Determinants of Bank Competitiveness in Digital Era A Case Study of South Korea

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ABSTRACT

Technical innovations in Digital Era provide the incentives for banks to redesign their business operations to enhance their competitiveness. Prior studies use financial indicator as factors that affect bank competitiveness, however, with the technology advancement, Information Communication Technology (ICT) become major factors in assessing banks' competitiveness. The aim of this study is to analyze specific ICT factors, as well as financial factors, affecting bank competitiveness. This study examines all 17 commercial banks in South Korea. The ICT factors are measured by IT center operation and IT scandal released in news or mass media while the bank competitiveness is proxied by market share of each bank both in the borrowing and lending market. In addition, the study tests to retrospect financial indicators in comparison with ICT factors. Using OLS regression models, this study finds that, in the case of Korean commercial banks, ICT factors plays an importance role in bank competitiveness, however, the financial factors still have greater influences on market share than ICT factors. The implication is that banks should leverage the ICT innovation since there is a surge of ICT based non-bank financial service providers that have started to assume roles that have been traditionally played by banks. Furthermore, this study raises implications for policy makers to consider ICT security regulations in the banking market. This study contributes to the literatures by supporting the fact that the positive relationship between IT scandals and market share suggests implications to concentrated banking sectors and provides alarming with authority's monitoring system.

JEL Classification: G21, M15

Keywords: ICT factors, Financial factors, Bank competitiveness, Commercial banks, South Korea

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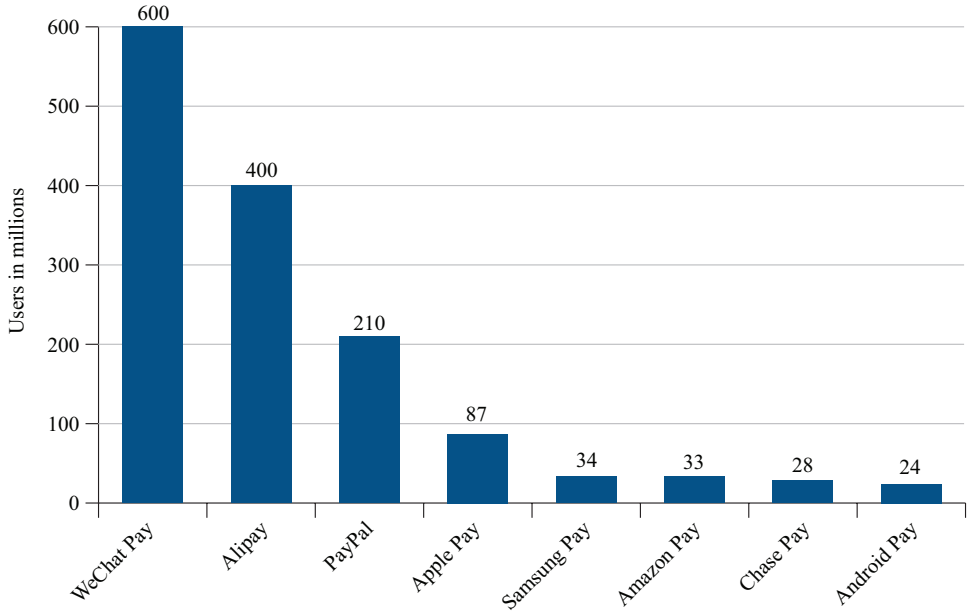
1. INTRODUCTION

A shift to a digital economy requires fundamentally different viewpoint to produce goods and services across borders. It accelerates a stimulus to competitiveness across all industries, new moments for business affairs, and new challenges for tapping into global markets (UNCTAD, 2017). Digital Era is referred to as digital transformation (Reis, Amorim, Melao, & Matos, 2016) and industry 4.0 (Morrar, Arman, & Mousa, 2017). The core concept of these jargon terms highlight that traditional social structures could be innovated as a whole by applying digital technology; thus, technical-driven factors are assumed to be primarily critical in digital era.

Banking industry is recognized as one of the business activities that has fully utilized ICT (Information and Communication Technology) factors to fulfill banking transactions and to improve service quality to its customers (Kasemsan & Hunngam, 2012). However, as digital technology becomes more tangible, uncertainties regarding future survival of bank in digital era have increased over the years and banks are being forced to be transformed fundamentally, thus, new technologies provide the impetus for banks to redesign their business and operating models. As digital capabilities develop, new technologies arise, in turn, the expectations from customers are getting higher. Non-banks institutions and technology-oriented service providers are continually entering the banking ecosystem. The degree of competition soars as well and the dynamics of the broader financial services in the banking ecosystem is getting totally different (Dermine, 2016). Therefore, competitiveness of banks and their sustainability in digital era is more getting complicated not only for banks itself, but also for the government and other financial institutions. The tendency of threatening the traditional banks could be found simultaneously in the contemporary world, such as PayPal in Google, Apple Pay, Samsung Pay, Go-Pay in Indonesia, Ali-Pay and many social media financial transaction platform.

As shown in figure 1, many types of competitions in the banking sector have been identified. In 2016, notably, for the first time in 24 years in banking industry, two direct banks which provide financial services based on ICT newly got banking approvals in South Korea ("Announcement of a direct bank approval," 2016). They do not have branch networks. Like this example, as advanced new technology appears, new types of financial services emerge by other non-bank entities through digital financial scheme.

Figure 1
The number of users of leading mobile payment platforms worldwide as of August 2017



Source: Statista, 2019.

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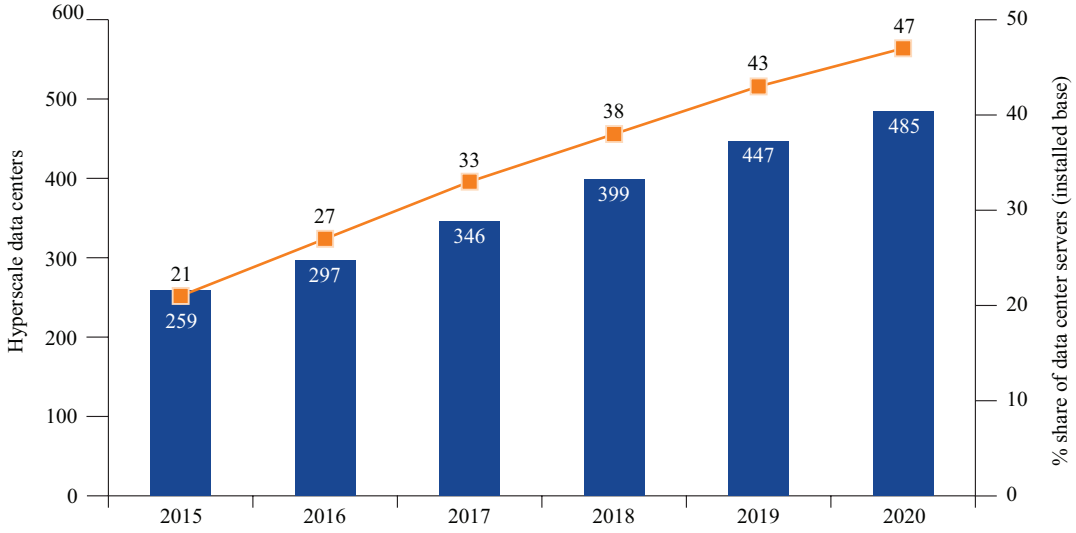
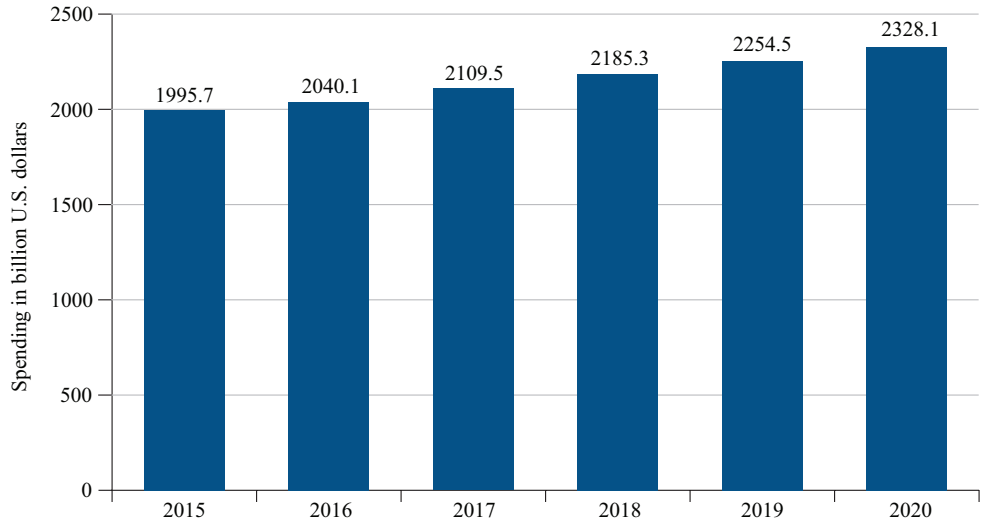
To address the challenges, most countries are actively chasing the digital opportunity through ICT investment in infrastructure. Many previous papers and research emphasized on the strategic aspect of ICT investments to obtain competitive advantages (Porter & Millar, 1985; Rai, Patnayakuni, & Patnayakuni, 1997; Sambamurthy, Bharadwaj, & Grover, 2003). Globally, it is found that the trend of ICT investments increase dramatically. According to the data form World Bank, the number of giant data centers, referred to as hyper-scale (The World Bank Group, 2018) due to the size and the capacity to provide storage and servers will be built up to 485 by 2020 (see figure 2). ICT investment is projected to total $2.3 trillion in 2020, an increase of 3.2 percent from expected spending of $2.2 trillion in 2019 (see figure 3). In line with, according to the data from the Bank of Korea, the total budget of ICT in Korean commercial banks is $5.08 billion in 2017, an increase of 3.6 percent compared to the previous amount. Korean financial firms have upgraded their ICT system investing in hyper-scale IT center, referred to as post-next generation system since 2014 by a few major commercial banks (*The Analysis of Financial Informative Development*, 2018). Meanwhile, security instability such as data leakage and privacy concerns

Figure 2
Hyper Scale Data Centers



Source: World Bank, Information and Communications for Development 2018.

Figure 3
IT Spending Forecast Worldwide from 2015 to 2020



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are growing as Digital Era becomes more and more accessible. Many previous studies found that an IT security is the most recognized important factor in financial service sector (Aregbeyen, 2011; M.C. Lee, 2009; Mokhlis, Mat, & Salleh, 2008; Murray & Schlacter, 1990). The significance of security has increased remarkably through the experience of new types of financial fraud (Parker, 1997).

Generally, there have been several factors affecting the competitiveness of the banking sector. Setting aside macro-economic factors such as inflation, GDP and market capitalization, which are beyond the control of bank management (e.g., Ebrahimi, Arshadi, & Salimi, 2016; Erina & Lace, 2013), while internal factors such as Deposit ratio, Return on Asset (ROA) and Net Interest Margin (NIM), and other financial indicators are considered as traditional factors of bank competitiveness. There have been many researchers in many different countries investigated the traditional factors and provided evidence of the importance of such factors in bank competitiveness (e.g., Ebrahimi et al., 2016; Kawshala & Panditharathna, 2017; Kiseľáková, Hečková, & Chapčáková, 2013; Tahir, Shah, & Afridi, 2017). However, such impact on Korean commercial banks has not been fully investigated yet. It might be meaningful to investigate the correlation in the regional differences, South Korea case. Moreover, in terms of new approaches to find new determinants of bank competitiveness in digital era is, currently, noticeably limited. In this regard, the main objective of this study is to investigate the technology-based determinants of bank competitiveness of Korean commercial banks by controlling the impact of traditional factors. In terms of the technology-based determinants, this paper tests the impact of IT investment and security issues on bank competitiveness. IT investment, as measured by IT center operation of Korean commercial banks and security issues, as measured by IT security scandal released by the press to the public and bank competitiveness, as measured by market share both in borrowing and lending market respectively. Thus, this research is conducted to find out the influence of IT center operation and IT security scandals upon market share of Korean commercial banks both in borrowing and lending markets. At the same time, this study is to analyze the effect of financial indicators such as deposit ratio, Return on Asset (ROA) and Net Interest Margin (NIM) upon market share.

This study aims to provide evidence of the influence of ICT factors on Korean commercial banks case, how the results are different to the previous studies and cast implications to the banking sector in other countries. In addition, this study is to retrospect the role of financial indicators in the banking sector to contribute to the literature by adding different regional paths for further understanding of the relationship between financial indicators and market share. This paper is comprised of five sections as follows: Section two reviews the related literature and Section three shows the relevant methodology, section four pinpoints the data collection and the results of data analysis. The last section suggests implications for the Korean commercial banking system for the upcoming digital era.

2. LITERATURE REVIEW

2.1. Technology-based determinant of bank competitiveness

Information Technology (IT) provides multiple benefits toward the whole industry in terms of transforming value chain, product development, changing the nature of competition, creating competitive edge and risk management (Porter & Millar, 1985). On the other hand, other research argued that the strategic importance of IT has decreased because the role of IT factors has changed from strategic resources to commodity levels such as infrastructural technology. Thus, huge investment into IT might need to be avoided and IT managers have not to lead, but only to follow the standard technology (Carr, 2003).

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The relationship between ICT investments and bank performance has diverse results. One study showed that ICT Investment have a significant influence on firm's performance (Sambamurthy et al., 2003). This paper argued that IT roles as a platform to improve firm's organizational capabilities and strategic process capabilities, in turn, these contribute to significantly improve firm's performance. Another case also found that IT investment influences on intermediate tools such as inventory turnover, rather than directly impact on bank performance as measured by ROA (Barua, Kriebel, & Mukhopadhyay, 1995). However, very little research has been conducted regarding the relationship between ICT investments and financial performance. One earlier study described that IT investments are significantly influence on firms' performance (Rai et al., 1997). The study tried to find the relationship between ICT investments and firm's performance by applying diverse measurements. ICT investment, as measured by IT capital, IT budget, client systems, and IT infrastructure investment and firm's performance, as measured by total sales, ROA, ROE, labor productivity, and administrative productivity. One meaningful approach from the study is the usage of ROA and ROE to measure bank performance as financial indicators.

Conversely, there is another view that IT investment has little relationship with bank profitability (e.g., Beccalli, 2007; Izzo, 2008). Beccalli (2007) collected data from 737 European banks to test IT investment's influence on bank performance. This paper differentiated the type of IT sectors such as hardware, software and service. The results showed that if IT investment is outsourced, it has a positive relationship with ROE, while if IT investment is directly purchased, it has a negative impact on bank performance. Izzo (2008) showed that IT investments has a negative relationship with ROA. In addition, another study showed that IT investment has not directly influenced on bank performance when measured with net profit, ROA, and ROE. The results showed that financial performance is improved when strategic decisions such as vertical diversification are associated with IT investment together (Shin, 2001). Without it, it has no relationship between IT investments and net profit, ROA, and ROE. Literature provides limited evidence demonstrating the clear relationship between ICT investment and market share in the banking sector.

Security and the degree of stability and safety is some measures of the important factors affecting banks' profitability. The previous studies showed that information security has a positive influence on banks' performance (Alber & Nabil, 2015). This study examined the relationship between information security standards and banks performance in Egypt. The sample size was 13 Egyptian banks. Information security standards, as measured by ISO 27001, Information Security Management System (ISMS), and Payment Card Industry Data Security Standards (PCI-DSS) and banks performance, as measured by ROA, ROE, ROC (Return on Capital), NPL (Non-Performing Loans Ratio), and stock's market return. The results showed that the adaptation of ISO-27001 has influence on ROC, while PCI-DSS affects NPL. It pointed out that the influence of information security on financial indicators vary and inconsistent.

The role of security in the banking sector is highly associated with customer's bank selection process. In Malaysia, the most important element for undergraduates to select their bank is to feel secure and ATM service ranked as the second factor to affect bank selection. It surveyed respondents and used factor analysis method (Mokhlis et al., 2008). The same results are found in other countries. In Nigeria, after surveying 1,750 respondents in the 292 banks to find factors affecting bank selection, safety of funds and secured ATMs are found as the first and second parameters out of the top 10 parameters (Aregbeyen, 2011). In addition, in conjunction with on-line banking adaptation, the instability of security or privacy risk is one of the major factors to adversely affect online banking adoption (M.C. Lee, 2009). The study focused on finding indicators of online banking adoption. Different to the previous studies, this study found both positive and negative factors with respect to intention to use online banking. The results showed that security, privacy and financial risks are negative factors, while usefulness, benefits and attitude are positive factors. Furthermore, there is another approach to find the relationship between security and performance. One study argued that information security

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is not a direct factor for organizational performance, but a motivational factor for firm's performance (Kong, Jung, Lee, & Yeon, 2015).

This paper surveyed 215 employees in 16 Korean securities firms. It confirmed that information security is not as hygiene factors, but as motivational factors based on Herzbeg's two-factor theory. However, the measurement of organizational performance is not based on financial performance but relied on survey results. One earlier study commented that obtaining a good reputation for securing information might magnify firm's ability to retain and improve market share (Ula, Ismail, & Sidek, 2012) and it suggested that full-scale information security governance system should be set for banking sector. However, this study failed to show the relationship between security issue and market share with financial data, only examined, compared the components of information governance standards such as ISO 27002, ISSA (Information System Security Association), COBIT (Control Objectives for Information and related Technology), CGTF (The Corporate Governance Task Force), CISWG (The Corporate Information Security Working Group), and PCI (PCI Data Security Standard). As discussed, except the study conducted by Alber and Nabil (2016), many previous researches are focus on non-financial or indirect financial measures in their studies. Meanwhile, there is a few studies that emphasized the role of supervisory exams (Chortareas, Girardone, & Ventouri, 2012; Gunther & Moore, 2003). Gunther and Moore (2003) strongly argued that supervisory exams lead to improve financial performance of banks. In addition, Chortareas, Girardone and Ventouri (2012) found that official supervisory activities might improve the efficiency of banks in terms of reducing operating risks and such supervisory roles are more important to nations with higher quality banks.

Customers conduct a range of activities in internet-based circumstances including online shopping and online banking. The adoption of Internet banking is deeply related to access to the Internet (Sathye, 1999). In addition, the adoption of Internet banking services is relied on Internet access(Sadiq Sohail & Shanmugham, 2003). The use of Internet banking will be accelerated on the condition of higher widespread access to the Internet. In addition, individuals who have a higher educational background tend to use E-banking products. Furthermore, people who have high-income, high financial assets have frequently used E-banking products (Anguelov, Hilgert, & Hogarth, 2004). The study concludes that the main key drawbacks are instability of privacy and security. Demographic variables are deeply related to customers' adoption in technology (Kolodinsky, Hogarth, & Hilgert, 2004). This paper found factors affecting customer's adoption to bank technologies such as internet/mobile banking based on database from Federal Reserve Board Commission. It found that complexity, observability and risk tolerance are main factors to affect the technology adoption. In addition, demographic variables such as income, assets, education and age are associated with the adoption. The elderly has a difficulty to deal with electronic banking technology. The severity of competition in the financial market triggers shift from internet banking to the mobile banking platform. Mobile banking is highly involved with innovative ways through the use of Information and Communication Technology (ICT) (Wonglimpiyarat, 2014). Mobile banking is regarded as a new phase of money transferring to upgrade the payment system. The mobile-commerce contributes the growth of opportunity for institutions in the financial services industry through mobile devices and wireless communication technologies (Tommi, 2007).

2.2. Traditional factors on bank competitiveness

Market share is one of the most acceptable indicators to reflect competitiveness and profitability of organizations (e.g., Genchev, 2012; Laverty, 2001). Gale (1972) was among the firsts to use market share as a proxy for competitiveness (Genchev, 2012). Prior to Gale (1972), the emphasize of company competitiveness is on the relationship between size and profitability (Yannopoulos, 2010). Gale (1972) emphasized the fact that highly concentrated industry has a greater significance relationship between market share and profitability than other industry. In

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addition, Genchev (2012) found the similar results through the investigation of 22 Bulgarian banks that the relationship between market share and ROE is significantly positive. The study implied that improving profitability was the critical way to magnify market share. The study further suggested that profitability is solely affected by management decisions and has little influence on macro-economic factors. Furthermore, Buzzell (2004) demonstrated that the elasticity of financial performance had a significant influence on market share based on PIMS (Profit Impact of Market Share) database. A recent study which utilized PIMS database marked that market share triggers key cost reduction and productivity improvement, in turn, it improves profitability (Buzzell, 2004). However, some of earlier studies argued that there is negative or no linkage between market share and profitability (Jacobson & Aaker, 1985; Magoro, 2009; Schwalbach, 1991). Many researchers recommended that unconditional belief on market share should be lessened, thus, there is no clear conclusive finding for the relationship between market share and financial indicators. A review of literature revealed a lack of research on the relationship between market share and ICT factors.

Deposit from customers is one of the key sources of funding for banks. In general, based on deposits, banks have more chances to provide loan to customers, then it tends to create profits in the future. Lee and Hsieh (2013) investigated factors that affect bank profitability and risk based on 42 Asian countries during 1994 to 2008, the study found that deposits have a positive relationship with ROA and ROE respectively and the lower level of deposits negatively influence on bank profitability because banks which have opportunities to utilize surplus deposits could raise loan balance (Lee & Hsieh, 2013). Deposits and loans also has a positive relationship with ROE of banks via investigating 35 European banks over the period 2009-2013 (Menicucci & Paolucci, 2016). This study utilized a regression analysis based on data collected from Bankscope and found that PLL (Provision of Loan Loss) has a negative relationship with ROE, on the other hand, asset size and capital ratio have a positive relationship with ROE in Europe. The findings gave implications to policy makers to increase the stability of banking industry. On the other hand, deposit has a negative relationship with ROA (Demirgüç-Kunt & Huizinga, 1998). The study examined 80 countries' bank data and concluded that a large dependence on deposit leads to low ROA.

Net Interest Margin (NIM) describes the capability of bank management and the employee in obtaining the income compared to the cost (Rose, 2001). The financial stability of banks based on its higher capitalized have higher Net Interest Margins (NIM) and also they are found to be more profitable (Demirgüç-Kunt & Huizinga, 1998). This study investigated bank-level data from 80 countries, it found that if domestic product accounts for the majority of bank assets, it led to lower margins. In addition, the study showed that a high competition among banks also triggers lower margins. This study added that foreign banks tend to have higher margins in developing countries compared to domestic banks, however, in developed countries, it showed the opposite result. With respect to market share, in Sri Lanka banking sector, there is no relationship between market share and NIM (Seelanatha, 2010). Conversely, the level of efficiency is the factor to affect market share. Efficient banks tend to charge lower NIM. A similar result found in Tunisian banking sector. This study used NIM as dependent variable to measure bank profitability. The result showed that there is a negative and significant relationship between market share and NIM (Hakimi, Hamdi, & Djelassi, 2015).

Return on Asset (ROA) and Return on Equity (ROE) are found to be strong indicators to impact on profitability (Bourke, 1989). The study examined the performance of banks in twelve countries to determine factors affecting profitability of banks with respect to internal and external perspective. It was one of the first approaches that mentioned internal factors of bank such as ROA and ROE. In addition, in terms of the overall performance of the banks, ROA is the indicator to be frequently used. Many previous studies demonstrated that there is a positive relationship between the asset size of banks and profitability due to the effect of economy of scale and ROA

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has a positive relationship with bank's efficiency estimated by DEA score (Sufian, 2009). The previous result shows that ROA is a powerful indicator demonstrating profitability of banks and ROE is more likely to be capable of generating cash (Erina & Lace, 2013). They examined the Latvian commercial banks based on the balance sheet data from Bank of Latvia and the Association of Latvian Commercial Banks. They showed that ROA has a positive relationship with operational efficiency, portfolio composition and management. However, it has a negative line with capital and credit risks. On the other hand, ROE has a positive line with portfolio composition, while it has a negative relationship with operational efficiency and credit risks. In terms of the relationship with market share, a strong and positive line between market share and ROA is found. A couple of researchers examined this relationship. Nigerian commercial banks case showed that a bank which has a large market share tends to achieve a higher ROA (Ejoh & Acquah, 2014; Etale, Bingilar, & Ifurueze, 2016). In earlier study found that there is a positive link between concentration and ROE by investigating banks in Canada, Europe and Japan (Short, 1979).

3. METHODOLOGY AND DATA

This study draws the data of 17 commercial banks that actually all commercial banks listed in South Korea in 2017. The observation period is from 2011 to 2017. The supporting secondary data are acquired from the financial statement of each commercial banks which were officially provided by the Korea Federation of Bank (KFB) including the Banking Statistics System (BSS) and Financial Supervisory Service (FSS) in Korea. Non-financial information is also collected from reports to parliamentary audit committee and news released to the media. To analyze the determinants of bank competitiveness, two technology-based factors are employed as independent variables, namely: IT security scandals, and IT center operation. This study also controls the impact of traditional factors, such as Deposit ratio, Return on Asset (ROA), and Net Interest Margin (NIM). The following table presents the research variables and their corresponding measurements.

Table 1
Measurement of the dependent and independent variables

Variables	Measurement
$MS_{(borrow)}$	Market Share (Borrow) = the amount of saving in each bank/the total amount of saving in the market
$MS_{(lend)}$	Market Share (lend) = the amount of loan in each bank/the total amount of loan in the market
IT sec	The number of IT security scandals reported in the media
IT ctr	The existence of IT center in any given year (if present = I, otherwise = 0)
Depr	Deposit Ratio = the amount of deposit of each bank/the total amount of asset of each bank
ROA	Return on Asset = the net income of each bank/the total amount of asset of each bank
NIM	Net interest margin (data provided by Banking Statistics System (BSS))

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Since the presence of IT centers and IT-related scandals are random, this study employs OLS regression models to test the hypotheses. Regarding the techinology, the first hypothesis is that there is a negative impact of IT security scandals on bank's market share, and the second hypothesis is that there is a positive impact of IT center operation existence and bank's market share. The statistical model used is as follow

$$MS\ (borrow,lend)_{i,t} = \beta_0 + \beta_1\ ITctr_{i,t} + \beta_2\ ITctr_{i,t} + \varepsilon \quad (1)$$

Subsquently, to test financial fundamental factors' influence, the extended research model is developed as shown below,

$$MS\ (borrow,lend)_{i,t} = \beta_0 + \beta_1\ ITsec_{i,t} + \beta_2\ ITctr_{i,t} + \beta_3\ Depr_{i,t} + \beta_4\ ROA_{i,t} + \beta_5\ NIM_{i,t} + \varepsilon \quad (2)$$

4. EMPIRICAL RESULTS

4.1. Main Analysis

Table 2 shows the descriptive statistics of dependent and independent variables: Market share, both in borrowing and lending market, IT Security scandals, IT center operation, deposit ratio, Return on Asset (ROA), and Net Interest Margin (NIM) of 17 commercial banks over the period from 2011 to 2017.

Table 2
Descriptive statistics of the dependent and independent variables in borrowing and lending market

Variables	No. of observation	Mean	Median	Stdv	Min	Max
MSB	119	5.70%	2.42%	6.24%	0	17.98%
MSL	119	5.04%	1.91%	5.37%	0	14.60%
ITS	119	0.89	0	1.40	0	6
ITC	119	0.31	0	0.46	0	1
DR	119	67.64%	77.76%	25.28%	0	90.02%
ROA	119	0.34%	0.41%	0.69%	-6.20%	1.07%
NIM	119	1.92%	2.08%	0.76%	0%	3.12%

The descriptive statistics in the Table 2 show that the average market shares (borrowing and lending sector) are 5.70% and 5.04% respectively. The reason why the minimum market share is zero is due to the fact that the appearance of two *internet banks* newly established in 2016, therefore, during the year of 2011 to 2016, those of the banks' market share is zero. In terms of IT security scandal, the majority of data is related to leakage of personal information, inability to access to the internet banking system or mobile banking system, temporary shutdown of the online system, and diverse errors related to money transfer, ATM and so on revealed by the press and social media. According to banks information, two banks had IT center in 2004 for the first time and 12 banks have operated IT center currently out of 17 commercial banks. However, during the sample period, only 3 banks have operated IT center since 2011.

In addition, deposit ratio, Return on Asset (ROA) and Net Interest Margin (NIM) clearly demonstrated that the commercial banks in South Korea greatly vary, especially after the

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appearance of the two internet-based commercial banks based on non-branch scheme. For example, the lowest deposit ratio is 0% and the highest reaches 90.02%. One of the outstanding points is the low level of ROA. The huge variation also appears in Return on Asset (ROA), from – 6.20% to 1.07%. The highest ROA ratio is 1.07%. It means that the capabilities for producing revenue are low compared to its asset size. Furthermore, the average Net Interest Margin (NIM) of 1.92%, the lowest NIM ratio is 0% due to the internet-based banks and the highest reaches to 3.12%.

The correlation analysis result in table 3 indicates that the technology variables (ITS & ITC) are positively correlated with banks market share in borrowing and lending markets. In terms of control variables, in borrowing market, deposit ratio (0.346) and ROA (0.138) has correlated with market share respectively. However, according to the table, NIM (-0.023) has shown negative relation with market share in borrowing market. In addition, in terms of lending market, deposit ratio (0.2887) and ROA (0.147) has also positive relation with market share. On the other hand, NIM (-0.015) has also indicated negative relation with market share in lending market. It is worthwhile to note that lowering net interest margin might be beneficial to widening its market share, both borrowing and lending markets. In a second step, the static model applied in this study uses a Regression Analysis to measure the strength of the correlation between each independent variable and the dependent variable. Especially, the paper calculated and analyzed competitiveness characteristics in terms of ICT and control variables which have been considered important determinants for bank competitiveness. The paper examines each variables' influence of market share in both borrowing and lending markets in the sole and combination manner. The results of the research model are presented in Table 4 and Table 5.

Table 3
Correlation matrix for borrowing and lending market

	MSB	MSL	ITS	ITC	DR	ROA	NIM
MSB	1	-					
MSL	-	1					
ITS	0.5015*	0.4820**	1				
ITC	0.5017*	0.5539*	0.1434	1			
DR	0.3468	0.2887	0.2535	0.2311	1		
ROA	0.1387	0.1473	-0.0602	-0.0872	0.1311	1	
NIM	-0.0238	-0.0152	0.0749	-0.0088	0.7539	0.2625	1

* significant at α = 10%.
** significant at α = 5%.

The results in table 4 confirm that ICT factors are joint determinants of the borrowing market share indicated by a significant F-test and acceptable adjusted R^2. The IT security scandal, however, the results show that the interaction between IT security scandal and market share has generated a positive and significant effect on the market share at α = 1%. Additionally, IT center operation also has positive relationship with market share in the borrowing sector at α = 1%. The results hold even after including financial performance factors (see column 3). The inclusion of traditional financial factors as control variables has increased the explanatory power of the model to 57.54%. The model is indicated by a significant F-test result at α = 1%. In terms of control variables, DR and ROA have positive relationship with the market share at α = 1%. NIM, on the other hand, has negative relationship with the market share at α = 1% significant level. All control variables are found to be significant.

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ICT factors are significant and positive relationship with the market share in the borrowing sector. The results suggest that the operation of IT center is significant to increase the market share of the borrowing sector because it might be increasing the convenience of usage of banking system and accessibility to products and so on. However, one surprising result is that IT security scandal will trigger the increase in the market share of borrowing. It casts an important implication to consider. As previously discussed, the control variables are found to be significant at $\alpha = 1\%$. The reason that NIM has negative relationship with the market share is sensible. With lower net interest margin, commercial banks could aggressively market customers and increase banks stance in the market. Through this result, we suppose that, for Korean commercial banks, the fundamental financial factors are still crucial and significant.

Table 4
The Results of the regression model on borrowing

Variables		MSB (t-stat)	MSB (t-stat)
IT	IT insecurity	0.0194*** (6.2477)	0.0165*** (5.8737)
	IT center	0.0585*** (6.2518)	0.0460*** (5.3260)
Control variables	Deposit ratio	-	0.1296*** (5.1273)
	ROA	-	2.3165*** (4.0802)
	NIM	-	-4.1542*** (-5.1494)
Adjusted R^2		0.4305	0.5717
F-Statistics		45.6026 (0.0000)	32.5109 (0.0000)

** Significance at the 5% level (at $\alpha = 0.05$).
*** Significance at the 1% level (at $\alpha = 0.01$).

Next is the results of analysis in lending market (see table 5). The second column of table 5 shows that ICT factors in the lending market share play important role on the bank competitiveness (indicated by a significant F-test and adjusted R^2 of 46.31%). IT security scandal and IT center operation have the same tendency in the lending market as in the borrowing market. IT security scandal and market share in the lending sector has a positive relationship and a significant effect on the market share at $\alpha = 1\%$ significant level. IT center operation has also generated a positive and significant level. The results hold even after adding financial performance factors similar to the result of the borrowing market.

The third column of table 5 shows results of the extended model by including control variables. The results show that DR and ROA have positive impacts on the market share at $\alpha = 1\%$. Similarly, in the borrowing market, NIM, has negative relationship with the market share at $\alpha = 1\%$.

The results suggest that the operation of IT center is significant to increase the market share of the lending sector as well due to accumulating data and managing strategy for terms and conditions of loans. However, similar to the previous result in the borrowing sector, IT security scandal will trigger the increase in the market share of lending. The results suggest the same implication for the analysis in the later stage. The fundamental financial factors are still important

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in the lending sector. The control variables are found to be significant at α=1%. The relationship with market share is also in the same line. After including control variables, the model shows a significant F-test result and a higher explanatory power (54.52%). According to the result, this study demonstrates that the fundamental financial factors might be crucial both borrowing and lending market by increasing the validity and the explanation of the model.

Table 5
The Results of the regression model on lending

Variables		MSL (t-stat)	MSL (t-stat)
IT	IT insecurity	0.0156*** (6.0303)	0.0144*** (5.7979)
	IT center	0.0567*** (7.2624)	0.0511*** (6.6800)
Control variables	Deposit ratio	-	0.0672*** (3.0044)
	ROA	-	2.0036*** (3.9833)
	NIM	-	- 2.4178*** (- 3.3828)
Adjusted R^2		0.4631	0.5452
F-Statistics		51.9060 (0.0000)	29.3014 (0.0000)

** Significance at the 5% level (at α = 0.05).
*** Significance at the 1% level (at α = 0.01).

4.2. Robustness Test

To test for the robustness of the main results, this study uses different banking specific indicators for profitability and efficiency. On the same justification, this study keep emplying OLS regression models, however, the robustness tests use Return on Equity (RoE) as a measurement for profitablity and Operating cost over operating income (OCOI) as a measurement for efficiency. The results are shown in table 6 and 7.

In borowing market (see table 6), the results show similar results to the main analysis. Both technology variables retain their significance, and so the traditional financial variables. Similar to ROA in the main analysis, ROE in the robustness check has a positive and significant coeeficient implying that bank profitability is positively related to the market share in the borrowing market. The OCOI variable also shows same result with NIM that it is negatively related to the market share in borrowing market, though with less importance as shown by smaller coefficient. Overall, the financial factors are still important factors to bank's competitiveness.

Next is the robustness check for the lending market. The regression analysis results are shown in table 7.

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Table 6
The Results of the regression model on borrowing

Variables		MSB (t-stat)	MSB (t-stat)
IT	IT insecurity	0.0194*** (6.2477)	0.0172*** (6.1541)
	IT center	0.0585*** (6.2518)	0.0435*** (5.0861)
Control variables	Deposit ratio	-	0.1283*** (5.1197)
	ROE	-	0.3216*** (4.3186)
	OCOI	-	-0.0235** (-2.2749)
Adjusted R^2		0.4305	0.5782
F-Statistics		45.6026 (0.0000)	33.3620 (0.0000)

** Significance at the 5% level (at α = 0.05).
*** Significance at the 1% level (at α = 0.01).

Table 7
The Results of the regression model on lending

Variables		MSL (t-stat)	MSL (t-stat)
IT	IT insecurity	0.0156*** (6.0303)	0.0151*** (6.0909)
	IT center	0.0567*** (7.2624)	0.0490*** (6.4709)
Control variables	Deposit ratio	-	0.0662*** (2.9889)
	ROE	-	0.2823*** (4.2873)
	OCOI	-	-0.0177* (-1.9331)
Adjusted R^2		0.4631	0.5539
F-Statistics		51.9060 (0.0000)	30.3141 (0.0000)

* Significance at the 10% level (at α = 0.10).
** Significance at the 5% level (at α = 0.05).
*** Significance at the 1% level (at α = 0.01).

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ROE has a positive and significant coefficient, showing bank's profitability influences the market share in the lending market. The result is similar to ROA's result in the main analysis. In the lending market, OCOI still shows some degree of significance, however it is weaker than the effect of NIM on the lending market share. This could be argued that although OCOI is a common bank efficiency indicator used in some countries (e.g., Indonesia), it is not a main indicator that is regularly checked by Korean Central Bank. Overall, the robustness test shows that the main analysis holds when the specific bank performance indicators are used.

5. DISCUSSION

The positive relationship between IT center operation and market share contrasts or partly opposites the arguments by Carr (2003), Beccalli (2007), Shin (2001), and Barua, Kriebel and Mukhopadhyay (1995) but is similar to the work of Porter and Miller (1985), Sambamurthy, Bharadwaj and Grover (2003), and Rai, Patnayakuni and Patnayakuni (1997). Add to the prior studies, this study provides evidence that the existence of IT center operation in Korean commercial banks increases their market share, both in borrowing and lending markets. As expected, the investment in IT center enhances the credibility of Korean commercial banks in term of stability and safety of their transactions that increases the customers' trusts reflected in higher market shares.

Regarding the IT security scandal, this study finds surprising results of positive impacts of IT security scandal on market share. We argue that this might be incurred by and indirect influence. In general, when an insecurity scandal occurs, the bank might be closely monitored by the regulators. The strict monitoring and auditing from the authority is perceived by customers, somehow, as certainty degree that banks will be secured instantly and upgrade the system to protect them from further risks. This argument is in line with the findings of Gunther and Moore (2003) and Chortareas, Girardone and Ventouri (2012) by emphasizing the role of supervisory of government (i.e., financial authority) on financial institutions, such as banks.

Another possibility to explain the positive relationship between IT security scandal and market share is that the majority of the insecurity scandals happened among the major reputable banks. Times to times, the occurrence of IT insecurity from minor banks or local banks tend to be less focused or dismissed by the media. Given, major banks' rigid and powerful stance in the market, IT insecurity scandal might little affect their market share promptly and directly. In this regard, one limitation of study is that there is no prompt and instinct data on the date of the incidents as the market share and other data is based on annual basis. Thus, it can be argued that there is a gap period between IT security scandal and the data application. During the remaining period after the occurrence of IT security scandal, there is a possibility to recover the loss of market share from banks themselves. Therefore, IT security scandal might not deter customers to stay with the banks.

With respect to Deposit ratio, the positive influence on market share supports prior studies (e.g., Lee and Hsieh, 2013; Menicucci and Paolucci, 2016). The finding implies that the more deposit over the asset of a bank signals its capability to provide funds to customers in lending market. On the other hand, the higher deposits also gives a degree of assurance to customers in borrowing market. In addition, regarding Return on Asset (ROA), the positive influence on market share supports the finding of Fitch (2012), Ejoh and Acquah (2014), and Etale, Bingil ar and Ifurueze (2016). ROA shows the overall efficiency performance of a bank. It is normally understood that the more efficient is a bank, the more reputable it is from the point of view of customers, both in borrowing and lending markets.

However, the negative influence on the market share with respect to NIM is a surprising finding. The finding contrasts to prior studies (e.g., Lartey et al., 2013). However, it supports the

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findings of Seelanatha (2010) and Hakimi et al. (2015). The negative relationship between NIM and market share suggests that the more NIM a bank gets, the less likely the bank is to have market share. The explanation of this is that higher NIM implies that higher margin between lending and borrowing rates. From the perspective of customers in borrowing market, the banks charge higher interest rate, meanwhile the customers in lending market may think that they are given lower interest rate relatively to other banks. Our argument is in line with the result of Demirgüç-Kunt & Huizinga (1998) that found a high competition among banks triggers lower margins. Additionally, Seelanatha (2010) showed that banks with high market share tend to increase profit through low margin.

In terms of the degree of influence for factors, the results show that control variables both in borrowing and lending market, have stronger influence than ICT factors. This provides the fact that in Korean, until now, it seems that traditional roles of bank are dependent more on financial factors. It could be argued that banks may not have optimized their IT capabilities as a competitiveness driver. However, as many non-banks financial service providers appear and has taken some of the banking market, Korean banks should gear up their IT facilities to compete. Furthermore, the increase trend of number of internet banks (IT-based banking business without branch) will push banks to catch up with non-banks financial service providers to prepare for competition in digital era.

6. CONCLUSIONS

This study aims to provide the evidence of the ICT factors as Korean commercial banks competitiveness determinants in digital era both in borrowing and lending markets. This study contributes to the banking research area, in particular, the role of ICT on bank performance. The statistical analyses evident that market share in Korean commercial banks can be partially attributed to their ICT capabilities. IT security scandal casts surprising result, however we argued that the scandal could be perceived as promptly monitoring by Korean government or financial authority. IT center operation is found to be crucial for Korean commercial banks in digital era. Additionally, in Korean banking industry, the fundamental financial indicators are still important source of bank competitiveness.

The findings in this study have several implications. Firstly, the findings imply that banks should pay attention on developing its ICT facilities as one of competitiveness sources in digital era. It offers implications for commercial banks to keep setting up upgraded IT system in the digital era since the speed of adopting new technology and financial services from customers will be fast. Secondly, government or financial authority should respond promptly on the bank security incidences involving banks IT facilities. The unexpected result in terms of IT insecurity, the current major banks' convergence into market share is very stable and rigid, therefore, even though IT insecurity could not deter its current position, rather, customers could feel secure from the expectation from the Authority's strict monitoring and supervisory measures. In this regard, policy maker needs to reconsider regulations to awakening major banks and its customers as well.

The limitations presented here allow us to discuss the opportunities for future research. First, in terms of IT security scandal, our sample focused only on news or media released cases and commercial bank sector in one country, namely South Korea and secondly, we focused only on two variables with respect to ICT factors: IT security scandal and IT center operation as independent variables. Factors, such as the speed of recovery of IT failure, the technology used and other IT banking aspects can provide additional explanation on the relationship between ICT and market share and even verify multiple combination effect by adding other control variables.

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