The Effects of IT Expenditures on Banks' Business Performance: Using a Balanced Scorecard Approach

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Abstract

This study uses the balanced scorecard (BSC) framework to assess the business performance of information technology (IT) expenditures in the Korean banking industry. The relationship between IT expenditures and bank's financial performance or market share was significantly different depending upon the level of IT. For banks that maintain high IT level, IT expenditures appear to have (1) increased labor productivity, (2) decreased payroll expenses and increased operating and total administrative expenses, (3) increased market share, and (4) increased revenue and profit. The evidence suggests two important practical implications. First, if banks effectively use IT strategy to improve competitive advantage, they are likely to reduce payroll expenses and increase market share as well as profitability. Second, this study posits that bank managers should consider using a balanced scorecard approach to measure business performance of both IT and management strategies. Thus, evidence of this study provides guidance for achieving competitive advantage in the banking industry. (Key Words: IT performance, bank's financial performance, Balanced Scorecard approach, IT expenditure).

1. Introduction

Firms invest substantial amounts of resources to sustain or to enhance firms' competitive advantage— their ability to compete in the global economy.[1] Expenditures that affect an entity's ability to compete usually are discretionary. These expenditures are made to sustain or increase shareholder value through (1) a revenue growth strategy by expanding new markets, new customers, products, and services and (2) a productivity strategy where-by improvements are made in the cost structure and in asset utilization. These two strategies apply across the entire value chain through research and development (R&D), product design, delivery, and customer service. IT strategy and investment have become critical elements in aligning and implementing these corporate strategies for increasing shareholder value. In the banking industry, IT strategy and performance measurement are important links throughout the corporate BSC.

Investing on IT is highly important for improving core competencies for firms in the banking industry. Information technologies are essential tools for developing new financial services (i.e., financial products) and to provide effective and convenient services to their customers. The environment in banking industry has become IT intensive. Investing on IT in the banking industry is analogous to investing on R&D in the manufacturing industry. Banks generally move into on-line banking systems using IT such as CD/ATM (cash dispenser and automated teller machines), ARS (automated response systems), Home/Firm banking and Internet banking as major business tools to provide financial services to their customers.

Several prior studies have investigated the economic consequences of IT on the banking industry. The principal research question asked by most prior studies is whether IT provides positive economic benefits or not. Although the evidence appears mixed, some prior studies provide evidence that 'IT productivity paradox' disappear when the use of IT is well matched with its business strategy such as a revenue growth and/or productivity strategy (e.g., Porter, 2001; Simmons, 1998; and Brynjolfsson and Yang, 1996). Thus, bank manager's first consideration in investing IT becomes how they should strategically combine the use of IT with business strategy for a higher business performance. This practice in investing IT leads to the inference that the economic consequences of IT expenditures could be realized by financial and/or non-financial measures depending on its strategic use. The new research question, then, is what performance measures should be employed to capture the possible economic consequences of IT expenditures. Thus this study introduces the Balanced Scorecard (BSC) approach (Kaplan and Norton, 1992) to measure the effects of IT expenditures on bank's financial and/or non-financial performance.

The main objective of this study is to investigate whether the relationship between IT expenditures and a bank's performance indicators in the BSC is significantly different depending upon IT level (a proxy for computerized banking functions) of sample firms. The BSC framework used in this study provides a useful framework to measure the economic consequence of strategic use of IT because the BSC provides a specification of strategic objectives and appropriate performance measures (in four areas- financial, customer, internal, and learning/growth perspective) of the strategy employed. This study finds that the relationship between IT expenditures and business performance is significantly different depending upon IT level of sample firms. The evidence provides strategic implications for IT utilization in the banking industry. This study should also broaden our understanding of the valuation and managerial control system issues related to IT.

2. Literature Review and Hypotheses Development

2.1 Studies in IT Investment

There are several studies that provide evidence on whether IT expenditures have a positive impact on organizational structure and economic performance of a firm. Advances in IT permit management to change and improve significant aspects of a firm's structure and operations (Porter, 2001; Stambaugh and Carpenter, 1992; Elliott, 1992). IT enables a firm to enhance its competitive advantage by improving its bargaining power with suppliers and customers, lowering operating and processing costs, enhancing product differentiation, changing competitive scope, and/or increasing barriers to entry (Porter and Millar, 1985).[2] This induces most firms to invest in IT, and the largest investors tend to be financial (i.e., banks), airline, telephone, film production, and consulting firms.

Prior studies on IT expenditures can be classified into two groups: those investigating (1) future economic benefits, and (2) the effect on a firm's financial performance. Studies of future economic benefits of IT usually focus on whether IT expenditure enhances a firm's productive capital that will provide future benefits. Factors contained in these studies have been competitive advantage, market share, and barriers to entry. Most of these studies find that IT expenditures do provide future economic benefits (Dos Santos, Peffers, and Mauer, 1993; Brown, Gatian, and Hicks. Jr., 1995; Hitt, 1999; Krishnan and Sriram, 2000).

Studies investigating the effect on firm's profitability focus on whether the IT expenditure is converted into business value; e.g., reduced expenses, increased revenue, or improved operating performance. The evidences appear mixed on the effect of IT on financial performance (Brynjolfsson and Yang, 1996). Some studies find that the economic impact of capital expenditures is greater for IT than non-IT (Banker, Kauffman, and Morey, 1990; Brynjolfsson and Hitt, 1993; Dewan and Kraemer, 2000). Other studies partially support a positive financial performance of IT (Hitt and Brynjolfsson, 1994; Barua, Kriebel, and Mukhopadhyay, 1995). For example, Hitt and Brynjolfsson (1994) find that IT improves the firm's productivity and creates substantial value for consumers, but does not improve profitability. In sum, prior studies show that IT: (1) reduces operating or processing costs (e.g., Barua, Kriebel, and Mukhopadhyay, 1995); (2) increases market share and productivity (e.g., Hitt and Brynjolfsson, 1994); and (3) increases future economic benefits and profitability (e.g., Brown, Gatian, and Hicks, Jr., 1995; Krishnan and Sriram, 2000; Dewan and Kraemer, 2000).

2.2 Development of Hypotheses

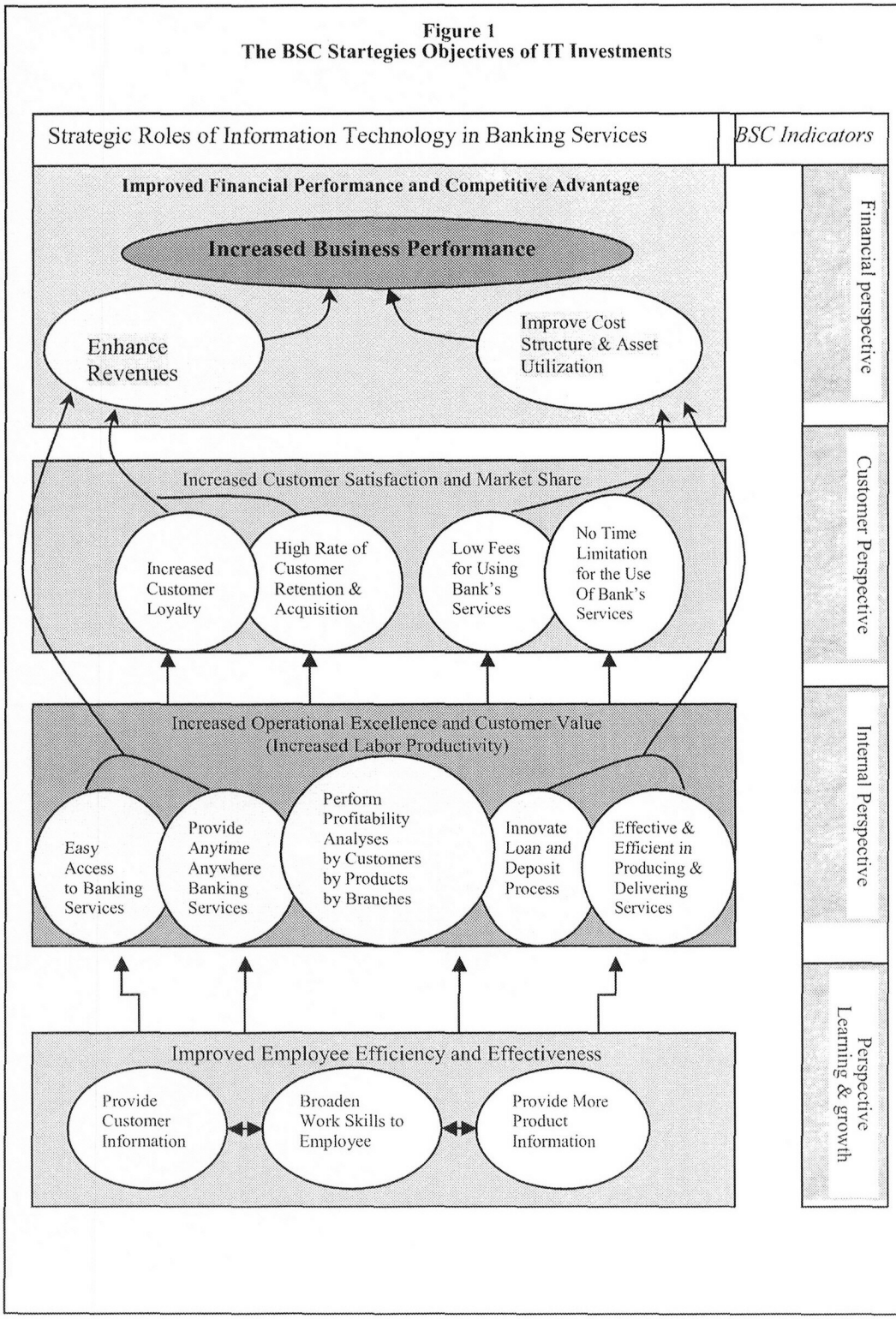
This study introduces the Balanced Scorecard (BSC) approach to measure IT performance since the BSC can track the key strategic roles of IT and also links performance measure for the strategies (Kaplan and Norton, 1992; 2001a; 2001b). The BSC contains four sets of measures that are designed to capture the firm's business strategy such as IT strategy. These measures are related to firm's (1) learning and growth activities, (2) internal business processes, (3) customer value, and (4) financial performance. The modified BSC and its performance measures for IT strategy of the banking industry are shown in the Figure 1.

As suggested by prior studies, IT provides more timely and accurate information to improve management decisions. (e.g., Elliott, 1992; Hannan and McDowell, 1990). For example, IT can provide more information on existing customers and products of the firm to its employees so that they can improve their daily decision making procedures (i.e., broadening working skills). This strategic role of IT will contribute for firms to make a motivated and prepared workforce (i.e., improve training, and efficiency and effectiveness of workforces). The BSC shown in Figure 1 represents this line of IT performance as performance in 'learning and growth perspective.'

The specific examples of IT utilization in the banking industry are various. IT utilization such as CD/ATM, internet banking, and computerized bank functions enables banks to provide financial services anytime and anywhere. This gives an easy access to their customers. The use of IT also gives an opportunity for banks to innovate processes in developing and delivering financial product as well as procedures in lending and depositing. This strategic role of IT will contribute to the banks' increased operational excellence and thus the labor productivity of its employees (i.e., performance in 'internal perspective'). If this is the case, the effect of IT expenditures on increasing labor productivity will be different depending upon the IT level (a proxy for computerized banking functions) of banks. Thus, this study hypothesizes that the effect of IT utilization on cost reduction is greater for high IT level banks (i.e., banks that spend more on IT) than for low IT level banks. This leads into the first alternative hypothesis:

H_1: The effect of IT expenditures on increasing labor productivity is greater for high IT level banks than low IT level banks.

Figure 1
The BSC Startegies Objectives of IT Investments



Banks also use IT to produce management information about the cost of financial services they provide, profitability analyses by customer groups and by services they offer as well as management performance evaluation of each branch (Ernst and Young, 1995). That is, banks use IT to innovate loan and deposit processes, to make and deliver financial services (i.e., products) as well as to manage their business. IT utilization such as CD/ATM and on-line bank functions enables banks to reduce labor cost (Thatcher and Oliver, 2001; Alpar and Kim, 1990). Thus, IT-based on-line banking and management systems should decrease labor and total administrative expenses of the firm. If this is the case, the effect of IT expenditures on reducing total expenses will be different depending upon the IT level of banks. This study hypothesizes that the effect of IT utilization on cost reduction is greater for high IT level banks than for low IT level banks. This leads into the second alternative hypothesis:

H_2: The effect of IT expenditures on reducing administrative expenses (i.e., payroll and operating expenses) is greater for high IT level banks than low IT level banks.

IT utilization helps banks to better serve their customers by delivering a variety of financial services quickly as possible at the nearest location, if not anytime and anywhere. Current customer satisfaction should be improved as well as attracting new customers. Saloner and Shepard (1992) suggests that the positive association between IT utilization (e.g., ATMs) and benefits to depositors is a function of the number of ATMs. That is, the use of IT such as on-line banking systems not only increases the number of customers served in a given market, but also aids in expansion into new geographic areas and thus a bank's market share (Hannan and McDowell, 1990). Therefore, the use of IT such as on-line banking systems should have a positive impact on customer satisfaction and market share since it gives customers easy access to banking services. This strategic objective of IT is to improve the performance of the 'customer perspective' shown in Figure 1. Increased market share of one bank, however, results in a market share decrease by another bank. Consequently, the sum of the market share for all banks is equal to one. This study hypothesizes that IT utilization for firms with high IT level will increase market share while firms with low IT level will experience market share decreases, other factors remaining constant. This leads into the third alternative hypothesis:

H_3: IT utilization for high IT level banks has a greater positive impact on increasing market share than one for low IT level banks.

Prior studies suggest that IT expenditures have a significant and positive impact on firms' financial performance (e.g., Haynes and Thompson, 2000). To have a significant impact on financial performance, IT utilization needs to increase a firm's profit. As shown in Figure 1, IT investment leads to improve processes in producing and delivering financial products thereby improving service quality. Better service quality leads to higher customer satisfaction and thus market share. Increased market share means generating more revenues and possibly increasing profit if expenses do not rise at a faster rate than revenue. Profit can also be increased if marginal revenue exceeds marginal expenses. Ideal benefits of IT are realized by increasing market share, revenue, profit, or by reducing expenses at a faster rate than revenues.

As described in hypothesis two and three, IT provides more timely and accurate information to improve management decisions and customer satisfaction. Such improve-

ments enhance the entity's ability to compete and should lead to increasing market share, decreasing cost of products or services they provide thereby increase firm's financial performance. If IT expenditures have a positive impact on increasing a firm's market share, then IT should have a relative positive impact on the revenue of the firm as well. This study hypothesizes that IT utilization for firms with high IT level will have a greater positive impact on financial performance than firms with low IT level, other factors remaining constant. The fourth alternative hypothesis is:

H_4: Banks that spend more on IT will have a greater positive impact on financial performance (i.e., increasing revenue and profit) than other banks.

In sum, the hypotheses of this study are to test whether the degrees of relationship between IT expenditures and four major variables such as labor productivity, total expenses, market share and profitability are significantly different depending upon the IT level (i.e., differences of IT expenditures among banks). Findings will provide evidence on whether IT expenditures increase performances in three out of four strategic objectives of IT described in the BSC.

3. Research Design

3.1 Empirical Models

The first hypothesis states whether the effect of IT utilization on labor productivity is greater for high IT level banks (i.e., banks that spend more on IT) than for low IT level banks. To test this hypothesis, this study uses t-statistics to compare the labor productivity ratio between two groups (high IT level banks versus low IT level banks). We also conduct t-test for several other variables that are related to productivity measures.

The second hypothesis tests whether IT expenditures affect the bank's cost structure. The expectation is that reduction of expenses is greater for firms having high level of IT. The equation testing the second hypothesis is:

$$ADM{\cdot}PAY{\cdot}OPREX_{it} = \alpha_0 + \alpha_1 TA_{it} + \alpha_2 ITEXP_{it} + \alpha_3 ITNDX_{it} + \varepsilon_{it} \quad (1)$$

where

$ADM{\cdot}PAY{\cdot}OPREX_{it}$ = Administrative expense (ADMEX), payroll expense (PAYEX) and operating expense (OPREX) of firm i at the end of fiscal year t. $ADM{\cdot}PAY{\cdot}OPREX_{it}$ is a combined notation for those three dependent variables (DVs). The regression is run three times using three different DVs in equation (1).

TA_{it} = Total assets.

$ITEXP_{it}$ = IT expenditures.

$ITNDX_{it}$ = The interactive dummy variable between ITEXP and IT level (i.e., NDX- an index variable where high IT level firms equal 1 and low IT level firms equal 0). All dependent and independent variables are deflated by a firm-size proxy (numbers of branch owned by each bank).

α_0 = an intercept term.

$\alpha_1, \alpha_2, \alpha_3$ = regression coefficients on indicated variables.

ε_{it} = a stochastic disturbance term.

TA_{it} (total assets) in equation (1) is a control variable. The sign of α_1 should be positive and statistically significant since expense items ($ADM{\cdot}PAY{\cdot}OPREX_{it}$) of each firm are affected by total assets employed. The key components of this regression are α_2, the estimated coefficient of IT expenditure, and α_3, the estimated coefficient of the interactive dummy variables between $ITEXP_{it}$ and IT level (i.e., an indicator variable where high IT level banks are assigned to 1 and lower IT level banks are assigned to 0). These estimated coefficients provide evidence on whether the firms that spends more on IT (i.e., high IT level firms) have a greater impact on reducing administrative expenses, payroll expenses and operating expenses.

The third hypothesis tests whether IT expenditures affect market share of banks. To test the third hypothesis, the following equation (2) is used:

$$MSD{\cdot}L_{it} = \beta_0 + \beta_1 DLMGN_{it} + \beta_2 EQTR_{it} + \beta_3 NUMSTR_{it} + \beta_4 ITEXP_{it} + \beta_5 ITNDX_{it} + \varepsilon_{it} \quad (2)$$

where

$MSD{\cdot}L_{it}$ = Market share of deposits (MSD) and market share of loans (MSL) of firm i at the end of fiscal year t. $MSD{\cdot}L_{it}$ is a combined notation for those two dependent variables (DVs). The regression is run twice using two different DVs in equation (2).

$DLMGN_{it}$ = Interest spread between loan and deposit (i.e., margin).

$EQTR_{it}$ = Equity ratio using BIS (Bank for International Settlements) standards.

$NUMSTR_{it}$ = Number of stores (i.e., branches) each bank operates. Notations for other variables are the same as shown in equation (1).

The DLMGN, EQTR and NUMSTR are control variables since the market share (MSD·L) of each bank is affected by the interest spread between deposits and loans (DLMGN), the number of stores each bank operates (NUMSTR), and the equity ratio (EQTR), a bank safety measure. The sign of β_1 should be negative since the market share is increased at the lower $DLMGN_{it}$. The signs of both β_2 and β_3 should be positive because the market share is positively affected by EQTR and NUMSTR. The key components of this regression are β_4, the estimated coefficient of IT expenditure, and β_5, the estimated coefficient of the interactive dummy variables between $ITEXP_{it}$ and IT level of banks. These coefficients provide evidence to determine whether high IT level banks have greater impact on increasing market share.

The fourth hypothesis tests IT expenditures effect on revenue and operating income. The following equation is used to test the fourth hypothesis:

$$RV{\cdot}PR_{it} = \gamma_0 + \gamma_1 DLMGN_{it} + \gamma_2 EQTR_{it} + \gamma_3 TA_{it} + \gamma_4 ITEXP_{it} + \gamma_5 ITNDX_{it} + \varepsilon_{it} \quad (3)$$

where

$RV{\cdot}PR_{it}$ = Revenue (RV) and operating income (i.e., profit) (PR) of firm i at the end of fiscal year t. $RV{\cdot}PR_{it}$ is a combined notation for those two dependent variables (DVs). The regression is run twice using two different DVs in equation (3). Notations for other variables are the same as shown in equation (1) and (2).

The DLMGN, EQTR and TA are control variables since the revenue and profit (RV·PR) of each bank is affected by the interest spread between loans and deposits (DLMGN), the equity ratio (EQTR) and total assets (TA). The sign of γ_1 should be negative when RV is used as a dependent variable and positive when PR is used. The signs of both γ_2 and γ_3 should be positive because of the positive impact on revenue and profit by both EQTR and TA. Key components of this regression are γ_4, the estimated coefficient of IT expenditures, and γ_5, the estimated coefficient of the interactive dummy variable between $ITEXP_{it}$ and IT level. These coefficients provide evidence on whether banks that spend more on IT (i.e., high IT level banks) have greater impact on increasing revenue and operating income.

3.2 The Sample Data

This study uses data from all commercial banks in Korea for a nine-year period (1990-98). In the Korean banking industry each firm has the same fiscal year-end. The dependent variables used in this study can be grouped into four categories: i) The first category includes: · administrative expense ($ADMEX_{it}$), · payroll expense ($PAYEX_{it}$),· operating expense ($OPREX_{it}$) · and those are combined into a notation, $ADM{\cdot}PAY{\cdot}OPREX_{it}$, in equation (1). ii) The second category includes: · market share of deposits (MSD_{it}),· market share of loans (MSL_{it}) · and those are combined into a notation, $MSD{\cdot}L_{it}$, in equation (2). iii) The third category includes: · total revenue from operating activities (RV_{it}),· operating income as a profitability measure (Pr_{it}) and those are combined into a notation, $RV{\cdot}PR_{it}$, · in equation (3). iv) The last category includes: · labor productivity ratio ($LBPR_{it}$). This ratio is calculated by output divided by input, in this case, total interest and commission revenues divided by total expenses using per capita data.

Administrative expense ($ADMEX_{it}$) is calculated by combining payroll expense ($PAYEX_{it}$) with operating expense ($OPEXP_{it}$) at the end of each fiscal year for each firm. These three variables are divided by the number of branches (i.e., stores) as a proxy for firm-size. Market share of deposits (MSD_{it}) is calculated by deposits of each firm divided by total deposits of the banking industry at the end of fiscal year t. Market share of loans (MSL_{it}) is calculated in the same manner as MSD_{it}. Total revenue (RV_{it}) and operating income as a profitability measure (PR_{it}) are also deflated by the number of branches (proxy for firm-size). These data were taken from the financial statements at the end of fiscal year t. Total assets (TA_{it}) were collected from the financial statements of each firm in the banking industry and are deflated by the number of branches owned by each firm. The interest spread called margin ($DLMGN_{it}$), number of stores ($NUMSTR_{it}$) and the equity ratio ($EQTR_{it}$) were collected from "Business Statistics in Korean Banking Industry" published every year by the Bank of Korea[3].

Table 1
Descriptive Statistics for Major Variables

Variables	Mean (Std. Dev)									
	Pooled (90-98)	90	91	92	93	94	95	96	97	98
ADMEX	825 (219)	633 (159)	708 (163)	782 (190)	783 (164)	826 (181)	942 (248)	972 (202)	975 (194)	853 (240)
PAYEX	421 (110)	334 (104)	355 (103)	407 (83)	410 (76)	426 (81)	492 (129)	488 (92)	481 (94)	420 (125)
RV	4,837 (3,090)	3,051 (1,515)	3,737 (1,834)	3,825 (1,500)	3,564 (1,372)	4,163 (1,646)	4,795 (1,778)	4,961 (1,802)	7,246 (3,431)	10,004 (5,605)
PR	489 (890)	547 (316)	695 (426)	698 (407)	720 (395)	905 (519)	718 (296)	648 (292)	136 (868)	-1159 (1959)
ITEXP	96.9 (62.88)	77.1 (58.6)	100.7 (100.3)	72.2 (21.6)	72.78 (35.5)	101.8 (46.6)	132 (67.2)	138 (69.2)	96.8 (43.0)	87.05 (38.1)
TA	50.7 (23.9)	40.4 (18.1)	46.6 (23.6)	44.2 (19.4)	41.9 (18.0)	46.9 (19.6)	52.8 (20.6)	55.8 (21.7)	65.7 (28.5)	70.8 (31.4)
DLMGN	3.37 (1.46)	5.40 (1.79)	2.65 (1.25)	2.81 (1.33)	2.62 (1.32)	2.84 (1.28)	3.16 (1.01)	3.67 (0.85)	3.68 (0.75)	3.92 (0.95)
EQTR	11.32 (5.11)	12.61 (5.09)	11.43 (4.01)	14.35 (5.83)	13.00 (5.05)	11.97 (5.03)	10.75 (3.88)	9.90 (1.94)	7.99 (3.89)	8.06 (6.97)
NUMSTR	188 (147)	122 (104)	134 (112)	147 (116)	162 (123)	181 (130)	208 (131)	240 (157)	258 (169)	288 (212)
N	201	22	25	25	25	24	21	21	21	17

1) Variable names are in the body of the paper. Std Dev. = Standard Deviation. N = the number of sample observations.
2) DLMGN and EQTR = percent (%) per bank. NUMSTR = the number of stores per bank. All other variables represent data per branch since they are deflated by numbers of branch as a firm-size proxy. The monetary unit for TA is thousand millions in Korean Won and all other variable's monetary unit is millions.

Key independent variable in this study, IT expenditures ($ITEXP_{it}$), was collected from every bank in Korea as it was not publicly available.[4] IT level is calculated by the firm's IT expenditures divided by total IT expenditures of all Korean commercial banks for the sample year 1990-1998. An index variable (NDX) for IT level is assigned to all banks. The number 1 is assigned to firms exceeding the mean of all firms' IT expenditures and 0 for others. Thus an interactive dummy variable, $ITNDX_{it}$, is calculated by IT expenditures ($ITEXP_{it}$) multiplied by an index variable (NDX) for IT level 1 or 0.

The summary statistics of sample data are shown in Table 1.[5] Note that IT expenditures (ITEXP) were continuously increasing over the sample years except for years 1997 and 1998 when Korea was in a foreign currency crisis. Administrative expenses (ADMEX) were also increasing every year but payroll expenses (PAYEX) were decreasing after year 1995. It also shows that the average increasing rate of payroll expenses (22%) is lower than the average increasing rate of operating expenses (33%). This indicates that cost structure may be changing due to the use of IT; substituting operating (fixed) expense for payroll (variable) expense.

4. Empirical Results and Implications for Bank Managers

4.1 Empirical Analyses and Results

The t-statistics were used to test for difference of means for major performance variables between two groups. The key variable to test for the first hypothesis is the labor productivity ratio ($LBPR_{it}$). As shown in table 2, the mean of $LBPR_{it}$ is greater for high IT level banks, supporting the first hypothesis.[6] Note that the number of employee per year is greater for low IT level banks. This may indicate that low IT level banks utilize more personnel to operate their business thus resulting in higher payroll expense and lower labor productivity. Table 2 also shows that means of IT expenditures (ITEXP), total expenses (ADMEX), operating expense (OPREX), and profit (PR) are significantly greater for high IT level banks than for low IT level banks. However, the means of market share for deposits and loans are smaller for high IT level banks. The t-test results of these variables must be carefully interpreted because the exogenous factors that influence on these variables cannot be controlled in t-test. Thus, this study employs the regression approach to test whether the effects of IT expenditures on expense, market share, revenue and profit is different depending on the levels of IT (i.e., high IT level versus low IT level banks).

Table 2 Summary of T-Test (1990-1998 Pooled Data)

Variables	High IT Banks (N:99)	Low IT Banks (N:102)	t-value	Variables	High IT Banks (N:97)	Low IT Banks (N:104)	t-value
ITEXP	119	75	5.50***	MSD	3.770	4.890	-1.90**
ADMEXP	845	805	1.30*	MSL	3.820	4.810	-1.70**
PAYEX	415	428	-0.90	RV	5.041	4,639	0.90
OPREX	431	376	3.10***	PR	652	372	2.60***
EMPNO	4,012	5,340	-2.36***	LBPR	1.086	1.047	2.22***

1) The number for each variable is mean. The explanation for number unit is in Table 1.
2) The EMPNO and LBPR represent number of employee per year and labor productivity ratio (= output / input) per employee, respectively.
3) ***, **, * mean significant at the 1%, 5%, 10% level (one-tail test), respectively.

The results of the regression using equation (1) to test the second hypothesis are shown in Table 3. The sign of the estimated coefficient on total asset (TA_{it}), α_1, is positive and statistically significant for all three expense measures ($ADMEX_{it}$, $PAYEX_{it}$, and $OPREX_{it}$). Banks that employed more financial assets spend more money on payroll and operating activities.

Key components of regression equation (1) are α_2 and α_3, the estimated coefficients of variables $ITEXP_{it}$ and $ITNDX_{it}$. An examination of the coefficient of α_2 is used to determine how IT expenditures for low IT level banks (i.e., banks in which an index variable equal 0) impact on various expense items. The sign and magnitude of estimated coefficient (α_3) of $ITNDX_{it}$ indicates whether the effect of IT expenditures between two groups is different or not. That is, the estimated coefficient of $ITNDX_{it}$ (α_3) is a net effect of IT expenditure on the dependent variable for the group in which an index variable is assigned to 1, in this case high IT level banks. A combined coefficient of both $ITEXP_{it}$ and $ITNDX_{it}$, α_2 plus α_3, explains how IT expenditures for high IT level banks (i.e., banks in which an index variable equal 1) impact on various expense items.[8]

As shown in Table 3 the estimated coefficient of α_3 to payroll expenses ($PAYEX_{it}$) is negative and statistically significant. The effect of IT expenditures on decreasing payroll expense for high IT level banks is significantly greater than that of low IT level banks. The estimated coefficient of α_3 to operating expenses ($OPREX_{it}$) is positive and statistically significant.[9] This indicates that the effect of IT expenditures on increasing operating expenses is greater for high IT level banks. It also appears that IT expenditures have a marginal impact on increasing total administrative expenses ($ADMEX_{it}$) for low IT level banks. One possible explanation is that IT utilization changes the firms' cost structure, partially substituting operating (fixed) expenses for payroll (variable) expenses. This finding is similar to that observed by Thatcher and Oliver (2001) and Alpar and Kim (1990).

Table 3
Regression Coefficients of Model (1)
$\{ADM\text{·}PAY\text{·}OPREX_{it} = \alpha_0 + \alpha_1 TA_{it} + \alpha_2 ITEXP_{it} + \alpha_3 ITNDX_{it} + \varepsilon_{it}\}$

Dependent Variables	α_0	α_1	α_2	α_3	Adj-R^2 (F-value)
ADMEX	4.438 (18.29)***	0.740 (15.02)***	0.114 (1.37)*	-0.016 (-0.21)	0.616 (107.97)***
PAYEX	2.656 (17.743)***	0.629 (10.41)***	0.153 (1.50)*	-0.217 (-2.26)**	0.422 (49.72)***
OPREX	1.782 (13.14)***	0.722 (15.37)***	0.063 (0.80)	0.158 (2.13)**	0.651 (125.10)***

1) Variable names are in the body of the paper. T-values are in parenthesis and 201 observations are used in statistical analyses.
2) ***, **, * mean significant at the 1%, 5%, 10% level (one-tail test), respectively.

The results of the regression using equation (2) to test the third hypothesis are shown in Table 4. Note that the signs of the estimated coefficient (β_1) are negative and statistically significant, indicating that the lower interest spread contributes more to increasing market shares. The equity ratio and number of stores contribute to increase firm's market share of deposits and loans as expected. The signs of the estimated coeffi-

cients on the equity ratio ($EQTR_{it}$) and number of stores ($NUMSTR_{it}$), β_2 and β_3, are positive and statistically significant.

Key components of regression equation (2) are β_4 and β_5, the estimated coefficients of variables $ITEXP_{it}$ and $ITNDX_{it}$. The estimated coefficient of $\gamma 5$ is positive and statistically significant. The effect of IT expenditures on increasing market shares for high IT level banks is significantly greater than that of low IT level banks. The estimated coefficient of β_4 is statistically significant, however it is negative. This shows that increase of market share by high IT level banks is gained from loss of market share by low IT level bank. These results support the second hypothesis, which states that IT utilization for high IT level banks has a positive impact on market share.

The results of the regression equation (3) to test the fourth hypothesis are shown in Table 5. The sign of the estimated coefficient of γ_1 to the total revenue (RV_{it}) is positive and statistically significant as expected as greater revenues should be earned with larger interest spreads. However, the sign of the estimated coefficient of γ_1 to the profit measure (PR_{it}) is also statistically significant, but it is negative. This was not expected since the greater profit was expected with larger interest spread. One possible explanation for this is the possible misspecification of regression model.[10] Another more likely explanation is that this was a general period of declining profit in the Korean banking industry. The signs of the estimated coefficient of both the equity ratio ($EQTR_{it}$) and total assets (TA_{it}), γ_2 and γ_3, are mainly positive and statistically significant, indicating that they contribute to increase firms' financial performance.

Table 4 Regression Coefficients of Model (2)
$\{MSD \cdot L_{it} = \beta_0 + \beta_1 DLMGN_{it} + \beta_2 EQTR_{it} + \beta_3 NUMSTR_{it} + \beta_4 ITEXP_{it} + \beta_5 ITNDXD_{it} + \varepsilon_{it}\}$

Dependent Variables	β_0	β_1	β_2	β_3	β_4	β_5	Adj. R^2 (F-value)
MSD	0.003 (0.716)	-0.096 (-3.32)***	0.058 (1.83)**	0.959 (30.01)***	-0.182 (-3.67)***	0.148 (2.98)***	0.859 (244.22)***
MSL	0.009 (1.44)**	-0.154 (-4.21)***	0.073 (1.85)**	0.904 (22.55)***	-0.157 (-2.52)***	0.149 (2.40)***	0.778 (141.04)***

1) Variable names are in the body of the paper. T-values are in parenthesis and 201 observations are used in statistical analyses.
2) ***, **, * mean significant at the 1%, 5%, 10% level (one-tail test), respectively.

Table 5
Regression Coefficients of Model (3)
$\{RV \cdot PR_{it} = \gamma_0 + \gamma_1 DLMGN_{it} + \gamma_2 EQTR_{it} + \gamma_3 TA_{it} + \gamma_4 ITEXP_{it} + \gamma_5 ITNDX_{it} + \varepsilon_{it}\}$

Dependent Variables	γ_0	γ_1	γ_2	γ_3	γ_4	γ_5	Adj-R^2 (F-value)
PR	-0.505 (-1.93)*	-0.265 (-3.99)***	0.522 (7.80)***	0.230 (3.05)***	-0.061 (-0.53)	0.234 (2.20)**	0.310 (17.53)***
RV	-1.695 (-3.36)***	0.158 (4.29)***	-0.040 (-1.08)	0.970 (23.08)***	-0.197 (-3.08)***	0.115 (1.94)**	0.781 (143.96)***

1) Variable names are in the body of the paper. T-values are in parenthesis and 201 observations are used in statistical analyses.
2) ***, **, * mean significant at the 1%, 5%, 10% level (one-tail test), respectively.

Key components of regression equation (3) are γ_4 and γ_5, the estimated coefficients of variables $ITEXP_{it}$ and $ITNDX_{it}$. The estimated coefficient of γ_5 is positive and statistically significant, showing that IT expenditures provide greater increases in financial performance for high IT level banks than for low IT level banks. While the estimated coefficient of $ITEXP_{it}$ to the revenue (RV_{it}), γ_4, is statistically significant, it is negative. Total revenue for lower IT level banks is decreased due to the increase of total revenue by high IT level banks. One would expect this result because increases in revenue or market share by high IT level banks must be offset by decreases in low IT level banks. The effect of IT on increasing profit for low IT level group is negative but not statistically significant. These results tend to support the third hypothesis that IT utilization for high IT level group will have a greater positive impact on increasing financial performance than that of low IT level banks.

4.2 Managerial Implications

In the banking industry, many expenses are driven by the services required by individual customers rather than by corporate customers. Most of the transactions processed for individual customers are routine, which can be easily processed by on-line banking. This explains why moving to on-line banking system is very important for cost reduction and increased profitability. Also, with the gradual deregulation of the banking sector worldwide, commercial banks are now finding ways and means of ensuring profitability of their operations without compromising quality of services. IT is seen as a very important strategic tool for banks and it explains why banks have been heavily investing in information technology. The BSC framework proposed by this study can be used as a means for integrating and operationally implementing managerial control system, especially for banks heavily utilizing IT strategy. The proposed BSC links performance measures with strategic roles of IT. In this sense, the BSC framework and empirical findings reported in this study suggest at least two important managerial implications.

First, major findings of this study indicate that the relationships between IT expenditures and four sets of the BSC performance indicators were significantly different depending upon the level of IT. The level of IT is used as a proxy for computerized banking functions. For banks that maintain high IT level, IT expenditures appear to have (1) increased labor productivity measured by various variables such as a ratio of total revenues divided by total expenses, (2) decreased payroll expenses and increased operating and total administrative expenses. A distinctive feature of these findings is that firms' cost structure is changed by substituting operating (fixed) expense for payroll (variable) expense, thus its operating leverage. Management must be willing to accept positive and negative consequences of this changed cost structure. Which expense item is more important to improve firm's competitive advantage may vary among firms since cost-volume-profit relationship can be changed due to the use of IT and due to changes in the economic environment. Managers of banks can use IT as one of its strategic tools in conjunction with firm's cost structure.

Second, this study posits that bank managers may use a balanced scorecard approach to measure business performance of both IT and management strategies. The proposed BSC contains four sets of measures that are designed to capture the firm's IT strategy and it links performance measures with strategic roles of IT. Using this framework, this study finds that IT expenditures appear to have increased (1) labor productivity

(internal perspective), (2) market share of both deposits and loans (customer perspective), and (3) revenue and operating income (financial perspective) for high IT level banks.

However, some performances specified by this BSC framework can be better measured if banks adopt the activity based costing (ABC) systems (Kaplan and Norton, 2001b). The ABC system can provide operational measures in the BSC's internal process perspective and financial perspective, such as actual costs of financial services provided by on-line banking system. For example, the adoption of ABC system will give information about unit costs for processing transactions arising from various financial services and various groups of customers such as individual division, corporate division, retail division, or commercial division. It will also monitor the profitability by product, by customer, and by a geographical basis. That is, when the BSC framework is coupled with the ABC system, it can provide information for better management decisions, providing measurements of both efficiency of scale and scope. For example, the BSC with ABC systems can facilitate retaining the more profitable segments of operations, improving the profitability of the less profitable segments or division through utilizing better strategic objectives such as changes in pricing, improvement of product quality and service, technology improvements, and/or better relationship with their customers. The ABC system permits linkage to revenue growth strategy and to productivity strategy.

5. Summary and Conclusions

The objective of this study is to investigate whether IT expenditures are positively associated with financial and/or non-financial performance measures using a balanced scorecard approach proposed by Kaplan and Norton (1992, 2001a, 2001b). This study may be the first to introduce the balanced scorecard (BSC) approach to measure IT performance and to use it as a framework for the development of research hypotheses. The proposed (i.e., modified for IT strategy) BSC attempts to track the key strategic roles of IT suggested by prior studies and links performance measures for the strategies. The proposed BSC in Figure 1 contains four sets of measures that are designed to capture the potential performance of IT investment strategy. The three out of four sets in the BSC are used in this study as performance measures of IT expenditure. Those are measures on 1) labor productivity (internal perspective measure), 2) market shares (customer perspective measure), and financial measures (financial perspective such as expense, revenue, and profit).

Using the proposed BSC, this study examines whether the association between IT expenditures and measures of financial and/or non-financial performance are different for different IT levels of banks. The research shows that IT expenditures reduce payroll expenses for high IT level banks; but regardless of IT level, the use of IT does not reduce total expenses. Findings support results by Thatcher and Oliver (2001) and Alpar and Kim (1990). This study also finds that the use of IT for high IT level banks has a positive impact on increasing labor productivity and market share. This is also true for profitability. IT expenditures increase revenues and operating income for high IT level banks. The results of this research suggest that the economic benefits of IT expenditures do not accrue automatically. The IT plan must be formulated as an integral part of implementing management strategy, if IT investment is to achieve the optimal results. This is assisted by the BSC in Figure 1.

One possible limitation of this study is the selection of dependent variables. Labor productivity ratios, expense items, market shares, total revenues, and operating profits were used as dependent variables. These performance measures in the banking industry could be affected by other factors not used in the regression models. This could create a missing variable problem. Future research could use revenue figures created directly from the use of IT equipment (e.g., commission paid by CD/ATM users or market share created by on-line banking) to test the association between business performance and IT expenditures.

Another possible limitation of this research comes from selection of the variables to classify IT levels, a proxy for IT-based banking function. This study used IT expenditures per branch as a classification measure of IT level. But other variables such as number of IT personnel, CD/ATMs, workstation, mainframe, number of computerized services, and number of hours computer usage may have been used as a measure of IT level. IT expenditure was used because it had the highest inter-correlations with other IT related variables. Despite possible limitations related to the data used in this research, one of the strengths of this study is the scope of the data. It uses the entire population data of the banking industry in Korea over a nine-year period and provides evidence of significant associations between IT expenditure and business performance including financial and non-financial measures.

Endnotes

1. Examples of items that affect a firm's competitive advantage include its intellectual capital or knowledge assets, corporate and/or brand reputation, managerial/functional skills, and market orientation—its ability to search large databases for underlying trends, to create customer profiles, to target product and service needs, to offer novel products, and to access new markets (Bharadwaj, Bharadwaj, and Konsynski, 1995).

2. "Competitive advantage" is enhanced by changes that improve a firm's efficiency and/or effectiveness while maintaining or increasing customer satisfaction and market share. Thus, it increases the firm's ability to obtain and retain customers. IT can impact the ability of a firm to execute such strategies as product and service differentiation, inventory control, distribution support in a marketing department, and concentration in a particular market.

3. This study used the equity ratio by BIS (Bank for International Settlements) standards. This was calculated by the equity divided by total loans excluding risk-free loans. The interest spread called margin ($DLMGN_{it}$) is the difference between average loan interest and deposit interest.

4. Since every bank normally reports IT expenditures to the Korean Banking Supervisory Board, they generally have those figures available although they do not disclose those numbers in financial statements.

5. The number of sample firms is decreasing after the year 1993 because five banks were liquidated in the year of 1997 and IT expenditures for those firms are not available for those years. In year 1998, the sample firms become 17 banks because several banks were merged.

6. This study also used Mann-Whitney U statistics, a non-parametric test. The results from Mann-Whitney U statistics were similar to the results of t-statistics.

7. For a discussion of more detail statistical procedures, see Studenmund and Cassidy (1984).

8. The results of estimating the ordinary least square (OLS) equation (1) are presented in Table 2 and Table 3. Any statistical implication from OLS can be drawn only if the basic assumptions for OLS are met. Several tests are also conducted to ensure that our analysis did not violate the basic assumptions. The value of the studentized residuals was checked to ascertain whether there were any influential outliers. All observations were found to be in the acceptable range with the absolute value of studentized residuals smaller than three. The Belsley's condition indices indicated that multi-collinearity was not a problem (Belsley et al., 1980). White's (1980) test also indicated that the assumption of homoscedastic residuals was not seriously violated.

9. To test for possible misspecification of equation (3), this study included several other variables such as bad loans, but the results were the same. One possible explanation for this result could be found in Table (1). Table 1 shows that the profit was continuously decreasing in years 1995 through 1998. This may help to explain the negative sign of γ_1 to the profit measure.

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