency.

Table 6
Pairwise comparisons of the mean slopes of trajectory among economies before and after government intervention.

	Japan	South Korea	Hong Kong	Singapore	Taiwan
(a) Solvency – DA					
Japan	–	0.4571	–0.5570	–0.8804	–0.6560
South Korea	–0.3933	–	–1.0141*	–1.3375*	–1.1131**
Hong Kong	–0.2974	0.0959	–	–0.3233	–0.0990
Singapore	–0.2299	0.1634	0.0675	–	0.2243
Taiwan	–0.3718	0.0215	–0.0744	–0.1419	–
(b) Solvency – DF					
Japan	–	0.3652	–1.1215	–1.2779	–0.7645
South Korea	–0.6932	–	–1.4868	–1.6431	–1.1297
Hong Kong	–0.1317	0.5615	–	–0.1563	0.3571
Singapore	–0.1395	0.5538	–0.0077	–	0.5134
Taiwan	1.0067**	1.7000***	1.1385**	1.1462*	–
(c) Credit risk – ABDL					
Japan	–	0.8858	–2.7285	–3.5880	–1.2392
South Korea	–0.0594	–	–3.6143	–4.4738	–2.1251
Hong Kong	0.2568*	0.3162**	–	–0.8596	1.4892
Singapore	0.2752	0.3346	0.0184	–	2.3488
Taiwan	0.1002	0.1596	–0.1566	–0.1750	–
(d) Credit Risk – LRNPL					
Japan	–	–3.1636	–2.1217	0.2764	–2.1322
South Korea	1.8122	–	1.0419	3.4400	1.0314
Hong Kong	–6.8781*	–8.6903**	–	2.3981	–0.0105
Singapore	–3.5112	–5.3234	3.3668	–	–2.4086
Taiwan	–9.6325***	–11.4448***	–2.7545	–6.1213	–
(e) Profitability – ROA					
Japan	–	0.0403	0.1602**	0.0211	0.0122
South Korea	–0.1097*	–	0.1199*	–0.0192	–0.0281
Hong Kong	–0.1714**	–0.0617	–	–0.1391	–0.1480**
Singapore	–0.1129*	–0.0031	0.0586	–	–0.0089
Taiwan	–0.1186***	–0.0089	0.0528	–0.0057	–
(f) Profitability – GRA					
Japan	–	0.3444	4.4908***	3.8139**	1.0634
South Korea	0.8162	–	4.1465**	3.4695	0.7190
Hong Kong	–1.1557	–1.9719*	–	–0.6769	–3.4275**
Singapore	–1.4172	–2.2334	–0.2615	–	–2.7505
Taiwan	–0.7483	–1.5645*	0.4074	0.6689	–

DA = total deposits/total assets, DF = total deposits/total funding, ABDL = total allowance for bad debt/total loan, LRNPL = loan loss reserves/non-performing loans, ROA = return on assets, and GRA = growth rate of assets. The pairwise differences before and after government intervention are given in the upper and lower triangular matrices, respectively. For example, the differences of the mean slopes of trajectory of DA between Japan and South Korea before and after intervention are 0.4571 and –0.3933, respectively. Those between Japan and Hong Kong before and after intervention are –0.5570 and –0.2974, respectively.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

4.3. Policy implications

The economies with better bank performance in terms of each financial indicator are identified based on the two conditions. One is that the mean slope of trajectory of bank performance in the economy significantly improves after intervention for both internationalized and non-internationalized banks, and the other is that the mean slope of trajectory after intervention for the economy is not worse than that for any other economy. Two conditions need to be both met. The economies satisfying the first condition can be found by Table 5, and those satisfying the second condition can be obtained by Table 6.

According to Tables 5 and 6, the banks in South Korea and Taiwan performed better in DA after intervention than before and none of the mean slopes of trajectory of DA after intervention among the five economies showed significant difference. Therefore, South Korea and Taiwan are those with stronger bank performance in DA after intervention. For DF, South Korea is the only economy satisfying the two conditions. By considering DA and DF together, South Korea is the economy with the best bank performance after intervention. South Korea is also the economy with the best bank performance in terms of LRNPL, but no economy can be identified

for ABDL. Hong Kong has been shown in a similar way to be the only economy whose banks performed better in ROA and GRA after government intervention. The results are summarized in Table 7.

The existence of variation in the change pattern of bank performance among economies may be attributable to differences in government intervention policies during the global financial crisis. In response to the impact, Asian economies have implemented a series of policies to stabilize financial markets and to revitalize their economies. It has been shown in Table 7 that the banks in South Korea performed the best in solvency and credit risk and those in Hong Kong performed the best in profitability after government intervention. It is desirable to find effective means used by South Korea and Hong Kong. Through literature review, the policies adopted by the two economies have also been summarized in Table 7. They are briefly discussed as follows.

The policies used to improve solvency in South Korea include guarantee on deposits (Central Bank of the Republic of China, 2009; Kim and Rhee, 2009; Lee, 2009), interest rate cut (Kim and Kim, 2012a), and depreciation of domestic currency (Kawai, 2010; Kim and Kim, 2012a; Lee, 2009). Blanket guarantee on deposits and the increase of insurance amount on deposits were used in South Korea. The target rate decreased sharply from 5.25% in September

Table 7
Economies with stronger bank performance after government intervention and the policies used.

Financial indicator	Economy with stronger bank performance	Policy
DA, DF (solvency)	South Korea	1. Guarantee on deposits (Central Bank of the Republic of China, 2009; Kim and Rhee, 2009; Lee, 2009) 2. Interest rate cut (Kim and Kim, 2012a) 3. Depreciation of domestic currency (Kawai, 2010; Kim and Kim, 2012a; Lee, 2009)
LRNPL (credit risk)	South Korea	1. Bank recapitalization (Diamond and Rajan, 2011; Kim and Rhee, 2009; Park and Lee, 2009) 2. Credit guarantee (Central Bank of the Republic of China, 2009; Kim and Rhee, 2009; Lee, 2009)
ROA, GRA (profitability)	Hong Kong	1. Investment encouragement (Chen et al., 2011; Zhang and Tong, 2009) 2. Consumer and business financing (Zhang and Tong, 2009) 3. Expansion of public expenditures (Zhang and Tong, 2009)

DA = total deposits/total assets, DF = total deposits/total funding, ABDL = total allowance for bad debt/total loan, LRNPL = loan loss reserves/non-performing loans, ROA = return on assets, and GRA = growth rate of assets.

2008 to 3% by the end of the year, and further decreased to 2% in February 2009. The amount of liquidity increased rapidly. The loans to commercial banks by the Bank of Korea jumped from 6000 to 8000 trillion KRW before November 2008, to 21121 trillion KRW by December 2008, and further to 33055 trillion KRW by March 2009. The Korean won depreciated about 30% in nominal effective terms between September 2008 and March 2009 (−7% for Japan, 8.8% for Singapore, −0.1% for Hong Kong, and 9.5% for Taiwan) with the maximum depreciation rate of 67.8% occurring on March 2, 2009, whereas foreign reserve accumulation increased from 200.6 billion USD by the end of 2008 to 270 billion USD by the end of 2009. Dollar depreciation has boosted banks' competitiveness in solvency.

The policies used to improve credit risk in South Korea include bank recapitalization (Diamond and Rajan, 2011; Kim and Rhee, 2009; Park and Lee, 2009) and credit guarantee (Central Bank of the Republic of China, 2009; Kim and Rhee, 2009; Lee, 2009). Disposal of non-performing assets and recapitalization were tied together. The South Korean government established the Bank Recapitalization Fund, and used it to accumulate capital to prepare for recession and a possible increase in bank losses. Liquidity was boosted by injecting 20 trillion won in the economy, mainly by way of Bank of Korea's loans and institutional and private investment purchases guaranteed by the Korea Credit Guarantee Fund. South Korean banks increased BIS capital adequacy ratio over 12% and core capital tier 1 ratio over 9%.

The policies used to improve profitability of banks in Hong Kong include investment encouragement (Chen et al., 2011; Zhang and Tong, 2009) and consumer and business financing (Zhang and Tong, 2009). Free trade agreements were signed and tax breaks were used to attract foreign investment and to facilitate building a regional financial center. Infrastructure projects boosted investment in the short run. Hong Kong government's commitment was increased to 100 billion HKD with the provision of up to 70% guarantee to participating lending institutions granting loans to Hong Kong companies.

Governments can play an important role in stabilizing financial systems. Policy makers may learn the remedial devices that have been demonstrated useful in South Korea and Hong Kong. Well-designed policies, with appropriate timing, scope and means should be implemented in early stages of crises to achieve better effects. The Monetary Stabilization Bond (MSB) is a unique policy tool devised by the Korean government to control excess liquidity to manage export-driven economic growth. The MSB spread performs a signaling role in the transmission of external shocks to domestic financial markets (Kim and Kim, 2012b). Moreover, close international cooperation among the authorities of individual countries is needed to find better solutions to the problems we are facing (Hildebrand, 2008; McDowell, 2012). Specifically, such areas as transparency, valuations issues, risk management, market

infrastructure, rating agencies, and liquidity management could be priorities for action (Ackermann, 2008).

5. Conclusion

In this article, how the trajectory of bank performance is influenced by government intervention is examined and compared. Five Asian economies (Japan, South Korea, Hong Kong, Singapore and Taiwan) are covered, over the period 2007–2010, in which the global financial crisis occurred. The piecewise latent trajectory model was used for the analysis.

Our empirical results indicate that, during the global financial crisis, the linear trajectory of bank performance after government intervention (in the 3rd quarter of 2008) might improve, depending on the performance indicator, the economy, and whether banks are internationalized. It would seem reasonable to rely on short-term perspective of government intervention to cope with the financial crisis. The crisis can be just another opportunity to improve the current financial system. We have learned some financial reforms to reduce potential losses in facing possible financial crisis in the future.

The standard event study methodology may be used in the future to gain more insight about the effects of government intervention on bank performance. In addition to the bank industry, other industries may benefit from government intervention during the financial crisis. The piecewise latent trajectory model can be used again to examine the change patterns of performance before/after government intervention for other industries to better assess the effectiveness and efficiency of the policies made. We suggest that the piecewise latent trajectory model be used in situations where the comparisons of the change patterns before/after intervention are of interest.

References

- Ackermann, J., 2008. The subprime crisis and its consequences. *Journal of Financial Stability* 4, 329–337.
- Arena, M., 2008. Bank failures and bank fundamentals: a comparative analysis of Latin America and East Asia during the nineties using bank-level data. *Journal of Banking and Finance* 32, 299–310.
- Barrell, R., Davis, E.P., Karim, D., Liadze, I., 2010. Bank regulation, property prices and early warning systems for banking crises in OECD economies. *Journal of Banking and Finance* 34, 2255–2264.
- Bhattacharyya, A., Lovell, C.A.K., Sahay, P., 1997. The impact of liberalization on the production efficiency of India commercial banks. *European Journal of Operational Research* 98, 332–345.
- Bollen, K.A., Curran, P.J., 2006. *Latent Curve Models: A Structural Equation Perspective*. Wiley, Hoboken, NJ.
- Calomiris, C.W., Mason, J.R., 2001, May. Causes of U.S. Bank Distress during the Depression. *Federal Reserve Bank of Chicago*, pp. 530–554.
- Central Bank of the Republic of China, 2009, May. *Financial Stability Report (Issue No. 3)*. Central Bank of the Republic of China.

- Chen, H.Y., Lee, C.F., Tai, T., Wang, K., 2011. Fiscal and monetary policies in reaction to the financial tsunami by the Taiwanese government. *Review of Pacific Basin Financial Markets and Policies* 14, 153–169.
- Cukierman, A., 2011. Reflections on the crisis and on its lessons for regulatory reform and for central bank policies. *Journal of Financial Stability* 7, 26–37.
- Diamond, D., Rajan, R., 2011. Fear of fire sales, illiquidity seeking, and credit freezes. *The Quarterly Journal of Economics* 126, 557–591.
- Flora, D.B., 2008. Specifying piecewise latent trajectory models for longitudinal data. *Structural Equation Modeling* 15, 513–533.
- Goodhart, C.A.E., 2008. The regulatory response to the financial crisis. *Journal of Financial Stability* 4, 351–358.
- Hildebrand, P.M., 2008. The sub-prime crisis: a central banker's perspective. *Journal of Financial Stability* 4, 313–320.
- Hoshi, T., Kashyap, A.K., 2010. Will the U.S. bank recapitalization succeed? Eight lessons from Japan. *Journal of Financial Economics* 97, 398–417.
- Hsiao, H.C., Chang, H., Cianci, A.M., Huang, L.H., 2010. First financial restructuring and operating efficiency: evidence from Taiwanese commercial banks. *Journal of Banking and Finance* 34, 1461–1471.
- Kawai, M., 2010. Reform of the international financial architecture: an Asian perspective. *The Singapore Economic Review* 55, 207–242.
- Kim, B.H., Kim, S., 2012a. Transmission of the global financial crisis to Korea. *Journal of Policy Modeling*, <http://dx.doi.org/10.1016/j.jpolmod.2012.01.005>.
- Kim, I.J., Rhee, Y., 2009. Global financial crisis and the Korean economy. *Seoul Journal of Economics* 22, 145–179.
- Kim, J., Kim, Y.C., 2012b. Financial crisis and a transmission mechanism of external shocks: the signaling role of the Korean Monetary Stabilization Bond. *Journal of Financial Stability*, <http://dx.doi.org/10.1016/j.jfs.2012.06.002>.
- Krimminger, M.H., 2008. The resolution of cross-border banks: issues for deposit insurers and proposals for cooperation. *Journal of Financial Stability* 4, 376–390.
- Lee, C.P., 2009. Notable features of 2008 financial crisis and directions of adjustment by the Korean economy. *Seoul Journal of Economics* 22, 181–215.
- Lee, K., Lee, C.H., 2008. The miracle to crisis and the mirage of the postcrisis reform in Korea: assessment after ten years. *Journal of Asian Economics* 19, 425–437.
- Li, F., Duncan, T.E., Duncan, S.C., Hops, H., 2001. Piecewise growth mixture modeling of adolescent alcohol use data. *Structural Equation Modeling* 8, 175–204.
- Littell, R.C., Milliken, G.A., Stroup, W.W., Wolfinger, R.D., Schabenberger, O., 2006. *SAS for Mixed Models*, Second ed. SAS Institute, Cary, NC.
- McDowell, D., 2012. The US as 'Sovereign International Last-Resort Lender': the Fed's currency swap programme during the great panic of 2007–09. *New Political Economy* 17, 157–178.
- Mishkin, F.S., 1999. Lessons from the Asian crisis. *Journal of International Money and Finance* 18, 709–723.
- Ongena, S., Smith, D.C., Michalsen, D., 2003. Firms and their distressed banks: lessons from the Norwegian banking crisis. *Journal of Financial Economics* 67, 81–112.
- Park, J.H., Lee, S., 2009. Global financial crisis: background, prospects, and its impacts on Korea. *Seoul Journal of Economics* 22, 77–94.
- Pasquariello, P., 2007. Informative trading or just noise? An analysis of central bank interventions. *Journal of Financial Markets* 10, 107–143.
- Praet, P., Nguyen, G., 2008. Overview of recent policy initiatives in response to the crisis. *Journal of Financial Stability* 4, 368–375.
- Raddatz, C., 2006. Liquidity needs and vulnerability to financial underdevelopment. *Journal of Financial Economics* 80, 677–722.
- Raveh, A., 2000. The Greek banking system: reanalysis of performance. *European Journal of Operational Research* 120, 525–534.
- Rotheli, T.F., 2010. Causes of the financial crisis: risk misperception, policy mistakes, and banks' bounded rationality. *Journal of Socio-Economics* 39, 119–126.
- Sabi, M., 1996. Comparative analysis of foreign and domestic bank operations in Hungary. *Journal of Comparative Economics* 22, 179–188.
- SAS Institute Inc., 2010. *SAS/STAT User's Guide (SAS 9.2)*. SAS Institute Inc., Cary, NC.
- Sohn, W., 2010. Market response to bank relationships: evidence from South Korea bank reform. *Journal of Banking and Finance* 34, 2042–2055.
- Stojanovic, D., Vaughan, M.D., Yeager, T.J., 2008. Do federal home loan bank membership and advances increase bank risk-taking? *Journal of Banking and Finance* 32, 680–698.
- Sturm, J.E., Williams, B., 2004. Foreign bank entry, deregulation and bank efficiency: lessons from the Australian experience. *Journal of Banking and Finance* 28, 1775–1799.
- Zhang, Y., Tong, S.T., 2009. *Hong Kong's Economy in the Financial Crisis*, EAI Background Brief No. 448. National University of Singapore, Singapore.
- Zopounidis, C., 1998. *Operational Tools in the Management of Financial Risk*. Kluwer Academic Publishers Groups, New York.