The Impact of Internet Banking on the Performance of the Korean Banking Industry: An Empirical Analysis

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Summary

This paper aims to verify the hypothesis that Internet banking, rapidly expanding in the Korean banking industry, allows banks to reduce cost and ultimately contribute to higher profitability. Our analysis, based on the quarterly financial statements of 20 Korean banks from 2000 to 2002, suggests that Internet banking, especially when it expands, contributes to reduction of banks' cost, while it does not affect their profitability. It implies that the primary objective of introducing Internet banking, which was to reduce the operating cost such as branch maintenance expenses, has been accomplished, but this cost-reduction effect has not reached the stage in which beneficial effects of Internet banking overcome the negative effect of initial investment on the profitability of banks. Considering that the growth potential of Internet banking consists in its cost efficiency, this also indicates that Korean banks' strategies of expanding Internet banking would ultimately bring positive outcomes.

The findings of this paper offer an important implication that Internet banking has increased social welfare by making banks distribute the benefit of cost reduction to customers in various forms such as preferential interest rates and fee exemption, rather than internalize the benefits to the banks' profits. This paper also finds an indirect evidence that benefits to the Internet banking customers has been primarily provided through the interest rate channel rather than non-interest service channel. In addition, we found that the people's preference for face-to-face transaction may be very low in Korea, which supports the hypothesis that the cost for securing customer base will be much reduced. From the results of empirical analyses, it can be also anticipated that the profit-enhancing effect of Internet banking will become more significant in the near future since the cost-reduction effect of Internet banking will be stronger with the technology development that reduces the cost of maintaining Internet banking system.

CHAPTER 1

Introduction

Internet banking can be defined as using the Internet as a delivery channel for banking services such as opening a deposit account, transferring funds, or lending. In various finance literatures, a common hypothesis is that Internet banking is clearly different from other delivery channels of banks such as branch offices, ATMs, and other remote routes, in terms of either benefits to customers of banking services or impact on competition structures of banking industry. Literally, the core difference comes from that the Internet banking services are channeled through the Internet, a globally open network. Customers, in addition to merely having another service channel apart from banks, benefit from being able to execute their banking business whenever and wherever they have access to the Internet. For banks, the scope of competition is not limited by the region or by country and it is more difficult to retain their customer base since switching cost, an opportunity cost paid by a customer when he/she changes his/her main financial institution, is lowered by Internet banking. Therefore, Internet banking is expected to introduce competitive pressure that may bring significant changes in banks' financial performance and the structure of banking industry.

Among various attributes of the Internet, such as low cost, time-saving promptness, and interactiveness, etc., the most important is the 'low cost' and this exerts a first-order influence on the performance of banks. For instance, banks can substantially reduce overhead expenses by jettisoning physical branch offices, which could be substituted by Internet banking system, and enhance their profitability.[1] Banks can use the resulting savings to reduce their loan interest rates or increase their deposit interest rates, retaining most profitable customers and attracting new customers without sacrificing earnings.

Looking for this cost-reduction effect, Internet banking has been actively and widely introduced by banks across the globe. In Korea, the introduction of Internet banking was somewhat late compared to other countries, but it expanding with one of the fastest speed in the world. And, based on the rapid increase in Internet banking population, the worldwide attention has been paid to the growth potential of Internet banking in Korea. The major factor that makes Korean banks endeavor to expand in the Internet banking market is the assumption that, having been exposed to fierce competition after the financial crisis, they can reduce operational costs to a great extent.[2]

However, many research on the banking industries of other countries report that the performance of Internet banking is not satisfactory thus far. Moreover, even Internet-only banks, which were expected to flourish and enjoy the cost reducing effects to the fullest, are

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[1] For example, according to DeYoung (2001a) based on a survey by Booz, Allen & Hamilton, it has been estimated that branch banking costs about $1.07 per transaction, telephone banking costs about $0.55 per transaction, ATM banking costs about $0.27 per transaction, and Internet banking costs about $0.01 per transaction. Table 2 of Sato and Hawkins (2001) also presented similar figures.

[2] Since it was introduced when the use of Internet was already widespread for commercial purposes, Koreans might be relatively more comfortable with Internet banking. This can be another factor that makes the rapid expansion of Internet banking in Korea.

adjusting their business strategies or being absorbed by incumbent traditional banks.[3]

This paper is interested in the effects of introduction and expansion of Internet banking on the profitability structure of the Korean banking industry, and tries to evaluate whether the performance of Internet banking in Korea is also poor. Thus, the paper aims to analyze financial statements of individual Korean banks for the past 3 years, and to find evidence of the cost reducing effect that is expected to be the most important merits of Internet banking.

Considering that only three years have passed since Korean banks introduced Internet banking and that its market continues to grow rapidly, it is certainly possible that the conclusions may be premature, and that predicting future development of Internet banking only based on the result of empirical analyses may be dangerous. However, it is still meaningful to offer a current picture of changes in the banking industry due to the introduction and expansion of Internet banking. Such a picture can provide an important initial step for analysis of financial market policies and strategies of individual banks as well as the likely future impact of Internet banking on the financial services industry.

The remainder of the paper proceeds as follows. Chapter 2 provides a brief description of Internet banking in the Korean banking industry and reviews some of the previous literature on topics related to this study. In Chapter 3, after describing the data, we test various hypotheses regarding the impact of Internet banking on the profitability and cost-efficiency of Korean banks, and interpret the results of our empirical analysis. Chapter 4, the final chapter, summarizes the major findings and concludes the paper.

[3] Banks offer Internet banking in two main ways. First, an existing bank with physical offices can establish a Web site and offer its customers Internet banking in addition to its traditional delivery channels of 'brick and mortar' branches. At present, all the Korean banks, like most banks in foreign countries, offer Internet banking using this 'click and mortar' business strategy. Second, a bank may be established as a “virtual,” or “branchless” bank, with a computer server that is housed in an office that serves as the bank’s legal address or at some other location. Virtual banks may offer customers the ability to make deposits and withdraw funds at automated teller machines (ATMs) or other remote delivery channels owned by other institutions. These are also called as “Internet-only banks” or “pure play Internet banks.”

CHAPTER 2

Internet Banking in Korea and Related Literature

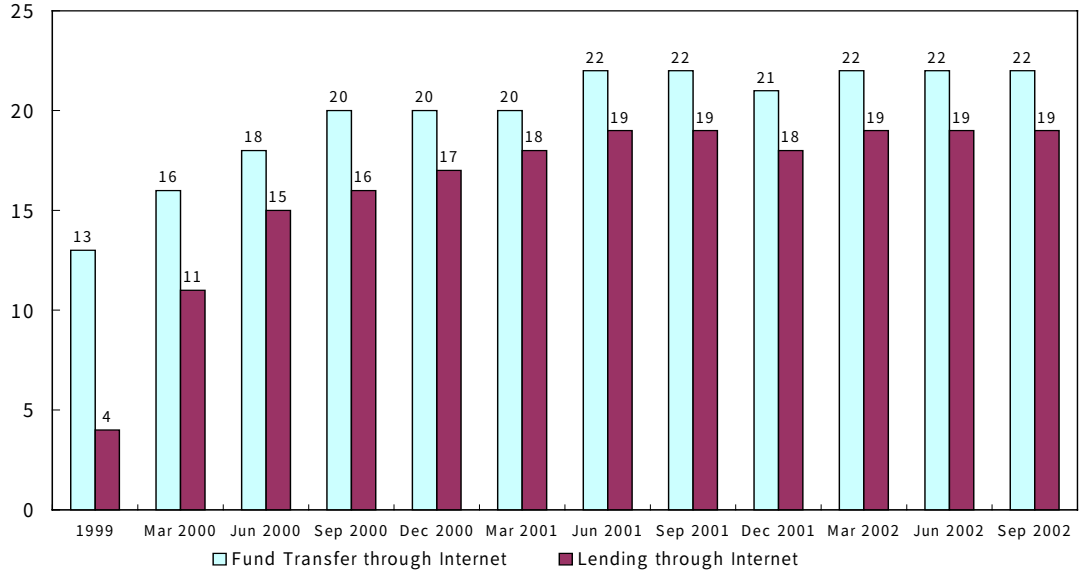
1. Overview of Internet Banking in Korea

Though Korean banks had provided information such as branch locations and product descriptions through their Web sites from the mid 1990s, it was only after the second-half of 1999 that they began offering 'transactional' Internet banking with which customers can transact business such as opening a deposit account or transferring funds. While the adoption of Internet banking system in Korea had a late start compared to other countries, but the rate of its expansion was remarkable.

After Shinhan Bank first introduced its Internet banking services in July 1999, about half of the other Korean banks followed providing the service during the second half of the same year, and by the end of the year 2000, all Korean banks were providing Internet banking service. Thus, the number of Internet banks in Korea increased from 13 at the end of 1999 to 22 at the end of June 2002, including Korea Post Bank, Korea Development Bank, and 2 foreign bank branches, Citibank and HSBC.

Most Internet banks in Korea also provide their customers with lending services through their Web sites. At the end of 1999, only 4 among 13 Internet banks provided Internet lending service, and at the end of June 2002, the number increased to 19.

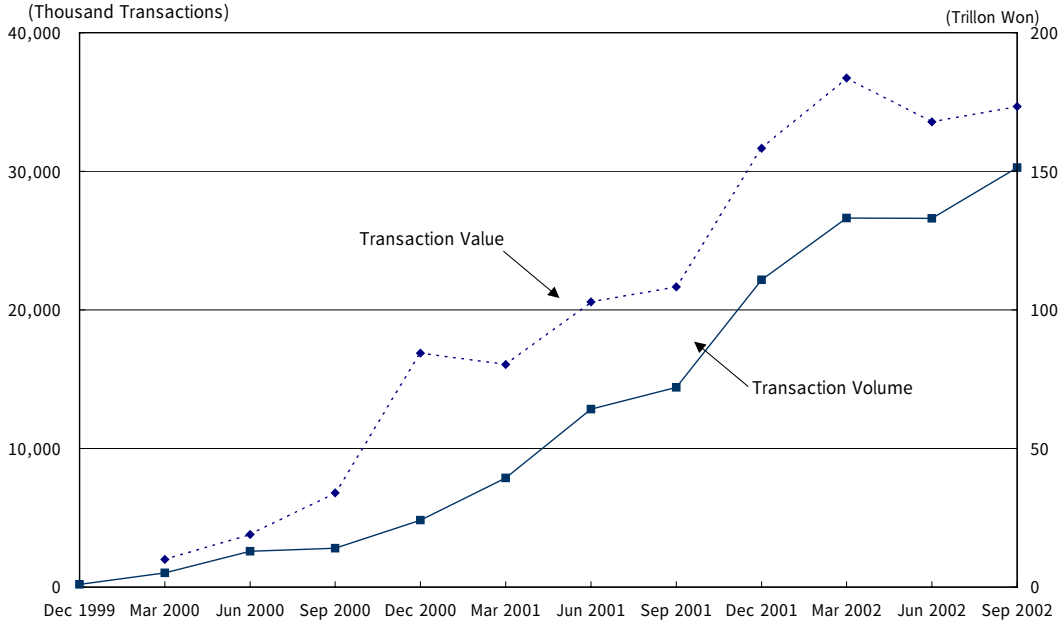
Figure 1. Numbers of Banks Providing Internet Banking Service in Korea



Source: The Bank of Korea, Press Releases.

The number of registered Internet banking customers also continued to grow rapidly and within approximately 3 years of its introduction, that is, by the end of September 2002, over 30% of the Korean population were using the service. The monthly transaction volume through the Internet banking service also rapidly increased from about 5 millions in 2000 to more than 30 millions amounting to 173 trillion won in September 2001, after recording the average quarterly growth rate of higher than 50% in 2001.

Figure 2. Monthly Transaction Volume and Value through Internet Banking in Korea



Source: The Bank of Korea, Press Releases.

Table 1. Average Share of Internet Banking Transactions in Korean Banking Industry

	June 2001	Dec. 2001	Mar. 2002	June 2002	Sep. 2002
Total Banks	5.9	8.8	10.5	11.7	14.1
Commercial Banks	8.5	14.2	14.5	17.9	22.1
Local and Specialized Banks	2.7	4.3	6.6	8.4	9.2

Source: The Bank of Korea, Press Releases.

The share of Internet banking transaction among all transactions including the representative 4 distribution channels, which are branch banking, phone banking, ATM banking as well as Internet banking, rapidly increased in Korea. The average Internet banking share of 22 Internet banks exceeded over 10 percent level in March 2002 and, due

to the impact from implementing five-day workweek by Korean banks from July 2002, the share rose to 14.1 percent for all banks and 22.1% for commercial banks in September 2002.

2. Previous Literature Regarding the Impact of Internet Banking

While there exist many theoretical industry analyses outlining the potential impact of Internet banking on cost savings, revenue growth, and increased customer convenience based on anecdotal evidence and conjecture,[4] little empirical analyses or systematic information exist. To the authors' knowledge, there is no empirical analysis on the impact of Internet banking prior to the present paper. This may stem from the lack of availability of appropriate data for empirical studies since Internet banking has only 3-year history in Korea.

Even in developed countries such as the U.S., it is only very recent that banks started to periodically report their Internet banking related business transaction trends to the supervisory authority,[5] and there are no regularly compiled data on this feature of banking industry. Therefore, assembling comprehensive information on the Internet banking activities of commercial banks has been quite difficult, and this may be a reason why there exist only a small number of empirical studies regarding Internet banking in these countries. However, their result should be interpreted with caution since even these rarely existing studies had been processed with data of the banks in specifically characterized categories.

Among the empirical studies on the impact of Internet banking, Furst et al. (2000, 2002) used the most comprehensive data set. They investigated whether offering Internet banking effects a bank's financial performance by examining about 2,500 national banks covered by the third quarter of 1999 'Report of Condition and Income' (the "call report") of the U.S. Office of the Comptroller of the Currency (OCC). In terms of the cost-efficiency, ratios of non-interest expenses of small banks with Internet banking were higher than non-Internet ones, while, for the larger banks, the ratio was not significantly different between Internet banks and non-Internet banks. Small and large banks showed different degrees of the impact of Internet banking on the profitability. For example, the ROEs of large banks with Internet banking were higher than those of non-Internet ones, while small Internet banks were less profitable than non-Internet small banks. The authors argued that the poor financial performance of small Internet banks may be the result of short-run costs incurred in making an investment in Internet banking, which could be significant for the smaller banks, while not prohibitive.

Sullivan (2000) provided another empirical research that compared Internet banks and non-Internet banks in terms of cost-efficiency and profitability by examining financial statements of the banks in the Tenth Federal Reserve District of U.S.[6] Most results were not very different to those of Furst et al. (2000, 2002), while expenses tended to be higher at Internet banks compared to the non-Internet banks. He concluded that banks have been neither helped nor harmed by their commitment to the Internet as a delivery channel, and explained that the increase in non-interest operating expenses due to the start-up costs had been offset by the increase in non-interest revenues due to the adoption of Internet banking.

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4 See Beck (2001), Claessens et al. (2000, 2001, 2002), DeYoung and Hunter (2001), Herbst (2001), and Lin et al. (2001).

5 The Office of Thrift Supervision (OTS) has not required prior notice for federally chartered thrifts until beginning in 1999, and in the third quarter of 1999 a line was added to the 'Report of Condition and Income' (the 'call report') for all banks and thrifts to report their uniform resource locator (URL). See Furst et al. (2002).

6 The Tenth Federal Reserve District consists of Oklahoma, Kansas, Nebraska, Wyoming, Colorado, western Missouri, and northern New Mexico.

DeYoung (2001a, 2001b) provided empirical analyses on the profitability and cost-efficiency of Internet-only banks to examine whether the Internet-only bank is viable business model. Contrast to the findings in Furst et al. (2002) and Sullivan (2000), he found that the average Internet-only bank earned significantly lower profits than the average traditional bank, due primary to low business volumes and high non-interest expenses. And he found that non-interest revenues of Internet-only banks is relatively lower, interpreting this to suggest that it is difficult to cross-sell fee-based financial products to loan and deposit customers over a distribution channel that minimizes person-to-person contact, because a large portion of Internet banking customers do not view the Internet-only bank as their main financial institution.

However, DeYoung (2001b) argued that relatively lower profitability of Internet-only banks in the U.S. could be attributed to that the learning process of these newly established banks was still underway. Thus, he concluded that as Internet-only banks age, they accumulate experience which may allow them to operate more efficiently, and as they grow larger they may generate scale-based savings not available to traditional banks that use less capital-intensive production and distribution technologies. Finally he predicted that, if the experience-based technology effects and the scale-based technology effects are large enough, the performance gap between Internet-only banks and traditional banks could narrow in the future, and thus, suggested that the Internet-only banking model may well be viable when executed efficiently.

CHAPTER 3

Empirical Analysis on the Impact of Internet Banking

1. Scope of Analysis

In what follows, using various econometric analyses, we try to verify the hypothesis that introduction and expansion of Internet banking allow banks to reduce cost and ultimately contribute to the financial performance of banks by enhancing their profitability. The primary interest of this paper is whether the Internet banking can enhance the bank profitability. However, analyzing only profit enhancement effect is not enough since the Internet banking is generally expected to not only benefit the bank profitability but also consumers' welfare by improving cost-efficiency. For example, when a bank, aiming to secure its market base for new business, provides preferential interest rates or service fee exemptions to its Internet banking customers, it is possible that the cost-reduction effect of Internet banking does not clearly contribute to enhancing profitability.

Thus, to more precisely analyze and to clearly understand the role of Internet banking, it is necessary to investigate its impact on the non-interest expenses and revenues, as well as the profitability of banks. The analysis on non-interest expenses provides important information on the cost efficiency due to Internet banking. And the analysis on the non-interest revenues provides a yardstick for judgement whether banks share the benefits of Internet banking with their customers[7] and, if so, which channel are the benefits to customers being delivered through.[8]

2. Data and Results

Previous empirical analyses of the economic effects of Internet banking have been performed using cross-section data. In countries like the U.S., where many banks compete with each other and show different patterns on the adoption of Internet banking, it is possible for the banking industry to provide enough number of observations and a variety of samples with which the cross section analysis could draw statistically meaningful results.

However, in the Korean banking industry, where Internet banking system was introduced just 3 years ago, only 20 banks from all the commercial banks, regional banks, and specialized banks combined which have retail banking divisions were available for analysis. Thus, the data are too limited to proceed to cross-section analysis and, because we

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[7] It is difficult to measure the value of Internet banking or its share for banks and customers. However, we may judge that, like Sullivan (2000), when Internet banking does not have any influence on the profitability because the non-interest revenues of banks is big enough to cancel out the initial investment expenses for system building, data imply that average customer do not sufficiently benefit from Internet banking.

[8] If the benefits to customers were delivered primarily through the preferential interest rates such as higher deposit rates and lower lending rates, the data would tell us that Internet banking does not influence on the non-interest expenses or revenues. If the benefits delivered primarily through the fee exemptions and other non-interest advantages, the data shows negative impact on non-interest revenues.

have about 10 quarterly data in the last 3 years, the time-series analysis is not an alternative, either. In addition, it is not easy to construct sample data that consist of various observations because, for example, half the banks in our sample started Internet banking services almost simultaneously in the second half of 1999.

To overcome such data limitations, the authors constructed a panel data of 20 banks, observed on a quarterly basis, from the first quarter of 2000 to the second quarter of 2002. This strategy accounts for at least 200 observations. So we can solve data problem, which arise when we use only cross section data or time series data and, since the sample data consist of each unit traced by time series, there are merits that we can include such as dynamic path of economic variables into the analysis.

A. Data

The sample period of our empirical analysis is 10 quarters from the first quarter of 2000 to the second quarter of 2002. Though Korean banks already offered Internet banking services in July 1999, the data available for our analysis were those after 2000 because the Bank of Korea first collected data to publicize the 'Domestic Use of Internet Banking Services' during the first quarter of 2000. And it was not until the first quarter of 2000 when quarterly financial statements of Korean banks were publicly open, as the amended 'Regulation on Supervision of Banking Business' required Korean banks to do so. Thus, the quarterly financial performance information of banks is available only from the first quarter of 2000.

Twenty banks were analyzed. Two foreign-bank branches, Citibank and HSBC, and two government-managed banks, but Korea Development Bank and Korea Post Bank, are excluded from the sample, taking into consideration that they have quite different business strategies compared to other banks. For the last quarter of 2001 to the second quarter of 2002, the data from Korea Housing & Commercial Bank and Peace Bank do not exist because they were merged with Kookmin Bank and Woori Bank, respectively. We include these two banks in the analysis, however, since the timing for adopting Internet banking is different for these merging banks and the information on the effect of introducing Internet banking might be unique for each bank before the mergers.

Though most variables used in our analysis have 200 observations, on average, however, considering that we do not have data for the last three-quarters of two merged banks, some variables have only 194 observations. Some other variables, whose series start from the last quarter of 1999, consist of 214 observations.

a. Data from Financial Statements of Banks

Data for financial conditions and performance of individual banks were mostly derived from financial statements published in 'Data Analysis, Retrieval and Transfer System' (DART, http://dart.fss.or.kr) of Financial Supervisory Service. Since each account in income statement are accumulated from the beginning of the year to the relevant quarter to analyze performance of a bank in a quarter, that is flow variable, we had to rewrite those income statements. Since stock variables related to the balance sheets are not needed for such an adjustment, we used same data that are publicized. In the case of National Agricultural Cooperative Federation and National Federation of Fisheries Cooperatives, we used quarterly financial statements publicized at their respective Web site because the 'DART Regulation' dose not apply to them,.

Variables used in our analysis are as follows. From the balance sheets of each bank, we

calculate ratios of total stockholders' equity, the ratio of interest-bearing assets,[9] the ratio of loan, and the ratio of won-denominated deposits, respectively to total assets of each bank. The market share based on deposit balance and market share based on loan balance of each bank are also respectively calculated. For the variables related to managerial characteristics of each bank such as number of employees, number of branches, and BIS capital adequacy ratios, which are not shown in balance sheets, are obtained from the 'Banking Statistics' of Financial Supervisory Service and 'Statistics Database' of the Bank of Korea. The number of employees and the number of branches are divided by the total assets of each bank to control the size effect. In addition, to control the differences of performance due to the restrictions on business area, we used a dummy variable sorting out nation-wide banks from local banks. Another dummy variable sorting out banks that received the restructuring-related public funds also used to consider the change of performance after the injection of the public fund.

From income statements, we used operating expenses, operating revenues, and their sub-items[10] and calculated their linear combinations, including non-interest operating expenses, non-interest operating revenues, net operating revenues,[11] interest income,[12] 'income before income tax' and 'net income before income tax and allowance for credit losses'. To measure profitability or cost efficiency of each bank, we calculated return on equity (ROE), return on assets (ROA), and some ratios related to relative expenses and revenues. The ratios related to expenses include the ratio of non-interest operating expense to total assets, the ratio of interest expenses to interest-bearing assets, the overhead ratio,[13] 'salaries & employee benefits per employee', and 'occupancy, furniture & equipment expenses per branch'. The ratios related to revenues include the ratio of non-interest operating revenue to total assets, the share of non-interest operating revenues,[14] the ratio of non-interest revenues,[15] and net interest margin.[16]

Most of data related to expenses or revenues to yield such variables and ratios keep their original name as in income statements publicized from banks, but some items are adjusted by different grouping of sub-items. These adjustments were needed to minimize possible distortion in quarterly flows of expenses or revenues, since operating expenses can be significantly affected by the regulatory changes in required loss-provision ratios. So, adjusted items are mostly related with allowance for credit losses and fees & commissions from trust account. Also, 'The Criterion of Bank Accounting Method' was enacted in 1998 to change some account names and classification standards.[17] However, for some variables we use account names of old accounting standard to deliver the implications of analysis

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9 Interest-bearing assets are sum of cash & checks, due from banks, traded securities, investment securities, and loans & discounts in the balance sheet of banks.

10 Operating expenses consist of interest expenses, commission expenses, salaries & employee benefits, occupancy, furniture & equipment expenses, and other operating expenses. Operating revenues consist of interest revenues, commission revenues, net fees and commissions from trust account, and other operating revenues.

11 Net operating revenues can be calculated from subtracting interest expenses from total operating revenues.

12 Interest income is interest revenues less interest expenses.

13 Overhead ratio is a ratio of non-interest operating expenses to net operating revenues.

14 The share of non-interest operating revenues is a ratio of non-interest operating revenues to total operating revenues.

15 The ratio of non-interest revenues is a ratio of non-interest operating revenues to net operating revenues.

16 Net interest margin is a ratio of interest income to interest-bearing assets.

17 For example, expenses classified as salaries & employee benefits are now classified into three sub-items including salaries, retirement allowance, and other employee benefits.

more clearly.

b. Internet banking data

Data regarding introduction and expansion of Internet banking are collected for 20 banks just as financial statement data. Most of these data are acquired from various press releases of the Bank of Korea. It was not easy, however, to secure consistent time series data of the present condition of bank's Internet banking. Among these data, we utilize starting dates of various Internet banking services and completion dates of related system building, amounts of funds transferred through Internet banking system, and shares of Internet banking transactions of individual banks in our analysis.

As an index of opening Internet banking service or not, we use a quarterly dummy variable obtained from the starting date of Internet banking in each bank. The starting dates of Internet banking can be traced from the third quarter of 1999, but, considering that all 20 banks could provide Internet banking service from the third quarter of 2000, the practical time span is short. There can be three different data series of starting dates, first, dates of allowing interaccount fund transfer through Internet banking system, second, dates of lending service, and third, dates of starting each bank's own Internet banking system.[18]

Most pervious empirical analyses on Internet banking in other countries recognize a bank as the Internet bank only if the bank offers 'transactional' Internet banking system, which allows the customer, at minimum, to initiate interaccount transfers. This might be based on considerations that a simple Web site providing branch and product information or even on-line balance inquiry has only minor impact on the bank's financial performance and that this simple Internet service system does not require greater commitment of a bank's resources to the Internet banking.

We follow the custom to identify Internet banks. However, if we choose data of starting dates of allowing interaccount fund transfer through Internet banking system, the observations are concentrated in the second half of 1999.[19] So it is difficult to analyze the effect of the Internet banking differentiated by the time of adoption. We also have similar difficulties when we choose data of starting dates of Internet lending service. Thus, we choose the third series of starting dates of Internet banking based on dates of starting each bank's own Internet banking system. Since the decision of a bank to build its own Internet banking system is closely related to the bank's judgement on the market demand for Internet banking and necessity of IT investment to secure market share and customer base, these data of starting dates can better reflect business strategies of individual banks. In addition, the difficulties that stems from concentration of observation can be alleviated when we use the completion date of building banks' own Internet banking system.

To measure the degree of expansion of Internet banking, we use a proxy variable that is a ratio of amount of interaccount transfer through Internet banking system to the total won-denominated deposit balance. The Bank of Korea provides average share of Internet banking transactions out of total transactions through four representative distribution channels, including branch, phone, ATM, and Internet. Though these shares could reflect the degree of Internet banking expansion better, it is impossible for us to use these data since the data exist biannually and only from June 2001. Nevertheless, the proxy used in our analysis is rational enough, considering that the value of funds transacted through

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18 Starting dates of interaccount fund transfer and lending service is collected based on press releases of the Bank of Korea and completion date of building banks' own Internet banking system is grasped from personnel of Financial Supervisory Service, Banktown, and relevant banks.

19 Total of 14 banks excluding Chohung, Woori, Seoul, Kookmin, Daegu, Pusan Bank started Internet banking service including interaccount transfer through Banktown in the second half of 1999.

Internet banking is proportionally increasing with its transaction volume, and the number of transactions through various channels is increasing proportionally to the deposit balance. Also, total Internet banking activities of banks could be represented by the volume and value of fund transferred since, as shown at the press releases of the Bank of Korea, the shares of Internet banking lending service is still immaterial.

B. Empirical Results

a. Internet banking and profitability

First of all, we investigate the impact of both introduction and diffusion of Internet banking on the profitability of the banking industry in Korea. Examining the simple correlation between the indexes representing activities related to Internet banking and bank's profitability, we proceed to embed the indexes into typical regressions used in many empirical studies and gauge the degree of comovement between the indexes and profitability after controlling for the variables that traditionally thought to be relevant to bank's profitability.

The empirical model we specify possesses the following panel structure with the two-way fixed effect.

$$y_{it} = \alpha + \beta z_{it} + \gamma' x_{it} + \mu_i + \eta_t + \varepsilon_{it} \qquad (1)$$

where y_{it} is the performance measure of bank i at time t, z_{it} is an index for Internet banking activities, and x_{it} is the vector of variables related to performance of the bank. As for the design of fixed effect, while μ_i represents an individual-specific time-invariant intercept, term η_t captures individual-invariant time effect. ε_{it} s are identically and independently distributed error terms with the mean 0 and variance σ^2.

Two popular measures for banks' performance have been used in many empirical studies; return on assets (ROA) and return on equity (ROE). We take ROE to represent the performance of banks in this paper[20]. Net income is used in the numerator when ROE is calculated in most of the cases but it shows a significant fluctuation during the time span covered in the paper. The Korean banking industry had gone through a turbulent restructuring process during the time so that the main portion of fluctuation in net income may mirror technical changes stemming from frequent changes in tax code and accounting practices rather than represent the performance of individual bank. Instead, we use 'net income before income tax and allowance for credit losses' to calculate ROE to minimize the influence of aforementioned institutional realignments unrelated to ordinary activities of banks.

We take two different indexes for measures of Internet banking related activities. One is the dummy for the quarter when a bank established its own Internet banking system (D1), which is intended to gauge the impact of introducing Internet banking on profitability. The other is the ratio of amount of interaccount transfer through Internet banking system to the total won-denominated deposit balance (D2) to represent the expansion in Internet banking. The rationale behind the distinction is that there may be two different forces working here. Internet banking may cause bank's profitability to be shifted down permanently when it is introduced or to be improved gradually as higher proportion of bank's fundamental task such as interaccount transfer is performed through on-line facilities. It seems that the main motive for banks to introduce Internet

[20] We performed the same analysis with ROA but could not find any substantial differences in the results to change the course of argument in the main text. The results of analysis with ROA can be obtained from the authors upon request.

banking and to extend its role lies in lower cost and ultimately higher profitability. It is, however, very difficult to predict the signs of estimated coefficients on D1 or D2 in our analysis. It was not until the second half of 1999 that banks started to establish their own Internet banking system to serve the customers though a group of banks including Shinhan Bank, Hanmi Bank, and now non-existing Korean Housing & Commercial Bank offered limited range of Internet banking services by contracting out to an independent service provider called "Banktown" system. Considering the fact that investment generally requires a certain amount of digestive period to realize its return and investment on information technology to extend the depth and the scope of Internet banking related services is still under progress, the time span we cover in the analysis, at most up to three years after the initial investment, is probably too short to produce a convincing answer to the question we raised.

As for the control variables other than measures for Internet banking related activities, we include total assets (ASSET), lagged ratio of equity to assets (E / A), dummy for injection of public fund (DF) to rescue banks on the verge of default due to foreign exchange crisis in 1997, and subsequent economic downturn. Total assets is expected to have a positive effect on ROE since large banks are generally regarded as having commanding advantages such as better accessibility through a network of many branches, higher consumer confidence on soundness of bank's operation, and economy of scale in providing services. Equity-to-assets ratio is also selected to be included in the regression to control for the influence of bank's trustworthiness on ROE. Increase in the ratio seems to contribute to enhancing the trustworthiness of a bank that it would eventually help its profitability to be improved. We, therefore, expect the sign of the estimated coefficient on the variable to be positive. Income and equity, however, are determined simultaneously by an accounting relationship at a given point of time that the ratio is not qualified for an explanatory variable in equation (1). To avoid the well-known econometric problem resulting from an endogenous explanatory variable, we take the lagged equity-to-assets ratio as an instrument for the current ratio. The dummy variable for the injection of public fund is included to capture possible beneficial effects of investment on stocks of banks in hardship and purchase of non-performing liabilities with public fund financed by issuing government-guaranteed bonds.

Loan-to-assets ratio (L / A), ratio of non-interest operating expenses to assets (NIE / A), overhead ratio (OR), and market share (MS) are also included in the regression as explanatory variables. Loan-to-assets ratio and ratio of non-interest operating expenses to assets are meant to explain the systematic effect on ROE of revenues and expenditure, respectively. Overhead ratio defined by ratio of non-interest operating expenses to net operating revenues is an indicator for managerial inefficiency so that one can predict the estimated coefficient to have a negative sign. Market share[21] would have a positive sign should large-sized banks possess enough market power to command excess profit.

As ROE's are very sensitive to fluctuations in macroeconomic environments with a noticeable seasonality, we specify the two-way fixed model as in (1) to allow for both individual specific and time specific effect on ROE[22].

Our sample consists of quarterly observations from 20 deposit banks in Korea, ranging from the first quarter of 2000 to the second quarter of 2002[23]. The summary statistics for the

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[21] Market share is defined as the simple average of market share based on deposit balance and market share based on loan balance of each bank.

[22] Formal statistical tests for individual and time effects also indicate the validity of the specification in (1).

[23] There were two major mergers in the fourth quarter of 2001, resulting in 18 deposit banks that we were able to gather samples only from 18 banks afterward. To avoid several statistical difficulties related to unbalance panel, we ignore the mergers and construct a balanced panel sample by repeatedly substituting observations from the two remaining banks for missing observations of the two merged banks. We also performed the same analysis only with 196 observations included in the original

variables in the paper is given in the <appendix>.

Table 2. Regression Result: ROE and Internet Banking

	Model I	Model II	Model III	Model IV
D1	-12.1075 (17.5776)	-28.8473 (17.7136)		
D2			-4.9246 (15.2329)	-4.4370 (16.2809)
ASSET		0.6213 (1.7331)		0.7229 (1.7464)
E / A		-0.9973 (7.6249)		-0.4598 (8.1487)
DF		95.3190*** (23.8179)		85.4440*** (23.5890)
L / A		3.6993*** (1.5457)		3.4280*** (1.5514)
NIE / A		-13.4898 (14.8906)		-11.7117 (14.9713)
OR		-0.0031 (0.0186)		-0.0047 (0.0188)
MS		-4.0904 (12.1228)		-5.4442 (12.2314)
R^2	0.1529	0.2370	0.1510	0.2250
Num. of obs.	200	200	200	200
F-statistic	1.0578	1.4606*	1.0427	1.4314*

1) dependent variable: ROE

2) *: statistically significant at 10% significance level, ***: statistically significant at 1% significance level.

3) F-statistic is the test statistic for joint significance of variables and all dummies for fixed effect.

Table 2 reports the regression results. Model I and Model II measures the effect of introducing Internet banking on ROE. On the other hand, Model III and Model IV investigate the effect of diffusion. First of all, both Model II and Model IV show reasonable fit. Except for lagged equity-to-assets ratio (E / A)[24], all explanatory variables possess the predicted signs for estimated coefficients. The improvement in R^2 indicates the joint significance of explanatory variables added in Model II or Model IV. Second, though we are able to obtain the predicted signs in most of the cases, the estimation result is in no way satisfactory in that only two explanatory variables, DF and L / A, have estimated coefficients significantly different from zero. Third, simple correlation analysis hints that neither

sample but could only find little difference.

[24] We found that it was quite hard to explain away the unexpected estimate in a convincing way.

introduction (D1 in model I) nor expansion (D2 in Model III) of Internet banking brings banks higher profitability. The conclusion holds even after we control the influence of other variables in Model II and Model IV. One can interpret the results in Table 2 stating that Internet banking would do harm rather than good to bank profitability, if really desired. It is, however, a very immature conclusion considering the fact that neither D1 nor D2 is statistically significant[25]. Betting on the safe side, we conclude that we cannot find a convincing evidence for a systematic relationship between Internet banking and profitability. As briefly discussed above, one can conjecture that the time span we cover in the analysis, at most, up to three years after the initial investment, is probably too short to give a definite answer. The results coincide with those of Furst et. al. (2002) and Sullivan (2000), both of which studied the relationship between Internet banking and profitability in the U.S. banking industry. Fourth, related to the recent wave of consolidation of banks, we can infer an interesting implication from the findings that neither bigger size nor higher market share can be associated with better performance at least up to now.

b. Internet banking and (non-interest operating) expenses

In previous section, we could not reject the null hypothesis that Internet banking does not contribute to improving performance of a bank. The rejection, however, does not necessarily lead us to the conclusion that Internet banking plays no role in determining profitability of banks. Once we recall the accounting identity that profit (income) is the difference between revenues and expenses, it becomes obvious that one cannot easily predict the effect of Internet banking on ROE. Generally speaking, investments on Internet banking are expected to enhance profit through lower expenses and higher revenues, which results in higher ROE by surpassing the increase in equity, the denominator in ROE formula. One can also offer a totally plausible explanation for the contrary case. That is, the time span covered in the sample is too short to observe the true effects of Internet banking related investment should Internet banking require significant initial investment and beneficial effects of the investment are realized with considerable time lags. In this section, we pursue the issue further by separately examining non-interest expenses and non-interest revenues.

As Internet banking is introduced and extends its territory, the unit operating expenses would be reduced through various channels such as shorter processing time and less paper work. The increase in cost efficiency is one of the strongest reasons to advocate establishing a widespread network of Internet banking. By analyzing the effect on unit non-interest expenses of introduction and increasing portion of Internet banking in a bank's typical operation[26], we try to test the hypothesis that, due to significant initial investment and delayed realization of beneficial effects of investment on Internet banking, it is natural that, with the sample covering too short a period of time, we should not observe improvement in profitability even after Internet banking related activities spread across the banking industry.

We make use of the same model as (1) with different interpretation of variables. The ratio of non-interest operating expenses to total assets (NIE/A) is taken as the dependent variable to represent a bank's cost inefficiency[27]. Non-interest operating expenses (NIE) is

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[25] D1 in Model II is marginally significant. The p-value is 10.53.

[26] In our case, it is interaccount transfer.

[27] It is needless to say that the pure effect of Internet banking should be obtained after the expenses and revenues related to Internet banking are separated from the expenses and revenues from other activities of a bank. Unfortunately, no balance sheet provides enough information for us to disentangle those different categories of expenses and revenues. For example, though it is highly likely that expenditure on certain items such as software purchase and R&D in information technology, data processing costs, and development and maintenance of the official website are related to Internet banking, according to the

obtained by subtracting interest expenditure from total operating expenses net of allowance for bad credits and operating expenses of trust assets[28]. The ratio, therefore, can be interpreted as a bank's unit operating expenses[29]. A bank with high expenditure other than interest payments on various deposits relative to total assets is generally regarded as inefficient in the sense that the bank spends a big chunk of expenditure on the activities not directly related to earning.

The arguments of cost function include 'salaries & employee benefits per employee' (PL), 'occupancy, furniture & equipment expenses per branch' (PK), and the ratio of interest expenses to total interest-bearing assets (IE/IBA). Assuming that all employees work the same amount of time and there are no economies of scale in expenditure on occupancy, furniture & equipment, 'salaries & employee benefits per employee' (PL) can be regarded as unit price of labor and 'occupancy, furniture & equipment expenses per branch' (PK) as unit price of capital. The 'ratio of interest expenses to total interest-bearing assets' (IE/IBA) in the mean-time characterizes funding structure of a bank and will be utilized for unit price of intermediate goods in producing banking services in our analysis.

Table 3. Regression Result: Expenses and Internet Banking

dependent variable: ln(NIE/A)				
D1	-0.1642** (0.0827)	-0.1204 (0.0820)		
ln(D2)			-0.0559** (0.0215)	-0.0428** (0.0214)
ln(PL)		0.3546*** (0.1122)		0.3519*** (0.1113)
ln(PK)		0.1475** (0.1599)		0.1987** (0.1628)
ln(IE/IBA)		0.0359* (0.0190)		0.0070* (0.0043)
R^2		0.6022		0.6269
Num. of obs.	200	200	193	193
F-statistic	7.9858***	7.8986***	8.4603***	8.4011***

1) *: statistically significant at 10% significance level, **: statistically significant at 5% significance level, ***: statistically significant at 1% significance level.
2) F-statistic is the test statistic for joint significance of variables and all dummies for fixed effect.
3) There are 7 observations that report 0's for D2. We drop those observations to take natural log of D2.

generally accepted accounting practice in Korea, they are mingled in the account of other operating expenses with other ordinary operating expenses such as purchasing of office supplies. The accounting practice is not specific to Korea and that is one reason we do not see many studies on the relationship between cost function and Internet banking, in general.

[28] We performed the same analysis with overhead ratio, which is a ratio of non-interest operating expenses to net operating revenues as the indicator for cost inefficiency. The result was not significantly different from that of the analysis in the paper. It is available from the authors upon request.

[29] In a strict sense, unit operating expenses should be defined as the ratio of non-interest operating expenses and the total value of service flow provided by a bank, for example, sum of total deposit taking and withdrawal as well as total loan and repayment. The difficulties in gathering reliable data forced us to use total asset, instead.

The trans-log cost function only with the first order terms are selected as the functional form. After adding a dummy for establishing independent Internet banking system and the proportion of interaccount transfer carried out through Internet banking to represent the extent of diffusion in Internet banking related activities respectively, we estimate the cost function with two-way fixed effect in panel specification.

The estimation results are reported in Table 3. The estimated cost function shows a reasonable fit and all coefficients except for one case are statistically significant and have predicted signs. In other words, a unit non-interest operating expense is positively related to unit prices of all inputs. Note that the dummy variable D1 loses statistical significance[30] when other control variables are added. It is difficult to help concluding that the introduction of Internet banking system does not shift down cost function of a bank. On the contrary, higher proportion of interaccount transfer through Internet banking seems to be associated with lower cost reflected in the statistically significant negative estimate on ln(D2).

Combined with the previous result that Internet banking is not related to better profit prospect, the result in Table 3 implies that the benefits of cost reduction brought by the expansion of Internet banking are dissipated across consumers through competitive pressure on banks. There are two channels through which competition among banks drives excess profit zero; discount or exemption of service fees, higher deposit rates, or lower lending rates. It is not possible to identify which route is taken when the benefits of cost reduction are dispersed across consumers and contribute to welfare gain for the society. We will address this issue later.

The finding that investment on Internet banking has already started to provide enhanced cost efficiency implies that we will eventually see improvement in profitability. With the development of information technology along with continuously improved cost efficiency, the beneficial effects of investment on Internet banking will outweigh cost of funding for initial and subsequent investment and ROE will be eventually improved. The finding also supports the premise that we will eventually observe improvement in ROE, thanks to less expenditure when trying to steer more customers to Internet banking.

Our finding in this section agrees with DeYoung's (2001b) argument that emphasized valuable aspects of learning effect in improving profitability as the realm of Internet banking extends.

c. Internet banking and (non-interest operating) revenues

We found that Internet banking did not affect profitability of a bank but contributed to reduction of non-interest operating expenses. In this section, we turn our attention to the revenue side to further investigate the relationship between Internet banking and profitability.

A bank's operating revenues consist of revenues from interest on loans and non-interest operating revenues. It is true that Internet banking indirectly helps increase interest revenues by extending loans. The bank actively involved in investment on Internet banking benefits from lower unit operating expenses as shown in the previous section and may offer lower interest rates for its loan services. It is also true that a bank with high proportion of transactions processed through Internet banking system can take advantage of additional non-interest revenue-basis such as fees on interaccount transfer. Most of the extended revenue sources must have been found in non-traditional business areas rather than traditional ones.

We focus on the relationship between Internet banking and non-interest operating

[30] The non-rejection of the null hypothesis that the estimated coefficient on D1 is not different from 0 is a marginal one. The p-value for the hypothesis is 14.39%.

revenues in this section. If Internet banking plays a part in boosting non-interest operating revenues, one can infer that banks with active Internet banking business have the tendency to pursue higher profitability in non-traditional operations. Banks show a great interest in business models such as private banking specifically targeting at affluent customers and increase investments to offer greater range of services in those areas. The strategy is based on the belief that Internet banking will bring sizable service fees as well as revenues generated by traditional interest margin.

We again make use of the model (1) to specify the relationship between Internet banking and non-interest operating revenues per unit of assets. The ratio of non-interest (operating) revenues is taken as the dependent variable in the estimations. Other than Internet banking related variables, D1 and D2, we include, as explanatory variables, total assets (ASSET), ratio of won-denominated deposits to asset (D / A), ratio of loan to assets (L / A), overhead ratio (OR), ratio of employees to assets (EM / A), and ratio of the number of branches to assets (B / A).

Table 4. Regression Result: Non-Interest Revenues and Internet Banking

	Model I	Model II	Model III	Model IV
D1	-0.1026 (0.0797)	-0.1622 (0.1804)		
D2			-0.0584 (0.0640)	-0.0530 (0.0707)
ASSET		-1.9292 (2.0347)		-1.6420 (2.0712)
D / A		-1.5385 (6.5144)		-2.0748 (6.7578)
L / A		-0.7180 (3.1243)		-0.9282 (3.1646)
OR		-2.3835*** (0.7140)		-2.1797*** (0.7190)
EM / A		-2.6030** (1.4780)		-2.1933* (1.1789)
B / A		0.2237 (0.2823)		0.2514 (0.3068)
R^2	0.5605	0.5965	0.5584	0.5879
Num. of obs.	200	200	200	200
F-statistic	7.4763***	6.9279***	7.4125***	6.6855***

1) dependent variable: non-Interest operating revenues
2) *: statistically significant at 10% significance level, ***: statistically significant at 1% significance level.
3) F-statistic is the test statistic for joint significance of variables and all dummies for fixed effect.

ASSET is included to control for possible scale effect in utilizing supplementary services and is not expected to have a specific sign. We would have expected a positive sign for total operating revenues or interest revenues, however, it is impossible to predict the sign *a priori* in case of non-interest revenues. Most supplementary services that customers demand are likely to be accompanied by the main business of banks, deposit

and loan. (D/A) and (L/A) are included to allow the possibility and the signs of both estimates are expected to be positive. Overhead ratio, the number of employees per unit of assets, and the number of branches per unit of assets are all included to control for the inputs required to produce the supplementary services that bring a bank non-interest operating revenues. If the production function exhibits monotonicity with respect to each input, all signs on these variables are predicted to be positive.

The estimation results appear in Table 4. The overall performance of the empirical model we specify to explain non-interest operating revenues is not satisfactory. Except for (B/A), all of the estimated coefficients have wrong signs, two of which, OR and (EM/A) are statistically significant. One possible account for the disappointing result in Table 4 is that the estimation suffers from the classical symptom of omitted variable bias. Due to difficulties in data availability, we did not include an important price variable, unit price (fee) of supplementary service.[31] Examining the estimates in Table 3, it is very difficult to support the hypothesis that the introduction and diffusion of Internet banking contribute to increase in non-interest operating revenues.[32]

In sum, we find that Internet banking plays a marginal part in reducing non-interest operating expenses but does not contribute to non-interest operating revenues or overall profitability of a bank. We want to attach two reservations in interpreting the findings in the paper. First, the history of Internet banking is short in Korea and it is hard to expect full scale realization of the effects of Internet banking in such a short period of time. Second, since banks started to offer Internet banking in groups, our sample does not have much variation in variables for Internet banking. The results in the paper should not be interpreted as the definite answers to the questions we raised in the paper.

d. Expansion of Internet Banking

In previous section, we uncover that Internet banking has not increased or decreased non-interest revenues. Combined with the findings in sub-section *a* and *b*, it provides us a possible account for the fact that in spite of beneficial effects of Internet banking on cost efficiency, we are not able to link expansion of Internet banking to higher profitability. That is, indirect cost required in inducing more customers and cost to maintain Internet banking system may have been big enough to counterbalance the cost reduction.

In this section, we specify an empirical model to identify determinants of the expansion of Internet banking service. We also try to test the hypothesis that a bank with higher market share takes an aggressive position in Internet banking related investment decision. Sullivan (2000) argues that uncertainty on demand for a new financial product offers a competitive edge to bigger banks when they first launch marketing drive for the new product. Furthermore, if customers retain strong preferences for face-to-face transactions and concern on the stability of banks they transact with in spite of convenience and cost efficiency of Internet banking, we would expect a positive relationship between market share and expansion of Internet banking[33].

For an empirical model to describe the investment decision on Internet banking, we include, as explanatory variables, total assets (ASSET), ratio of non-interest revenues to

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[31] Even in the presence of omitted variable bias, the statistically significant negative signs on overhead ratio and the number of employees per unit of asset have an interesting implication that increase in neither share of non-interest operating expenses nor labor input result in higher non-interest revenues.

[32] Although D1 seems to have a stronger link to the dependent variable than D2, it is just casual, therefore statistically unjustifiable, observation.

[33] This is also related to DeYoung's (2001) argument that since customers are interested in stability as well as cost and convenience in choosing banks with which they maintain deposit and loan accounts, banks with well-established reputation rather than newly licensed Internet-only banks show stronger preference for investment on Internet banking.

net operating revenues (NIR / NOR), net interest margin in the previous quarter (NIM(-1)), ratio of won-denominated deposits to asset (D / A), dummy for nationwide or provincial banks (DNP), dummy for injection of public fund (DF), and finally market share (MS).

ASSET will have a positive sign in the sense that a bigger bank would be able to attract cheaper fund for investment on Internet banking. The ratio of non-interest revenues to net operating revenues[34] is not only an indicator for aggressiveness of bank's management strategy but a channel through which a bank enhances its profit basis by frequent use of supplementary services such as interaccount transfer. A positive sign on (NIR / NOR) is expected. Lagged net interest margin is included to control profitability indicator for a bank and is not expected to have a specific sign. One can expect a positive sign if a bank with higher profitability in interest related operation attracts fund for initial investment with ease. On the contrary, a bank with a disappointing performance in traditional operation may choose Internet banking as an instrument to improve overall profitability and invest in Internet banking aggressively.

Since a bank less dependent on traditional way of supply and allocation of fund will be more likely to adopt a new way of doing business, higher ratio of deposit to assets would be associated with more active transactions related to Internet banking. DNP is defined as 1 if it is for nationwide bank and 0 if otherwise. DF is defined as 1 if public fund is injected into the bank and 0 if otherwise. Market share is calculated as the average of market share based on deposit balance and market share based on loan balance of each bank.

The ratio of amount of interaccount transfer through Internet banking system to the total won-denominated deposit balance (D2) is taken as the dependent variable to measure the expansion of Internet banking.

To allow for the truncation at 0 in the dependent variable, we use two-way fixed effect Tobit model instead of ordinary two-way fixed effect model. The empirical model is given as,

$$y_{it}^{*} = \alpha + \beta' x_{it} + \mu_i + \eta_t + \varepsilon_{it} \tag{2}$$

$$y_{it} = \begin{cases} 0 & \text{if } y_{it}^{*} \le 0 \\ y_{it}^{*} & \text{if } y_{it}^{*} > 0 \end{cases} \tag{3}$$

Assuming that $\varepsilon_{it} \sim n.i.d.\left(0, \sigma^2\right)$, the log likelihood function is given by,

$$L(\alpha, \beta) = \sum_{i=1}^{N} \sum_{t=1}^{T} \left[I_{it} \ln \left[\frac{1}{\sigma} \phi \left(\frac{y_{it} - \alpha - \beta' x_{it} - \mu_i - \eta_t}{\sigma} \right) \right] + (1 - I_{it}) \ln \left[1 - \Phi \left(\frac{\alpha + \beta' x_{it} + \mu_i + \eta_t}{\sigma} \right) \right] \right] \tag{4}$$

where I_{it} is the indicator function defined as $I_{it} = I_{[y_{it}>0]}$, $\phi(\cdot)$ is density function of a random variable with the standard normal distribution, and $\Phi(\cdot)$ is the cumulative

[34] Note that net operating revenues is obtained by subtracting interest cost from total operating revenues.

distribution function of a random variable with the standard normal distribution[35].
The result of the estimation appears in Table 5.

The estimated model possesses desirable ingredients of a good empirical model; a good fit and statistically significant estimates with plausible signs. First, the faster the expansion of Internet banking is, the higher net interest margin in the previous quarter and the higher deposit-to-assets ratio. Second, nationwide banks and banks with public fund injection for restructuring are much more aggressive in pursuing the business model based on information technology. Third, contrary to theorization popularized by Sullivan (2000) and DeYoung (2001), banks with higher market share are negatively associated with more extensive dependence on Internet banking measured by the proportion of amount of interaccount transfer through Internet banking system out of the total won-denominated deposit balance. The finding indicates that smaller banks confronting with turbulent market environment have been more active in accepting Internet banking as a device to overcome uncertain prospects and enhance profitability. In addition, the result gives indirect evidence that the preferences for face-to-face transaction are not strong in Korea.

Table 5. Regression Result: Expansion of Internet Banking

Explanatory Variables	*Estimates*	*Standard errors*
ASSET	0.7570	0.6810
(NIR / NOR)	0.0004	0.0004
(NIM(-1))	0.4659**	0.1999
(D / A)	0.0080*	0.0049
DNP	0.6044***	0.1676
DF	0.1172*	0.0676
MS	-0.0865**	0.0441
Maximized Likelihood	-130.2206	
LR statistics	48.6854***	
Num. of obs.	200	

1) dependent variable: proportion of interaccount transfer through Internet banking system out of total deposit in Korean Won.
2) *: statistically significant at 10% significance level, ***: statistically significant at 1% significance level.
3) LR statistics is the test statistic for the null hypothesis that all variables in the table are jointly insignificant. The distribution of the test statistic under the null hypothesis is χ^2 with the degrees of freedom 7.
4) The number of censored observations is 193 and uncensored is 7.

[35] That is, $\phi(z) = \frac{d\Phi(z)}{dz}$.

CHAPTER 4

Conclusion

This paper is an empirical analysis to verify the hypothesis that the Internet banking, rapidly expanding in the Korean banking industry, allows banks to reduce cost and ultimately contribute to higher profitability. Major findings from the empirical analysis are as follows.

First, from the analysis of relationship between Internet banking and bank performance, we found that introduction and expansion of Internet banking did not influence the financial performance of banks, especially in terms of profitability.

Second, we examined whether the introduction and expansion of Internet banking contributed to reducing non-interest expenses and enhancing management efficiency. While there is no evidence that the introduction of Internet banking have enhanced the cost efficiency of banks, we found that the expansion of Internet banking did contribute to enhancing cost efficiency of banks. That is, although Internet banking could not influence banks' profitability or cost-efficiency when the system was introduced for the first time, it played a role in changing the cost structure of the banks. It implies that the primary objective of introducing Internet banking, which was to reduce the operating cost such as branch maintenance expenses, has been accomplished, but this cost-reduction effect has not yet reached the stage in which beneficial effects of Internet banking overcome the negative effect of initial investment on the profitability of banks. Considering that the growth potential of Internet banking consists in its cost efficiency, this also indicates that the strategies of the Korean banks to expand Internet banking would ultimately bring positive outcomes.

Third, we could not find any support for the hypothesis stating that introduction and expansion of Internet banking positively affects non-interest operating revenues of Korean banks. This implies that benefits to the Internet banking customers have been primarily provided through the interest rate channel such as higher deposit rate or lower lending rate rather than non-interest service fee channel.

In addition, we found that the people's preference for face-to-face transaction may be very low in Korea, which supports the hypothesis that the cost for securing customer base will be much reduced.

All these findings, lower cost without higher profit, offer an important implication that Internet banking has increased social welfare by making banks to distribute the benefits of cost reduction to customers in various forms such as preferential interest rates and fee exemption, rather than internalize the benefits to the banks' profits. At the same time, it can be also anticipated from our results that profit-enhancing effect of Internet banking will become more significant in the near future since the cost-reduction effect of Internet banking will be stronger with the technology development that reduces the cost of maintaining Internet banking system.

Progress of IT profoundly contributes to the development of banking and financial services industry, and this tendency is expected to continue. Among the contributions, the introduction of Internet banking is one of the most important. Hence, a clear understanding of its pros and cons is critical in the research of the banking industry. Although it should be admitted that the future of Internet banking is uncertain, researchers need to provide a

precise analysis on the rapidly growing Internet banking market and its effects on the market structure of the banking industry.

It goes without saying that it may be too early to evaluate the impact of adoption and expansion of Internet banking on the performance of Korean banking industry, whose business behavior and attitude are changing rapidly after the currency crisis followed by the financial restructuring. In addition, since Internet banking in Korea is about only 4 years old, the data presented in this paper may not be sufficient by themselves to support any aforementioned conclusions. Thus, the result of this paper's empirical analysis should be interpreted with some caveats in mind. Regardless of these potential limitations, however, this paper can be evaluated as a rare attempt to offer a picture of the current market for Internet banking in Korea by investigating its impact on the performance of banks, and results of this paper could be utilized as indicative evidence of the related theories and hypotheses.

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Appendix. Summary Statistics for the Variables in the Analysis

Table A. Summary Statistics for the Variables in the Analysis

	Num. Of obs.	Unit	Mean	Median	Standard Deviation	Max	Min
D1	194		0.8608	1.0000	0.3470	1.0000	0.0000
D2	187	%	0.2368	0.0600	0.5304	3.3584	2.43E-05
ASSET	194	10 trillion Won	3.5045	2.6377	3.0510	16.1038	0.1168
E / A	194		0.0387	0.0396	0.0144	0.0720	0.0002
DF	194		0.3711	0.0000	0.4844	1.0000	0.0000
L / A	194		0.5698	0.5688	0.0675	0.7451	0.4245
NIE / A	194		0.0073	0.0064	0.0041	0.0464	0.0034
OR	192		1.1851	0.6436	2.7756	27.9888	0.3114
MS	194	%	5.1546	3.6586	4.6605	24.6197	0.2066
PL	194	Million Won	13.4646	13.2649	3.7423	26.1426	6.2159
PK	194	100 million Won	1.3081	1.2695	0.4752	3.0036	0.4155
IE / IBA	194		0.0138	0.0139	0.0038	0.0414	0.0053
D / A	194		0.6287	0.6361	0.1000	0.8013	0.3641
EM / A	194	Persons / billion Won	0.1719	0.1587	0.0680	0.4591	0.0744
B / A	194	Branches / billion Won	0.0122	0.0112	0.0502	0.0291	0.0556
NIR / NOR	194		0.4024	0.4857	0.6247	2.6444	-4.1250
NIM(-1)	194	%	0.5546	0.5476	0.1702	1.1779	-0.0608
DNP	200		0.7000	1.0000	0.4702	1.0000	0.0000