The Korean Economic Review
Volume 36, Number 1, Winter 2020, 29-58.

The Efficiency of Financial Holding Companies in Korea*

Garam Ahn** · Frederick Dongchuhl Oh*** · Junghum Park****

This study uses data envelopment analysis to examine whether the government-driven policy of promoting the creation of financial holding companies enhances the productive efficiency of the Korean financial system. We find that financial holding company affiliation has no substantial effects on commercial banks, life insurance companies, and securities companies, regardless of whether or not the financial holding company is owned by the government. However, we find a positive association between the asset diversification of financial holding companies and the productive efficiencies of their affiliated commercial banks, indicating a possibility that financial holding companies can improve efficiency with increased diversification. Our results suggest that the Korean government's policy of promoting the creation of financial holding companies should be reconsidered.

JEL Classification: C14, C61, G21, G22, G24, G28
Keywords: Financial Holding Company, Efficiency, Data Envelopment Analysis, Financial Institution, Diversification

I. Introduction

In October 2000, the Korean government enacted the *Financial Holding Companies Act* to facilitate the creation of financial holding companies. This policy was driven by the government as a plan for restructuring the banking sector to

Received: July 4, 2017. Revised: Feb. 4, 2018. Accepted: June 13, 2018.

* We are very grateful to the editors (Kwanho Shin and Yoon-Jae Whang) and the two reviewers for their guidance and constructive comments. We also thank Hyung Seok Kim and Jinyong Kim for their helpful comments. Any errors that remain are ours.

** Second Author, Ph.D. Student, KAIST College of Business, Korea Advanced Institute of Science and Technology, 85 Hoegi-ro, Dongdaemoon-gu, Seoul 02455, Korea. E-mail: ys98163@kaist.ac.kr

*** Corresponding Author, Associate Professor, KAIST College of Business, Korea Advanced Institute of Science and Technology, 85 Hoegi-ro, Dongdaemoon-gu, Seoul 02455, Korea. E-mail: dcoh415@kaist.ac.kr. Phone: +82-2-958-3416. Fax: +82-2-958-3160

**** First Author, Ph.D. Student, Department of Economics, University of Essex, Wivenhoe Park, Colchester CO4 3SQ, UK. E-mail: pjh0101@gmail.com

improve the competitiveness of financial institutions, many of which became insolvent after the 1997 financial crisis.[1] A financial holding company controls different types of financial institutions through ownership of the institutions' stocks, thus engaging in a wide range of financial activities. As of December 2013, 13 financial holding companies had been established in Korea, starting with the creation of the Woori Financial Holding Group in April 2001. However, the system of operating financial holding companies has recently been questioned because of the excessive intervention of financial oversight authorities and the occurrence of managerial problems between the holding companies and their weighty banks (The Korea Herald, 2014).

Despite several theoretical arguments on the numerous potential benefits of financial holding companies, the question regarding the effectiveness of such companies is largely empirical. The direct benefits include various scope economies, such as the sharing of client information and the cross-selling of products. There are also indirect benefits.[2] However, Korean financial holding companies do not operate as efficiently as the theoretical arguments suggest because they fail to enjoy such benefits, whether direct or indirect. For example, the benefits from diversification are not necessarily realized because commercial banks take a dominant share in most financial holding companies, either in terms of revenue or asset size, such that these financial holding companies are not well diversified enough to realize the benefits. Moreover, government involvement in the management of financial holding companies may prevent the companies from using diversification benefits to improve their productive efficiency. Substantial anecdotal evidence indicates that the Korean government is involved in the process of selecting the chief executives and directors of Korean financial holding companies.[3] Aside from the direct costs related to the creation of a new holding company, the literature indicates that conglomeration may intensify agency problems by making it difficult to align the incentives of outside investors with those of managers, thereby leading to a lack of managerial effort (Rotemberg and Saloner, 1994) and a distortion in internal resource allocation (Scharfstein and Stein, 2000).

The question of whether the establishment of financial holding companies has

---

[1] The introduction of financial holding companies in Korea was largely motivated by a need for the imminent restructuring and structural reform of the financial sector when the so-called Asian Flu generated severe financial crises across most Asian countries. The Korean government expected that the financial holding company system would provide a friendlier environment for bank restructuring and thus improve transparency in the corporate governance of financial institutions. See the press release of the Financial Supervisory Service (2000).

[2] For example, a financial holding company improves monitoring delegation (Diamond, 1984) and relationship lending (Petersen and Rajan, 1994), which together lead to more efficient capital allocation through the use of internal capital markets (Gertner, Scharfstein, and Stein, 1994).

[3] For an article on the recent turmoil regarding the leadership of a Korean financial holding company, see Lee (2010).

improved the financial system's efficiency is important because it is directly related to policy decisions regarding the financial system. Compared with an analysis of accounting-based measures for profitability and operating performance (Naceur and Omran, 2011), efficiency analysis allows us to judge clearly the overall effect on the financial system independent of changes in factor prices. Hence, the results of productive efficiency changes directly indicate whether the policy promoting the creation of financial holding companies is viable or not.

The main hypothesis of this study is that commercial banks, life insurance companies, and securities companies affiliated with financial holding companies exhibit greater productive efficiency than do other companies of the same type. In this regard, we employ the notion of technical efficiency, which represents how efficiently the company under consideration uses inputs compared to a fully efficient company producing the same output. Data envelopment analysis (DEA) is also used to measure such efficiency. Contrary to our hypothesis, the results indicate that financial holding company affiliation has no significant effect on the productive efficiency of financial institutions.

Furthermore, we investigate the effect of the structural characteristics of financial holding companies. First, we perform a cross-sectional analysis of DEA efficiency scores to test whether the extent of asset diversification in financial holding companies affects the productive efficiency of financial institutions. We find that asset diversification has a positive effect on productive efficiency. Next, we divide the dummy variable of financial holding company affiliation into two dummy variables according to whether or not the government takes the largest equity shares of financial holding companies. We then perform a similar cross-sectional analysis to investigate the effect of government ownership of financial holding companies and find that such ownership has no significant effect on the productive efficiency of financial institutions.

In sum, the policy of promoting the establishment of financial holding companies in Korea is largely unsuccessful. The establishment of Korean financial holding companies does not help improve the Korean financial system's efficiency. The finding that the asset diversification of financial holding companies has a positive impact on the efficiency of their affiliated commercial banks indicates the need for policy reconsideration to help established Korean financial holding companies further diversify their services to enhance productive efficiency. Our results in this regard are consistent with the studies on financial conglomeration in Korea that suggest a negative effect on the market value of financial companies (Park, Park, Chang, Ko, and Chung, 2009) and an insignificant effect on the profitability of commercial banks (Lee and Park, 2010). Our results likewise support the argument that the failure of business diversification explains why financial conglomeration in Korea does not improve productive efficiency.

Although there has been a worldwide trend toward the deregulation of financial

service industries since the late 1990s, the results reported in the literature regarding the effect of financial conglomeration on the performance of financial companies are rather mixed. For example, prior studies on bank diversification in the United States following the passage of the Gramm–Leach–Bliley Act in 1999 suggest that the diversification of bank holding companies does not lead to any significant improvement in risk-adjusted profit (Chang and Elyasiani, 2015; Stiroh and Rumble, 2006) and even causes a negative effect on the productive efficiency of affiliated banks (Elyasiani and Wang, 2012). However, using combined abnormal returns from US bank holding company acquisitions, Filson and Olfati (2014) find that such diversification creates value. Outside of the United States, the results appear to be mixed as well. For example, while Laeven and Levine (2007) analyze 43 countries and find that diversification causes a discount in market valuation,[4] other studies report the positive effects of financial conglomeration on cost and profit efficiency (Shen and Chang, 2012; Vander Vennet, 2002) and profitability (Elsas, Hackethal, and Holzhäuser, 2010; Sanya and Wolfe, 2011). These mixed results can be interpreted as a sign that the effect of financial conglomeration possibly interacts with many other factors, including business strategy and market environments, as stated in our results. These country-specific factors are important in understanding the differences in the results on diversification between our study and Elyasiani and Wang (2012). For example, they include the differences in the scope of financial regulations on asset diversification across countries.

This paper is organized as follows: Section 2 summarizes the DEA methodology, Section 3 discusses the data and empirical models of our research, Section 4 reports the empirical results, and Section 5 concludes the paper.

II. Data Envelopment Analysis

In this study, DEA is used to measure the efficiency of Korean financial institutions. DEA is a prominent methodology of frontier analysis that measures efficiency in the sense of how close financial institutions are to a "best-practice" frontier. Frontier analysis methods differ in their ways of determining the best-practice frontier on an input–output space. The DEA aims to provide a linear programming technique for determining the best-practice frontier, as introduced by Charnes, Cooper, and Rhodes (1978). In this regard, DEA has several advantages over other frontier analysis methods. For example, it does not require any explicit specification of the functional form of the efficiency frontier, which is unknown and, therefore, arbitrarily determined. Moreover, it does not require data on output prices,

[4] Note that a discount in market valuation does not necessarily imply a decrease in productive efficiency because other factors also drive changes in market valuation, such as changes in factor prices.

for which it is often difficult to find appropriate proxies. Among different kinds of efficiency that can be estimated by DEA,[5] we utilize the notion of technical efficiency, which represents how close the input usage of a given company is to those of the best-practice efficient companies that are producing the same output.

The basic problem of input-oriented DEA is as follows.[6] Suppose there are N companies, indexed by $n = 1,\cdots,N$. Each of these companies commonly performs a production activity that converts I inputs into J outputs, where $i = 1,\cdots I$ indexes inputs, and $j = 1,\cdots,J$ indexes outputs. For a company $n \in \{1,\cdots,N\}$, $(x_i^n)_{1\le i\le I}$ denotes a vector of its inputs, and $(y_j^n)_{1\le j\le J}$ denotes a vector of its outputs. The objective of DEA is to measure the companies' productive efficiency on the basis of the input and output data. Without loss of generality, consider a company with inputs $(x_i^0)_{1\le i\le I}$ and outputs $(y_j^0)_{1\le j\le J}$ among these N companies and denote it as company 0. To obtain the company's DEA efficiency score, we solve an optimization program that is formulated as follows:

$$\max e^0 = \frac{\sum_{j=1}^{J} u_j^0 y_j^0}{\sum_{i=1}^{I} v_i^0 x_i^0},$$

subject to

$$\frac{\sum_{j=1}^{J} u_j^0 y_j^n}{\sum_{i=1}^{I} v_i^0 x_i^n} \le 1; n = 1,2,\ldots,N,$$

$$v_i^0, u_j^0 \ge 0; i = 1,2,\ldots,I; j = 1,2,\ldots,J.$$

The program above requires us to find a combination of non-negative weight numbers (i.e., u_j^0 and v_i^0 for $i = 1,2,\cdots,I$ and $j = 1,2,\cdots,J$) that maximizes a ratio of weighted outputs to weighted inputs for the company, subject to the condition that the similar ratios for all companies are not greater than 1. The maximum of this ratio, which varies between 0 and 1, is the DEA efficiency score assigned to the company. If the efficiency score equals 1, then the company is said to be DEA efficient. To obtain additional insight, we can consider the simplest case of $I = J = 1$, which corresponds to a problem of finding a non-negative weight $\alpha(:= \frac{v_1^0}{u_1^0})$, maximizing $e^0 = \frac{y_1^0}{x_1^0}\frac{1}{\alpha}$, and subject to $\frac{y_1^n}{x_1^n} \le \alpha$ for all n. In this case, the maximum value of e^0 equals the proportion of the input–output ratio for company 0 compared to the maximum attainable input–output ratio for all companies. This number is directly interpreted as how efficiently company 0 produces its outputs compared to the best-practice company. Charnes, Cooper, and Rhodes (1978) transformed the aforementioned problem into a linear programming

---

[5] For a detailed explanation of such concepts, see Coelli (1996).

[6] For the presentation of DEA, we follow the notation used by Sathye (2003).

problem to make it easier to solve. To solve this problem, we use software developed by Coelli (1996).

DEA is useful in measuring the productive performance of financial institutions. With regard to commercial banks, numerous studies compare the efficiency of one group of banks to that of another by using DEA efficiency scores, for example, government ownership (Bhattacharyya, Lovell, and Sahay, 1997; Sathye, 2003), market structure (Hou, Wang, and Zhang, 2014), bank size (Devaney and Weber, 2002; Drake and Hall, 2003), and foreign ownership (Havrylchyk, 2006). Recently, this methodology has been widely used in studying various aspects of the worldwide trend of bank consolidation in the 1990s. For example, Elyasiani and Wang (2012) find a negative association between activity diversification of bank holding companies in the United States and the productive efficiency of commercial banks affiliated with them. Furthermore, Chronopoulos, Girardone, and Nankervis (2013) examine whether the stock market price changes in operating efficiency as a result of bank mergers and find a significant relation between merger premium and post-merger efficiency gains.

DEA is also used extensively in the literature on non-bank financial institutions. For example, Cummins, Weiss, Xie, and Zi (2010) test for scope economies in the US insurance industry and show that strategic focus (either on life–health or property–liability insurance) is superior to conglomeration. In addition, DEA is used in the analyses on the efficiency of Asian securities companies. For example, Fukuyama and Weber (1999) use DEA to measure the productivity changes of Japanese securities companies during 1988–1993 and find that the collapse of the bubble economy in 1990 caused all such companies to experience a productivity decrease. Wang, Tseng, and Weng (2003) also use DEA efficiency scores to investigate the productive efficiency determinants of Taiwanese securities companies. They find that company size and service concentration are positively associated with efficiency scores.

III. Model Specification and Data

3.1. Model Specification

As noted in Section 2, DEA is used to measure the productive efficiency by year for commercial banks, life insurance companies, and securities companies. Specifically, we employ the notion of technical efficiency. Profit and cost efficiency measures that use DEA require data on factor prices, which are likely to be highly sensitive to the choice of proxy variables. Thus, technical efficiency provides us with a clearer evaluation of productive efficiency. This approach yields separate efficient

frontiers for each type of financial institution for each year of the sample period.[7] Efficiency scores vary between 0 and 1: The best practice companies have scores equal to 1, and other companies have scores between 0 and 1.[8]

To measure the DEA efficiency scores, we draw on the literature to determine adequate inputs and outputs. Given our concern that an excessive amount of inputs and outputs may lead to a large proportion of firms lying on the efficiency frontier, which makes comparing the performance of various firms possible, we only consider the main principal activities performed by each type of financial institution. For commercial banks, we presume that banks intermediate funds between depositors and borrowers (the so-called bank intermediation approach): *LABOR* (i.e., number of full-time employees), *DEPOSIT*, and *TAS* (i.e., tangible assets) are taken as inputs, while *LOAN* and *SECURITIES* are taken as outputs. The three inputs and two outputs represent the principal activities performed by commercial banks. Many existing studies on the banking sector use this approach to estimate the efficiency of commercial banks (Drake and Hall, 2003; Havrylchyk, 2006), including those in the Korean banking sector (Hall and Simper, 2013).

For life insurance companies, we consider two types of principal services provided by insurers to measure productive efficiency: risk-pooling and financial intermediation. Thus, we choose *INC_BNF* (i.e., amount of insurance benefits paid by the company) and *INV_ASSET* (i.e., invested assets) as outputs, as considered by Cummins, Weiss, Xie, and Zi (2010). *LABOR* (i.e., number of full-time officers plus agents) and *OPEX* (i.e., operating expenses) are chosen as inputs because they are regarded as principal inputs to perform the activities of risk pooling and financial intermediation, respectively.

For securities companies, three types of principal activities are considered: brokerage, underwriting, and equity dealing. This approach is based on previous studies on Asian securities companies (Fukuyama and Weber, 1999; Wang, Tseng, and Weng, 2003). Accordingly, we choose *LABOR* (i.e., number of full-time employees) and *CAPITAL* (i.e., tangible fixed assets plus intangible fixed assets) as inputs to perform these activities. We also choose *BROKERAGE* (i.e., brokerage revenue), *UNDERWRITING* (i.e., underwriting revenue), and *EQUITY_*

---

[7] The use of separate efficient frontiers by year allows us to avoid comparisons between the same company's efficiencies in different years (see Cummins, Weiss, Xie, and Zi, 2010).

[8] Note that efficiency scores can be decomposed into pure technical efficiency and scale efficiency (Färe, Grosskopf, and Lovell, 1985). However, given that our sample is not large, we suspect that using the decomposed scores (i.e., pure technical efficiency) will provide misleading analyses for firms with a relatively large size. As noted by Havrylchyk (2006): When only one firm is particularly large relative to other firms, the firm is very likely to lie on the efficiency frontier under the assumption of variable returns to scale, and thus, its pure efficiency score simply equals 1. Furthermore, the efficiency scores could be used to construct Malmquist indices of productivity, which will measure annual changes in productive efficiency of financial institutions in our context. However, we choose to focus on the cross-sectional variation of efficiency, which is more directly analyzed with efficiency scores.

DEALING (i.e., equity dealing revenue) as outputs because these revenue variables reflect the intensity of the three principal activities of securities companies.

We perform the univariate and multivariate analyses of the DEA efficiency scores related to financial holding company affiliation for each type of financial institution (i.e., commercial banks, life insurance companies, and securities companies). For the analyses on the determinants of efficiency scores, the observations of the year of establishment of the financial holding company with which the financial institution is affiliated is excluded because of potential concerns related to the confounding effects in these conversion years. With efficiency scores varying between 0 and 1 and a substantial portion of firms having efficiency scores equal to 1, numerous existing studies use a Tobit regression of the efficiency scores to find the effect of some firm-specific characteristics on the productive efficiency of commercial banks (Elyasiani and Wang, 2012; Havrylchyk, 2006), insurance companies (Cummins, Weiss, Xie, and Zi, 2010), and securities companies (Wang, Tseng, and Weng, 2003). Following this line of literature, we use Tobit regression to find the determinants of these scores. The following regression equations are used:

$$TE^*_{i,t} = \alpha_0 + \alpha_1 FHC_{i,t} + \varepsilon_{i,t}; \tag{1}$$

$$TE^*_{i,t} = \alpha_0 + \alpha_1 FHC_{i,t} + f(Controls_{i,t}) + \varepsilon_{i,t}; \tag{2}$$

$$TE^*_{i,t} = \alpha_0 + \alpha_1 FHC_{i,t} + \gamma_t + \varepsilon_{i,t}; \tag{3}$$

and

$$TE^*_{i,t} = \alpha_0 + \alpha_1 FHC_{i,t} + f(Controls_{i,t}) + \gamma_t + \varepsilon_{i,t}, \tag{4}$$

where $TE_{i,t}$ is the DEA efficiency score of financial institution i at time t, and $TE^*_{i,t}$ is the unobservable dependent variable used for the cross-sectional analyses, such that $TE^*_{i,t}$ equals 1 if $TE^*_{i,t} > 1$ and takes the same value as $TE^*_{i,t}$ otherwise. $FHC_{i,t}$ is the dummy variable that equals 1 if the financial institution is affiliated with a financial holding company, and 0 otherwise; and γ_t is a time-t dummy variable. Our main hypothesis asserts that the coefficients on $FHC_{i,t}$ are positive for all regressions.

We draw on the literature to choose control variables that may affect the productive efficiency of commercial banks (Havrylchyk, 2006), insurance companies (Cummins, Weiss, Xie, and Zi, 2010), and securities companies (Wang, Tseng, and Weng, 2003). For commercial banks, *SIZE* (i.e., logarithm of total assets), *LOAN_RATIO* (i.e., proportion of loans to total assets), and *VOLATILITY* (i.e., variance of annual returns on assets over three years prior to the current year) are expected to be associated with productive efficiency. The signs of the coefficients on these control variables are ambiguous. For example, while some previous results find increasing returns to scale using DEA (Drake and Hall, 2003), no general agreement exists in the literature over the relationship between bank size and

efficiency. Moreover, the effects of *LOAN_RATIO* and *VOLATILITY* are likely to depend on the market and regulatory environment and, therefore, differ across countries.

For life insurance companies, we choose *SIZE* (i.e., logarithm of total assets), *EQUITY_RATIO* (i.e., proportion of equity capital to total assets), and *RISKY_INV* (i.e., proportion of stocks and real estate to total invested assets) following Cummins, Weiss, Xie, and Zi (2010). These authors find a positive association between company size and efficiency, a negative relationship between the ratio of equity capital over total assets and efficiency, and a negative relationship between the riskiness of investments and efficiency, even though the differences in some cross-country factors may lead to different signs of these variables' effects.

For securities companies, the control variables are *SIZE* (i.e., logarithm of total assets), *OP_RISK* (i.e., value of losses in equity dealing divided by operating revenue), and *H* [i.e., Herfindahl–Hirschman index (HHI)] based on revenues from three types of services, namely, brokerage, underwriting, and equity dealing). In this context, Wang, Tseng, and Weng (2003) find that company size and the extent of operating risk are positively associated with efficiency.

To examine the impact of the extent of diversification in financial holding companies, we construct a measure of asset diversification in one such company, where X denotes the total assets of a financial holding company, and X_0 denotes the assets of its largest subsidiary. To measure the extent to which the assets of financial holding companies are evenly distributed across their affiliated banks, life insurance companies, and securities companies, we define $DIV_{i,t}$ as follows:

$$DIV_{i,t} = 1 - \left| \frac{X_0 - (X - X_0)}{X} \right|.$$

If a company-year observation does not belong to a financial holding company, then its $DIV_{i,t}$ will be 0. This asset-based measure reflects the comparison between the financial holding company's core financial service and all other services, an approach that is similar to that used by Laeven and Levine (2007).

To test for the various impacts of financial holding companies across the extent of asset diversification, we use the following regression equations:

$$TE^*_{i,t} = \alpha_0 + \alpha_1 DIV_{i,t} + \varepsilon_{i,t}; \tag{5}$$

$$TE^*_{i,t} = \alpha_0 + \alpha_1 DIV_{i,t} + f(Controls_{i,t}) + \varepsilon_{i,t}; \tag{6}$$

$$TE^*_{i,t} = \alpha_0 + \alpha_1 DIV_{i,t} + \gamma_t + \varepsilon_{i,t}; \tag{7}$$

and

$$TE^*_{i,t} = \alpha_0 + \alpha_1 DIV_{i,t} + f(Controls_{i,t}) + \gamma_t + \varepsilon_{i,t}. \tag{8}$$

To investigate the effect of government ownership of financial holding companies, we perform similar regressions with those used for our main hypothesis. In particular, $FHC_{i,t}$ is divided into two dummy variables, $FHC\_GOV_{i,t}$ and $FHC\_PRIV_{i,t}$, in which $FHC\_GOV_{i,t}$ ($FHC\_PRIV_{i,t}$) equals 1 if the financial institution belongs to a financial holding company where the government (a non-government shareholder) takes the largest possession of equity shares, and 0 otherwise. To test for the various impacts of government-owned and privately owned financial holding companies, we use the following regression equations:

$$TE^*_{i,t} = \alpha_0 + \alpha_1 FHC_{GOV_{i,t}} + \alpha_2 FHC_{PRIV_{i,t}} + \varepsilon_{i,t}; \quad (9)$$

$$TE^*_{i,t} = \alpha_0 + \alpha_1 FHC_{GOV_{i,t}} + \alpha_2 FHC_{PRIV_{i,t}} + \alpha_3 DIV_{i,t} + f(Controls_{i,t}) + \varepsilon_{i,t}; \quad (10)$$

$$TE^*_{i,t} = \alpha_0 + \alpha_1 FHC\_GOV_{i,t} + \alpha_2 FHC\_PRIV_{i,t} + \gamma_t + \varepsilon_{i,t}; \quad (11)$$

and

$$TE^*_{i,t} = \alpha_0 + \alpha_1 FHC_{GOV_{i,t}} + \alpha_2 FHC_{PRIV_{i,t}} + \alpha_3 DIV_{i,t} + f(Controls_{i,t}) + \gamma_t + \varepsilon_{i,t}, \quad (12)$$

where the variables other than $FHC\_GOV_{i,t}$ and $FHC\_PRIV_{i,t}$ are similar to those of our main regressions.

3.2. Data

Our sample comprises 150 company-year observations of commercial banks, 140 company-year observations of life insurance companies, and 240 company-year observations of securities companies from 2004 to 2013. Although financial holding companies first appeared in Korea in 2001, we exclude the initial period from 2001 to 2003 because the new regulatory environment may have required an adjustment period. This circumstance reflects a radical change in the market environment, possibly making it difficult to interpret the results obtained for the period. These initial years were characterized by a wave of bank consolidations in Korea. The HHIs are relatively stable throughout our sample period from 2004 to 2013.[9] For example, only one consolidation happened in the banking industry during this period (i.e., Shinhan Bank and Chohung Bank). Foreign life insurance and securities companies are also excluded because they are likely to have a different production technology from that of domestic companies. The asset proportion of foreign companies in life insurance (securities) industries never exceeds 20% (10%) over the sample period.

For the data regarding asset diversification, we use the Data Analysis, Retrieval, and Transfer System provided by the Financial Supervisory Service. All other data

[9] See Figure 3 of Yun and Jin (2011).

are taken from the Financial Statistics Information System operated by the Financial Supervisory Service.

IV. Empirical Results

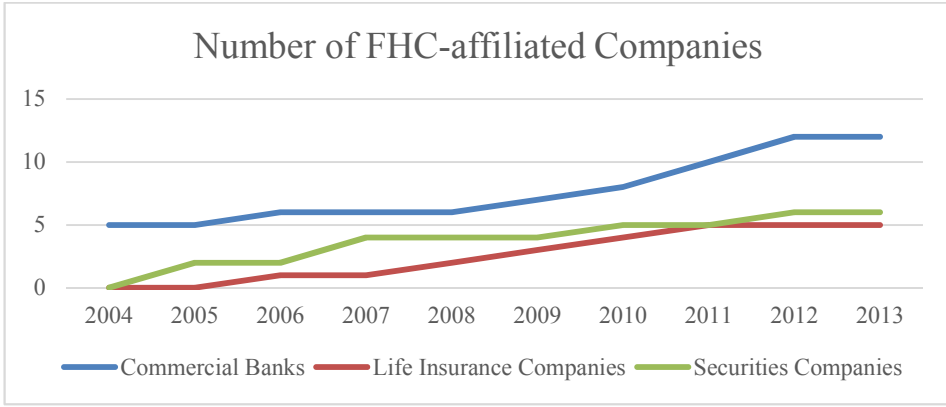
Table 1 presents the number of financial holding company affiliations (Panel A) and summary statistics by year for our sample of commercial banks (Panel B), life insurance companies (Panel C), and securities companies (Panel D). Panels B, C, and D show that mean *FHC* increases over time, a result that reflects an increasing trend among the proportion of companies in all three types of financial institutions affiliated with financial holding companies. Mean *FHC* also varies substantially across the types of financial institutions: 0.5422 for commercial banks, 0.1898 for life insurance companies, and 0.1730 for securities companies. These figures indicate that more than half of the observations are of commercial banks affiliated with financial holding companies. However, most life insurance and securities companies are still standalone.

Table 2 presents the average efficiency scores of commercial banks, life insurance companies, and securities companies by year and financial holding company affiliations. It shows that the average efficiency score is 0.7489 for commercial banks, 0.7288 for life insurance companies, and 0.5475 for securities companies. No

[Table 1] Descriptive Statistics by Year

The panels below report the number of financial holding company affiliations (Panel A) and the descriptive statistics of variables used in our analyses, such as DEA inputs and outputs and the control variables associated with efficiency scores, for commercial banks (Panel B), life insurance companies (Panel C), and securities companies (Panel D).

Panel A: Number of FHC-affiliated Companies



Panel B: Commercial Banks

LABOR is the number of full-time employees. *DEPOSIT*, *TAS* (i.e., tangible assets), *LOAN*, and *SECURITY* are the nominal values in units of 1,000 won. *FHC* is the dummy variable that takes 1 if the company is affiliated with a financial holding company in that year. *SIZE* is the logarithm of total assets. *LOAN_RATIO* is the proportion of loans to total assets. *VOLATILITY* is the variance of annual returns on assets (ROA) over the three years prior to the year of observation.

		Inputs			Outputs		*FHC*	*SIZE*	*LOAN_RATIO*	*VOLATILITY*
		LABOR	*DEPOSIT*	*TAS*	*LOAN*	*SECURITY*				
2013	N	15	15	15	15	15	14	14	14	14
	Mean	6,806	64,034,568	1,640,552	66,253,390	16,731,509	0.8571	7.8382	0.7011	0.1424
	Median	4,093	33,694,805	831,934	28,538,740	12,528,943	1	7.8785	0.7213	0.0439
	SD	6,187	63,846,400	1,585,284	62,838,353	13,059,855	0.3631	0.5363	0.0764	0.2750
2012	N	15	15	15	15	15	15	15	15	15
	Mean	6,477	62,339,955	1,627,772	63,232,055	17,498,196	0.8000	7.7796	0.6929	0.0503
	Median	4,059	38,652,334	757,638	30,051,701	14,199,185	1	7.8114	0.7038	0.0141
	SD	5,958	61,643,043	1,572,381	60,317,405	13,858,742	0.4140	0.5530	0.0651	0.0761
2011	N	15	15	15	15	15	13	13	13	13
	Mean	6,324	59,714,974	1,608,784	61,021,805	17,136,729	0.7692	7.8013	0.6954	0.0613
	Median	4,265	34,086,887	744,101	35,648,967	13,283,612	1	7.9832	0.7116	0.0374
	SD	5,879	60,923,850	1,552,436	59,263,914	13,868,425	0.4385	0.5920	0.0652	0.0571
2010	N	15	15	15	15	15	14	14	14	14
	Mean	6,297	54,907,782	1,486,346	56614,732	16,230,437	0.5714	7.7338	0.6937	0.0379
	Median	4,313	34,226,108	721,592	37699,732	13,270,703	1	7.9036	0.6998	0.0315
	SD	5,950	57,261,225	1,,472,007	55730,409	12,957,300	0.5136	0.5828	0.0542	0.0274
2009	N	15	15	15	15	15	13	13	13	13
	Mean	6,460	50,544,380	1,479,642	54,500,315	16,018,275	0.5385	7.6782	0.6972	0.0850
	Median	4,246	31,537,910	716,936	34,579,834	13,829,175	1	7.7195	0.6931	0.0455
	SD	6,646	55,031,350	1,485,305	54,618,193	13,210,663	0.5189	0.6111	0.0597	0.0798

2008	N	15	15	15	15	15	14	14	14	14
	Mean	6,169	47,185,028	1,485,109	52,294,037	16,468,470	0.4286	7.6812	0.6439	0.1291
	Median	3,742	25,861,277	806,071	31,158,230	12,112,576	0	7.8387	0.6782	0.0285
	SD	6,228	51,015,966	1,484,490	53,452,184	15,330,258	0.5136	0.5831	0.0963	0.2764
2007	N	15	15	15	15	15	15	15	15	15
	Mean	5,519	39,985,859	1,316,664	45,943,858	15,046,094	0.4000	7.6576	0.6774	0.0903
	Median	4,040	22,465,794	791,976	24,512,350	9,760,733	0	7.7240	0.6768	0.0097
	SD	5,314	43,975,436	1,191,235	46,386,208	14,685,468	0.5071	0.5668	0.0772	0.2472
2006	N	15	15	15	15	15	15	15	15	15
	Mean	5,074	38,564,184	1,265,862	39,874,129	14,459,130	0.4000	7.6139	0.6690	0.2010
	Median	4,190	26,364,993	793,869	20,714,588	12,409,802	0	7.7545	0.6697	0.0494
	SD	4,819	40,153,717	1,143,635	39,661,740	12,717,268	0.5071	0.5656	0.0744	0.3535
2005	N	15	15	15	15	15	14	14	14	14
	Mean	4,617	32,967,277	1,077,476	32,531,909	10,227,699	0.3571	7.5129	0.6553	0.4431
	Median	4,016	27,493,970	782,480	20,121,038	7,050,651	0	7.7077	0.6446	0.0759
	SD	4,443	33,923,696	950,981	32,475,309	9,907,985	0.4972	0.5620	0.0656	0.8598
2004	N	15	15	15	15	15	15	15	15	15
	Mean	4,669	30,802,207	1,038,585	30,307,916	12,151,990	0.3333	7.5004	0.6673	0.1548
	Median	3,859	27,488,106	774,529	23,583,237	11,424,047	0	7.7172	0.6529	0.1102
	SD	4,840	32,988,315	923,956	31,962,280	11,632,506	0.4880	0.5596	0.0722	0.1400
Totals	N	150	150	150	150	150	142	142	142	142
	Mean	5,841	48,104,621	1,402,679	50,257,415	15,196,853	0.5422	7.6777	0.6790	0.1400
	Median	4,076	28,141,220	782,480	26,557,065	12,528,943	1	7.7889	0.6898	0.0403
	SD	5,547	51,023,688	1,333,385	50,730,589	12,990,772	0.5000	0.5630	0.0718	0.3415

Panel C: Life Insurance Companies

LABOR is the number of full-time officers and agents. *OPEX* is the operating expense. *INC_BNF* is benefits paid by the insurance company (the equivalent of benefits paid to policyholders). *INV_ASSET* is the amount of invested assets. *OPEX*, *INC_BNF*, and *INV_ASSET* are the nominal values in units of 1,000 won. *FHC* is the dummy variable that takes 1 if the company is affiliated with a financial holding company in that year. *SIZE* is the logarithm of total assets. *EQUITY_RATIO* is the proportion of equity capital to total assets. *RISKY_INV* is the proportion of stocks and real estate to total invested assets.

		Inputs		Outputs		*FHC*	*SIZE*	*EQUITY_RATIO*	*RISKY_INV*
		LABOR	*OPEX*	*INC_BNF*	*INV_ASSET*				
2013	N	14	14	14	14	14	14	14	14
	Mean	10,375	289,072	1,608,647	26,972,026	0.3571	7.2182	0.0650	0.0879
	Median	5,653	159,313	1,008,858	13,169,704	0	7.2397	0.0648	0.0730
	SD	12,107	331,955	1,861,419	41,036,467	0.4972	0.5265	0.0200	0.0756
2012	N	14	14	14	14	14	14	14	14
	Mean	11,119	264,587	1,535,053	24,823,246	0.3571	7.1748	0.0749	0.0831
	Median	5,946	147,411	979,343	11,632,114	0	7.1894	0.0718	0.0710
	SD	13,466	313,837	1,856,670	38,768,128	0.4972	0.5299	0.0195	0.0716
2011	N	14	14	14	14	14	14	14	14
	Mean	10,924	242,943	1,420,326	21,520,377	0.3571	7.1063	0.0712	0.899
	Median	5,360	127,718	928,714	9,361,980	0	7.1182	0.0698	0.0718
	SD	13,847	304,003	1,805,696	33,909,062	0.4972	0.5402	0.0203	0.0736
2010	N	14	14	14	14	14	14	14	14
	Mean	10,585	227,126	1,438,248	19,522,200	0.2857	7.0554	0.0729	0.0952
	Median	6,022	114,347	886,211	7,831,452	0	7.0594	0.0743	0.0681
	SD	12,548	297,695	1,933,982	31,701,775	0.4688	0.5554	0.0209	0.0785
2009	N	14	14	14	14	13	13	13	13
	Mean	11,647	212,640	1,513,428	17,243,504	0.2308	6.9803	0.0642	0.1066
	Median	6,577	110,275	764,328	6,653,482	0	7.0024	0.0601	0.0806

	SD	14,233	264,350	2,330,462	28,736,353	0.4385	0.6109	0.0160	0.0893
2008	N	14	14	14	14	13	13	13	13
	Mean	12,600	216,458	1,630,123	15,541,394	0.1538	6.9459	0.0553	0.1325
	Median	9,053	115,237	769,460	5,627,658	0	6.9303	0.0500	0.1369
	SD	14,434	256,872	2,429,260	26,482,791	0.3755	0.6112	0.0126	0.0803
2007	N	14	14	14	14	14	14	14	14
	Mean	10,159	210,762	1,650,195	14,456,974	0.0714	6.8342	0.0590	0.1392
	Median	6,345	107,939	688,136	5,103,449	0	6.8598	0.0609	0.1181
	SD	11,397	264,055	2,606,182	25,103,604	0.2673	0.6397	0.0159	0.0992
2006	N	14	14	14	14	14	14	14	14
	Mean	9,661	176,729	1,363,431	13,238,421	0.0714	6.7508	0.0558	0.1301
	Median	5,839	85,977	521,978	4,440,961	0	6.7907	0.0552	0.1277
	SD	11,780	244,515	2,226,811	23,463,355	0.2673	0.6721	0.0146	0.0899
2005	N	14	14	14	14	13	13	13	13
	Mean	9,445	188,412	1,503,996	12,124,508	0	6.7358	0.0544	0.1423
	Median	4,990	82,761	480,361	3,935,139	0	6.7240	0.0548	0.1555
	SD	12,436	266,609	2,577,828	22,134,324	0	0.6793	0.0148	0.1064
2004	N	14	14	14	14	14	14	14	14
	Mean	10,171	240,407	1,338,859	11,149,774	0	6.5613	0.0510	0.1326
	Median	5,442	140,221	411,608	3,331,984	0	6.6327	0.0467	0.1284
	SD	13,533	293,980	2,299,848	20,770,451	0	0.7663	0.0523	0.1113
Totals	N	140	140	140	140	137	137	137	137
	Mean	10,679	226,319	1,502,478	18,058,562	0.1898	6.9374	0.0626	0.1136
	Median	5,944	116,108	626,611	5,495,081	0	6.8699	0.0604	0.0931
	SD	12,613	277,554	2,141,746	29,420,911	0.3936	0.6304	0.0242	0.0884

Panel D: Securities Companies

LABOR is the number of full-time employees. *CAPITAL* is the sum of tangible and intangible fixed assets. *BROKERAGE*, *UNDERWRITING*, and *EQUITY_DEALING* are the nominal values of the revenues from these services in units of 1,000 won. *FHC* is the dummy variable that takes 1 if the company is affiliated with a financial holding company in that year. *Size* is the logarithm of total assets. *H* is the extent of concentration (i.e., Herfindahl-Hirschmann index) of the revenues from brokerage, underwriting, and equity dealing services. *OP_RISK* is the value of losses from equity dealing divided by operating revenue.

		Inputs			Outputs					
		LABOR	*CAPITAL*	*BROKERAGE*	*UNDER WRITING*	*EQUITY_ DEALING*	*FHC*	*SIZE*	*H*	*OP_RISK*
2013	N	24	24	24	24	24	24	24	24	24
	Mean	1,487	135,037	100,072	19,506	278,818	0.2500	6.8540	0.5546	0.3198
	Median	985	87,582	77,167	15,001	208,104	0	6.7883	0.5613	0.3129
	SD	915	119,983	75,557	12,064	208,128	0.4423	0.4167	0.0846	0.0860
2012	N	24	24	24	24	24	24	24	24	24
	Mean	1,572	141,439	105,683	19,059	326,593	0.2500	6.8499	0.5712	0.3099
	Median	1,060	88,954	74,296	16,891	295,535	0	6.8215	0.5322	0.3009
	SD	960	126,888	80,210	10,930	245,639	0.4423	0.3835	0.1383	0.1543
2011	N	24	24	24	24	24	23	23	23	23
	Mean	1,573	141,397	157,836	19,152	643,265	0.2174	6.7998	0.5997	0.3092
	Median	1,076	95,791	92,452	14,386	454,360	0	6.7147	0.5543	0.2593
	SD	997	120,993	123,765	14,133	689,002	0.4217	0.3678	0.1398	0.1808
2010	N	24	24	24	24	24	24	24	24	24
	Mean	1,539	158,549	150,400	19,679	522,812	0.2083	6.7219	0.5916	0.3580
	Median	1,056	119,780	89,232	17,294	389,975	0	6.686	0.5301	0.3395
	SD	985	149,392	123,790	11,939	505,054	0.4149	0.3668	0.1526	0.1817
2009	N	24	24	24	24	24	24	24	24	24
	Mean	1,498	168,562	164,474	21,179	404,796	0.2083	6.6040	0.5437	0.3304

	Median	1,054	124,858	100,382	14,993	245,716	0	6.5129	0.5193	0.3288
	SD	981	158,788	134,708	15,444	402,499	0.4149	0.4174	0.1120	0.1469
2008	N	24	24	24	24	24	23	23	23	23
	Mean	1,480	219,000	105,864	13,439	606,474	0.1739	6.4990	0.6462	0.2899
	Median	1,084	129,812	70,825	10,961	391,390	0	6.5244	0.5989	0.2578
	SD	981	217,972	89,112	10,832	647,169	0.3876	0.4955	0.1402	0.1651
2007	N	24	24	24	24	24	24	24	24	24
	Mean	1,384	197,478	167,621	14,447	332,325	0.1667	6.4046	0.5583	0.2595
	Median	1,059	87,198	110,509	11,620	85,017	0	6.4079	0.5380	0.2158
	SD	964	208,955	150,150	11,006	451,579	0.3807	0.5325	0.1105	0.1975
2006	N	24	24	24	24	24	24	24	24	24
	Mean	1,168	184,474	92,890	10,102	230,978	0.1667	6.2402	0.5299	0.2167
	Median	961	79,990	58,245	8,716	31,066	0	6.1800	0.5101	0.1112
	SD	842	201,547	86,141	8,070	363,370	0.3807	0.5450	0.1022	0.1934
2005	N	24	24	24	24	24	23	23	23	23
	Mean	1,100	191,775	116,411	8,483	108,820	0.0870	6.1289	0.5084	0.1464
	Median	884	89,512	74,186	7,525	41,784	0	6.0673	0.4931	0.1129
	SD	815	215,430	111,355	7,524	134,248	0.2881	0.5572	0.0734	0.1026
2004	N	24	24	24	24	24	24	24	24	24
	Mean	1,039	171,952	61,495	6,188	51,399	0	5.971	0.4866	0.1271
	Median	796	86,589	37,130	4,210	26,507	0	5.9314	0.4792	0.1125
	SD	776	185,595	57,170	6,632	58,870	0	0.5030	0.0592	0.0697
Totals	N	240	240	240	240	240	237	237	237	237
	Mean	1,384	170,966	122,274	15,123	350,628	0.1730	6.5077	0.5587	0.2669
	Median	1,020	97,704	76,273	11,956	157,489	0	6.5877	0.5249	0.2575
	SD	928	173,399	110,347	12,103	453,714	0.3790	0.5447	0.1212	0.1687

[Table 2] Average Efficiency Scores by Year

This table presents summary statistics for the efficiency scores of commercial banks, life insurance companies, and securities companies by year and financial holding company affiliation. As noted in Section 2, we use data envelopment analysis (DEA) to obtain efficiency scores. We exclude those company-year observations that have the same year as the establishment of the affiliated financial holding companies.

		Commercial Banks			Life Insurance Companies			Securities Companies		
		Total	FHC	Non-FHC	Total	FHC	Non-FHC	Total	FHC	Non-FHC
2013	N	14	12	2	14	5	9	24	6	18
	Mean	0.7309	0.7305	0.7335	0.753	0.8194	0.7161	0.6264	0.7313	0.5914
	Median	0.7195	0.7195	0.7335	0.8020	0.8300	0.6180	0.5300	0.6645	0.4995
	SD	0.2107	0.1989	0.3768	0.2074	0.2127	0.2074	0.2232	0.2196	0.2192
2012	N	15	12	3	14	5	9	24	6	18
	Mean	0.7108	0.7241	0.6576	0.8372	0.8184	0.8477	0.5689	0.6783	0.5324
	Median	0.6800	0.7350	0.5360	0.8330	0.7820	0.8820	0.4430	0.637	0.4185
	SD	0.2351	0.2302	0.3005	0.1475	0.1543	0.1521	0.2569	0.2754	0.2477
2011	N	13	10	3	14	5	9	23	5	18
	Mean	0.7100	0.7510	0.5736	0.8240	0.7682	0.8550	0.5183	0.6302	0.4873
	Median	0.9390	0.9620	0.3630	0.8410	0.6950	0.8680	0.4140	0.600	0.3920
	SD	0.3167	0.3089	0.3692	0.1640	0.1454	0.1735	0.2269	0.2294	0.2226
2010	N	14	8	6	14	4	10	24	5	19
	Mean	0.7161	0.7676	0.6475	0.8381	0.7915	0.8568	0.6528	0.7728	0.6212
	Median	0.7400	0.7440	0.6205	0.9215	0.8525	0.9215	0.6340	0.7350	0.5920
	SD	0.2466	0.2240	0.2793	0.1935	0.2605	0.1735	0.2220	0.1375	0.2318
2009	N	13	7	6	13	3	10	24	5	19
	Mean	0.7755	0.8618	0.6748	0.7315	0.5677	0.7807	0.6550	0.7358	0.6338
	Median	0.9570	0.9910	0.6735	0.7210	0.5780	0.8405	0.6395	0.6810	0.6100

	SD	0.2671	0.2200	0.3010	0.2094	0.1448	0.2053	0.2392	0.1665	0.2543
2008	N	14	6	8	13	2	11	23	4	19
	Mean	0.7237	0.8281	0.6453	0.6506	0.5165	0.6750	0.4500	0.3885	0.4630
	Median	0.7920	0.8460	0.5310	0.6560	0.5165	0.7150	0.4020	0.4080	0.4020
	SD	0.2659	0.1785	0.3037	0.1845	0.1973	0.1809	0.2153	0.1189	0.2308
2007	N	15	6	9	14	1	13	24	4	20
	Mean	0.7506	0.8575	0.6794	0.6659	0.695	0.6636	0.5228	0.4153	0.5443
	Median	0.7420	0.8460	0.6220	0.6250	0.6950	0.5840	0.4730	0.4085	0.5015
	SD	0.2242	0.1238	0.2532	0.2274	0	0.2366	0.2147	0.1590	0.2211
2006	N	15	6	9	14	1	13	24	4	20
	Mean	0.8136	0.9071	0.7513	0.7079	0.6490	0.7124	0.4483	0.2925	0.4795
	Median	0.8490	0.9475	0.6660	0.6820	0.6490	0.7150	0.3935	0.3155	0.4065
	SD	0.1900	0.1205	0.2078	0.2708	0	0.2708	0.2668	0.1372	0.2775
2005	N	14	5	9	13	0	13	23	2	21
	Mean	0.7939	0.7140	0.8383	0.7091	-	0.7091	0.4989	0.4685	0.5018
	Median	0.8790	0.8720	0.8860	0.7240	-	0.7240	0.4400	0.4685	0.4280
	SD	0.2756	0.4129	0.1789	0.2387	-	0.2387	0.2542	0.0007	0.2665
2004	N	15	5	10	14	0	14	24	0	24
	Mean	0.7606	0.6270	0.8275	0.5643	-	0.5643	0.5258	-	0.5258
	Median	0.8130	0.6680	0.9395	0.4755	-	0.4755	0.4765	-	0.4765
	SD	0.2802	0.3750	0.2114	0.2066	-	0.2066	0.2474	-	0.2474
Totals	N	142	77	65	137	26	111	237	41	196
	Mean	0.7489	0.7714	0.7223	0.7288	0.7414	0.7259	0.5475	0.5969	0.5371
	Median	0.7950	0.8350	0.6840	0.7240	0.7060	0.7250	0.4690	0.6000	0.4505
	SD	0.2468	0.2426	0.2509	0.2104	0.1920	0.2152	0.2440	0.2401	0.2441

striking trend is observed for the average efficiency scores over time. With regard to the comparison between companies affiliated with financial holding companies and those standing alone, financial holding company affiliation appears to be positively associated with the efficiency score. The average efficiency score for commercial banks affiliated with financial holding companies (i.e., 0.7714) has a slightly higher average than that for other commercial banks (i.e., 0.7223). A similar conclusion is drawn for the average efficiency scores for life insurance companies and securities companies.

Table 3 presents the results of Tobit regressions on commercial banks (Panel A), life insurance companies (Panel B), and securities companies (Panel C) to test our main hypothesis, which predicts that the coefficient on the *FHC* dummy variable is positive for all three types of financial institutions. Contrary to our hypothesis, these regressions show that the coefficient for *FHC* is insignificant, indicating that financial holding company affiliation has no significant impact on the productive efficiency of commercial banks, life insurance companies, and securities companies.

[Table 3] Effects of Financial Holding Company Affiliation on Efficiency

The panels below present the effects of financial holding company affiliation on the productive efficiencies of commercial banks (Panel A), life insurance companies (Panel B), and securities companies (Panel C). The dependent variable is *TE*, which is the efficiency score obtained by DEA, as introduced in Section 2. Other control variables are *SIZE*, *LOAN_RATIO*, and *VOLATILITY* for commercial banks; *SIZE*, *EQUITY_RATIO*, and *RISKY_INV* for life insurance companies; and *SIZE*, *H*, and *OP_RISK* for securities companies. These control variables are defined in Table 1. We also report the likelihood ratio chi-squared statistic, which is used to test the null hypothesis that all regression coefficients are simultaneously equal to 0. We exclude the company-year observations that have the same year as the establishment of the affiliated financial holding companies. The values in parentheses are standard deviations, and *, **, and *** denote the significant differences from 0 at the 10%, 5%, and 1% levels, respectively.

Panel A: Commercial Banks

	(1)	(2)	(3)	(4)
FHC	0.043	0.029	0.084	0.075
	(0.062)	(0.062)	(0.065)	(0.064)
SIZE		0.106*		0.137**
		(0.055)		(0.055)
LOAN_RATIO		0.747*		0.792*
		(0.440)		(0.435)
VOLATILITY		0.097		0.053
		(0.090)		(0.092)
Constant	0.802***	-0.530	0.821***	-0.748
	(0.046)	(0.463)	(0.097)	(0.465)
Year Dummies			Included	Included

Observations	142	142	142	142
LR chi-squared	0.49	10.14**	4.34	16.44*

Panel B: Life Insurance Companies

	(1)	(2)	(3)	(4)
FHC	0.022	0.065	-0.062	0.009
	(0.056)	(0.055)	(0.055)	(0.055)
SIZE		0.077**		0.028
		(0.038)		(0.040)
EQUITY_RATIO		2.774***		2.082**
		(0.904)		(0.870)
RISKY_INV		0.280		0.532**
		(0.269)		(0.267)
Constant	0.751***	0.006	0.571***	0.211
	(0.025)	(0.241)	(0.061)	(0.246)
Year Dummies			Included	Included
Observations	137	137	137	137
LR chi-squared	0.40	23.42***	24.70**	38.20***

Panel C: Securities Companies

	(1)	(2)	(3)	(4)
FHC	0.063	0.064	0.049	0.066
	(0.048)	(0.052)	(0.046)	(0.050)
SIZE		-0.080*		-0.060
		(0.041)		(0.043)
H		0.023		0.170
		(0.180)		(0.182)
OP_RISK		0.724***		0.618***
		(0.146)		(0.145)
Constant	0.553***	0.998***	0.543***	0.856***
	(0.020)	(0.262)	(0.054)	(0.272)
Year Dummies			Included	Included
Observations	237	237	237	237
LR chi-squared	1.71	34.73***	20.52**	52.56***

The coefficients for several control variables are significant and some of them have opposite signs compared to the results in studies on other countries. This result is not surprising because of the large differences in market and regulatory environments across countries. Among the control variables for commercial banks, the coefficient for *SIZE* is significantly positive, which is consistent with the existence of scale economies in the Korean banking industry. The coefficient for *LOAN_RATIO* is significantly positive, indicating that non-interest activities tend

to decrease the productive efficiency of commercial banks. For life insurance companies, the coefficient for *EQUITY_RATIO* is significant and positive, indicating an efficiency gain from the accumulation of equity capital. The coefficient for *RISKY_INV* is significantly positive in Equation (4), suggesting that insurers who invest more in risky assets tend to be more efficient. For securities companies, a similar conclusion is drawn by the significantly positive coefficient for *OP_RISK*.

To test for the different impacts of financial holding company affiliation on the productive efficiency of financial institutions across the extent of business diversification, we conduct analyses where the key variable is the asset diversification of financial holding companies instead of the dummy variable for financial holding company affiliation. Table 4 presents the results of Tobit regressions on commercial banks (Panel A), life insurance companies (Panel B), and securities companies (Panel C). For commercial banks, the coefficient for *DIV* is significantly positive, indicating that the extent of diversification in financial holding companies improves the productive efficiency of commercial banks. By contrast, this relationship does not hold for other types of financial institutions. Specifically, the coefficients for *DIV* are insignificant for life insurance and securities companies. These results indicate that commercial banks benefit from the presence of non-bank financial institutions under the same roof. However, the converse does not hold. Given that commercial banks play the central role in personal finance in Korea, clients use commercial banks as the main channel of their financial activities, and banks earn fees from these activities. This condition may explain why only commercial banks enjoy efficiency benefits from the presence of non-bank financial institutions under the financial holding companies.

[Table 4] Effects of Financial Holding Company Diversification on Efficiency

The panels below present the effects of financial holding company affiliation on the productive efficiencies of commercial banks (Panel A), life insurance companies (Panel B), and securities companies (Panel C). The dependent variable is *TE*, which is the efficiency score obtained by DEA, as introduced in Section 2. Among the independent variables, *DIV* is a measure of asset diversification in financial holding companies, as defined in Section 3. Other control variables are *SIZE*, *LOAN_RATIO*, and *VOLATILITY* for commercial banks; *SIZE*, *EQUITY_RATIO*, and *RISKY_INV* for life insurance companies; and *SIZE*, *H*, and *OP_RISK* for securities companies. These control variables are defined in Table 1. We also report the likelihood ratio chi-squared statistic, which is used to test the null hypothesis that all of the regression coefficients are simultaneously equal to 0. We exclude the company-year observations that have the same year as the establishment of the affiliated financial holding companies. The values in parentheses are standard deviations, and *, **, and *** denote the significant differences from 0 at the 10%, 5%, and 1% levels, respectively.

Panel A: Commercial Banks

	(5)	(6)	(7)	(8)
DIV	0.458***	0.344**	0.576***	0.435**
	(0.146)	(0.532)	(0.149)	(0.171)
SIZE		0.042		0.057
		(0.063)		(0.061)
LOAN_RATIO		0.620		0.706*
		(0.425)		(0.420)
VOLATILITY		0.111		0.060
		(0.088)		(0.090)
Constant	0.772***	0.023	0.820***	-0.081
	(0.034)	(0.532)	(0.088)	(0.523)
Year Dummies			Included	Included
Observations	142	142	142	142
LR chi-squared	9.51***	13.88***	16.92*	21.40*

Panel B: Life Insurance Companies

	(5)	(6)	(7)	(8)
DIV	-0.026	0.073	-0.130	-0.016
	(0.106)	(0.241)	(0.099)	(0.098)
SIZE		0.075*		0.026
		(0.039)		(0.040)
EQUITY_RATIO		2.877***		2.043**
		(0.919)		(0.889)
RISKY_INV		0.212		0.520**
		(0.260)		(0.263)
Constant	0.758***	0.021	0.576***	0.225
	(0.025)	(0.241)	(0.061)	(0.243)
Year Dummies			Included	Included
Observations	137	137	137	137
LR chi-squared	0.06	22.56***	24.31***	38.21***

Panel C: Securities Companies

	(5)	(6)	(7)	(8)
DIV	0.143	0.168	0.157	0.192*
	(0.110)	(0.109)	(0.107)	(0.104)
SIZE		-0.083**		-0.065
		(0.040)		(0.042)
H		0.036		0.184
		(0.180)		(0.181)
OP_RISK		0.733***		0.626***
		(0.146)		(0.144)

Constant	0.688***	1.014***	0.655***	0.871***
	(0.021)	(0.260)	(0.058)	(0.266)
Year Dummies			Included	Included
Observations	237	237	237	237
LR chi-squared	1.68	35.56***	23.61***	54.14***

The same analyses are conducted with the variables of *FHC* and *DIV* to test for the potential effect of the specialization within financial holding companies. For example, Berger, Hasan, and Zhou (2010) address this effect by constructing multiple measures of diversification within financial conglomerates in China. We distinguish between the specialized financial holding companies and standalone financial institutions through the variable of *FHC* in addition to *DIV*. The results are qualitatively similar from those with only *DIV*, indicating that the financial holding company affiliation itself does not have an impact on the productive efficiencies of financial institutions without asset diversification.

Additional analyses related to the government ownership of the financial holding companies' equity shares are also conducted. Panels A, B, and C of Table 5 present the results for commercial banks, life insurance companies, and securities companies, respectively. For commercial banks, life insurance companies, and securities companies, the coefficients for *FHC_GOV* and *FHC_PRIV* are generally insignificant, indicating that government ownership is not an important factor that explains the productive efficiency of these types of financial institutions.

[Table 5] Comparison Between Government-owned and Privately Owned FHCs

The panels below show the different impacts of affiliation with government-owned and privately owned financial holding companies on the productive efficiencies of commercial banks (Panel A), life insurance companies (Panel B), and securities companies (Panel C). *FHC_GOV* is the dummy variable that is set as 1 if the company is affiliated with a financial holding company of which the government is the largest shareholder, and 0 otherwise. *FHC_PRIV* is the dummy variable that is set as 1 if the company is affiliated with a financial holding company where the largest shareholder is not the government, and 0 otherwise. All other dependent and independent variables are defined in Table 1. We also report the likelihood ratio chi-squared statistic, which is used to test the null hypothesis that all of the regression coefficients are simultaneously equal to 0. We exclude the company-year observations that have the same year as the establishment of the affiliated financial holding companies. The values in parentheses are standard deviations, and *, **, and *** denote the significant differences from 0 at the 10%, 5%, and 1% levels, respectively.

Panel A: Commercial Banks

	(9)	(10)	(11)	(12)
FHC_GOV	0.070	-0.034	0.116	0.016
	(0.070)	(0.080)	(0.074)	(0.081)
FHC_PRIV	0.003	-0.044	0.040	-0.003

	(0.079)	(0.080)	(0.081)	(0.079)
DIV		0.392*		0.418**
		(0.200)		(0.194)
SIZE		0.033		0.060
		(0.65)		(0.065)
LOAN_RATIO		0.655		0.690
		(0.434)		(0.427)
VOLATILITY		0.103		0.060
		(0.089)		(0.090)
Constant	0.802***	0.085	0.819***	-0.097
	(0.046)	(0.544)	(0.096)	(0.537)
Year Dummies			Included	Included
Observations	142	142	142	142
LR chi-squared	1.10	14.22**	5.14	21.47

Panel B: Life Insurance Companies

	(9)	(10)	(11)	(12)
FHC_GOV	0.071	0.154**	-0.041	0.087
	(0.064)	(0.076)	(0.066)	(0.077)
FHC_PRIV	-0.010	0.027	-0.038	0.007
	(0.089)	(0.082)	(0.085)	(0.081)
DIV		-0.062		-0.08
		(0.119)		(0.113)
SIZE		0.072*		0.031
		(0.038)		(0.040)
EQUITY_RATIO		2.820***		2.091**
		(0.908)		(0.888)
RISKY_INV		0.381		0.573**
		(0.270)		(0.267)
Constant	0.746***	0.018	0.571***	0.189
	(0.025)	(0.239)	(0.061)	(0.246)
Year Dummies			Included	Included
Observations	137	137	137	137
LR chi-squared	1.26	26.65***	23.17***	39.49***

Panel C: Securities Companies

	(9)	(10)	(11)	(12)
FHC_GOV	0.098	0.004	0.087	0.013
	(0.069)	(0.109)	(0.068)	(0.105)
FHC_PRIV	0.036	0.017	0.021	-0.002
	(0.061)	(0.075)	(0.060)	(0.074)
DIV		0.155		0.180
		(0.169)		(0.165)
SIZE		-0.085**		-0.065
		(0.041)		(0.043)
H		0.037		0.182
		(0.181)		(0.182)

OP_RISK		0.732***		0.624***
		(0.146)		(0.145)
Constant	0.553***	1.020***	0.544***	0.870***
	(0.020)	(0.262)	(0.054)	(0.270)
Year Dummies			Included	Included
Observations	237	237	237	237
LR chi-squared	2.21	35.63***	21.11**	54.17***

We close this section with a discussion about the robustness of our results. First, recent debates have arisen regarding the statistical foundation for a two-stage procedure using DEA scores. In particular, several studies provide a theoretical and simulation-based argument for using ordinary least squares estimation in the second stage (Banker and Natarajan, 2008; Johnson and Kuosmanen, 2012), though Banker and Natarajan (2008) suggest that both procedures with OLS and Tobit estimations in the second stage perform better compared to parametric methods. On the basis of these arguments, we conduct the same analyses as in Equations (1)–(12) using ordinary least squares. The results show no qualitative difference with regard to the significance of the estimated coefficients of key variables (i.e., *FHC*, *DIV*, *FHC_GOV*, and *FHC_PRIV*), except for weak evidence for the positive effect of diversification on the affiliated securities companies [i.e., coefficients of *DIV* are positive at 10% significance level in Equations (5)–(8)].

Another potential concern is that the differences in the estimated efficiency across financial holding company affiliations may arise from endogenous selection because financial holding companies mostly establish their affiliated insurance and securities companies through mergers and acquisitions. For example, we would assume that financial holding companies choose those that are most efficient (i.e., underpriced). Conversely, they may choose inefficient organizations with the hope that the expertise of the conglomerate will enable the firm to gain experience and increase its efficiency. To deal with these possibilities, we construct a variable to capture the selection effect. *FHC_SEL* is defined as the dummy variable, which is set as 1 if the financial institution is currently or will be affiliated with a financial holding company, and 0 otherwise. We conduct the same analyses as in Equations (1)–(12), except that *FHC_SEL* is included as an additional control variable. The results do not change from the original results with regard to the significance of the estimated coefficients of key variables (i.e., *FHC*, *DIV*, *FHC_GOV*, and *FHC_PRIV*).

Finally, note that the market structure of financial institutions may influence the productive efficiency of these financial institutions. For example, OECD (2010) and Shin and Kim (2011) state that the degrees of competition and market concentration in the banking industry affect productive efficiencies. We conduct the same analyses as in Equations (1)–(12) by controlling for the HHI based on the total assets of financial institutions. Our results (i.e., *FHC*, *DIV*, *FHC_GOV*, and

FHC_PRIV) do not change qualitatively, though the productive efficiencies of all three types of financial institutions are negatively associated with HHI.

V. Conclusion

This study considers the effect of the establishment of financial holding companies on financial institutions in Korea by comparing the productive efficiency of financial institutions affiliated with financial holding companies with that of other companies. After considering a sample of commercial banks, life insurance companies, and securities companies that operated from 2004 to 2013, we find that financial holding company affiliation does not lead to an improvement of the productive efficiency of financial institutions. We also find that government ownership of a financial holding company has no difference in terms of productive efficiency.

Our results indicate that the policy of promoting the establishment of financial holding companies has not been effective in enhancing the productive efficiency of Korean financial institutions. Although a positive effect of business diversification is exerted on the efficiency of their affiliated commercial banks, Korean financial holding companies do not really improve the efficiency of their affiliated companies compared to those that stand alone. Numerous problems have been reported in Korea related to the governance of financial holding companies, such as government involvement in the selection of important positions in financial holding companies (The Korea Herald, 2014). These problems could have emerged from a highly concentrated market structure or from the excessive and inconsistent government regulation of financial institutions. Our results on government ownership are consistent with this explanation, implying that government ownership does not enhance the efficiency of financial holding companies. A potential implication of our results on asset diversification is that promoting asset diversification is helpful in improving productive efficiency. However, other dimensions of diversification driven by financial holding company affiliation exist, including varieties in financial services or in the loan portfolio of commercial banks (Archarya, Hasan, and Saunders, 2006; Berger and Mester, 1997). In this regard, our results imply that the Korean government should reconsider its policy of enhancing the efficiency of financial holding companies, and extensive empirical analyses are required for further assertion of the policy, including the comparison of changes in the efficiency with foreign financial institutions.

References

Acharya, V. V., I. Hasan, and A. Saunders (2006), "Should Banks be Diversified? Evidence from Individual Bank Loan Portfolios," *Journal of Business*, 79, 1355–1412.

Banker, R. D., and R. Natarajan (2008), Evaluating Contextual Variables Affecting Productivity using Data Envelopment Analysis," *Operations Research*, 56, 48–58.

Berger, A. N., I. Hasan, and M. Zhou (2010), "The Effects of Focus Versus Diversification on Bank Performance: Evidence from Chinese Banks," *Journal of Banking and Finance*, 34, 1417–1435.

Berger, A. N., and L. J. Mester (1997), "Inside the Black Box: What Explains Differences in the Efficiencies of Financial Institutions?*" Journal of Banking and Finance*, 21, 895–947.

Bhattacharyya, A., C. A. K. Lovell, and P. Sahay (1997) "The Impact of Liberalization on the Productive Efficiency of Indian Commercial Banks," *European Journal of Operational Research*, 98, 332–345.

Chang, M.-S., and E. Elyasiani (2015), "Do Insurance Activities Enhance the Performance of Financial Services Holding Companies?" *Applied Economics*, 47, 3559–3576.

Charnes, A., W. W. Cooper, and E. Rhodes (1978), "Measuring the Efficiency of Decision Making Units," *European Journal of Operational Research*, 2, 429–444.

Chronopoulos, D. K., C. Girardone, and J. C. Nankervis (2013), "How do Stock Markets in the US and Europe Price Efficiency Gains from Bank M&As?" *Journal of Financial Services Research*, 43, 243–263.

Coelli, T. (1996), "A Guide to DEAP Version 2.1, a Data Envelopment Analysis (computer) Program," CEPA Working Paper 96/08.

Cummins, J. D., M. A. Weiss, X. Xie, and H. Zi (2010), "Economies of Scope in Financial Services: A DEA Efficiency Analysis of the US Insurance Industry," *Journal of Banking and Finance,* 34, 1525–1539.

Devaney, M., and W. L. Weber (2002), "Small-business Lending and Profit Efficiency in Commercial Banking," *Journal of Financial Services Research*, 22, 225–246.

Diamond, D. (1984), "Financial Intermediation and Delegated Monitoring," *Review of Economic Studies*, 51, 393–414.

Drake, L., and M. J. B. Hall (2003), "Efficiency in Japanese Banking: An Empirical Analysis," *Journal of Banking and Finance*, 27, 891–917.

Elsas, R., A. Hackethal, and M. Holzhäuser (2010), "The Anatomy of Bank Diversification," *Journal of Banking and Finance*, 34, 1274–1287.

Elyasiani, E., and Y. Wang (2012), "Bank Holding Company Diversification and Production Efficiency," *Applied Financial Economics*, 22, 1409–1428.

Färe, R., S. Grosskopf, and C. A. K. Lovell (1985), *The Measurement of Efficiency of Prodution*, Kluwer-Nijhoff Publishing, Boston.

Filson, D., and S. Olfati (2014), "The Impacts of Gramm-Leach-Bliley Bank Diversification on Value and Risk," *Journal of Banking and Finance*, 41, 209–221.

Financial Supervisory Service (2000), "Policy Directions for the 2nd Stage of Banking Sector Restructuring," *Press Release*, 7 December.

Fukuyama, H., and W. L. Weber (1999), "The Efficiency and Productivity of Japanese Securities Firms, 1988-93," *Japan and the World Economy*, 11, 115–133.

Gertner, R., D. Scharfstein, and J. Stein (1994), "Internal vs. External Capital Markets," *Quarterly Journal of Economics*, 109, 1211–1230.

Hall, M. J. B., and R. Simper (2013), "Efficiency and Competition in Korean Banking," *Applied Financial Economics*, 23, 881–890.

Havrylchyk, O. (2006), Efficiency of the Polish Banking Industry: Foreign Versus Domestic Banks," *Journal of Banking and Finance*, 30, 1975–1996.

Hou, X., Q. Wang, and Q. Zhang (2014), "Market Structure, Risk Taking, and the Efficiency of Chinese Commercial Banks," *Emerging Markets Review*, 20, 75–88.

Johnson, A. L., and T. Kuosmanen (2012), "One-stage and Two-stage DEA Estimation of the Effects of Contextual Variables," *European Journal of Operational Research*, 220, 559–570.

Laeven, L., and R. Levine (2007), "Is There a Diversification Discount in Financial Conglomerates?" *Journal of Financial Economics*, 85, 331–367.

Lee, M., and J. Park (2010), "A Study on the Profitability of Commercial Banks Subordinating to Financial Holding Company," *Korean Journal of Financial Engineering*, 9, 191–214.

Lee, S. Y. (2010), "KB Financial Gets a New Chairman," The Wall Street Journal, 16 June.

Naceur, S. B., and M. Omran (2011), "The Effects of Bank Regulations, Competition, and Financial Reforms on Banks' Performance," *Emerging Markets Review*, 12, 1–20.

OECD (2010), "Competition, Concentration and Stability in the Banking Sector," < www.oecd.org/competition/sectors/46040053.pdf >.

Park, J. W., R.-S. Park, U. Chang, J.-K. Ko, and H. Chung (2009), "The Effect of Financial Conglomeration on Values of Financial Firms and Groups," *Journal of Money and Finance*, 23, 97–130.

Petersen, M., and R. Rajan (1994), "The Benefits of Lending Relationships: Evidence from Small Business Data," *Journal of Finance*, 49, 3–37.

Rotemberg, J., and G. Saloner (1994), "Benefits of Narrow Business Strategies," *American Economic Review*, 84, 1330–1349.

Sanya, S., and S. Wolfe (2011), "Can Banks in Emerging Economies Benefit from Revenue Diversification?" *Journal of Financial Services Research*, 40, 79–101.

Sathye, M. (2003), "Efficiency of Banks in a Developing Economy: The Case of India," *European Journal of Operational Research*, 148, 662–671.

Scharfstein, D., and J. Stein (2000), "The Dark Side of Internal Capital Markets: Divisional Rent-seeking and Inefficient Investment," *Journal of Finance*, 55, 2537–2564.

Shen, C.-H., and Y. Chang (2012), "To Join or Not to Join? Do Banks that are Part of a Financial Holding Company Perform Better than Banks that are not?" *Contemporary Economic Policy*, 30, 113–128.

Shin, D. J., and B. H. S. Kim (2011), "Efficiency of the Banking Industry Structure in Korea," *Asian Economic Journal*, 25, 355–373.

Stiroh, K. J., and A. Rumble (2006), "The Dark Side of Diversification: The Case of US Financial Holding Companies," *Journal of Banking and Finance*, 30, 2131–2161.

The Korea Herald (2014), "Korea's Major Financial Groups at Turning Point," 07 November.

Vander Vennet, R. (2002), "Cost and Profit Efficiency of Financial Conglomerates and Universal Banks in Europe," *Journal of Money, Credit and Banking*, 34, 254–282.

Wang, K.-L., Y.-T. Tseng, and C.-C. Weng (2003), "A Study of Production Efficiencies of Integrated Securities Firms in Taiwan," *Applied Financial Economics*, 13, 159–167.

Yun, K.-S., and Y. Jin (2011), "Research on Competition Structure of the Banking Sector and Consolidation between Banks," Korea Development < http://www.kdi.re.kr/research/subjects_view.jsp?pub_no=12255 >.