The Impact of Intellectual Capital on Efficiency: A Comparative Study between Foreign banks and Selected Thai Commercial Banks

Sarayuth Saengchan[1]

Faculty of Economics, Chulalongkorn University, Thailand

Abstract

In recent years, financial institutions, especially those in the banking industry, have experienced a dynamic and competitive environment. The banking industry is one of the most knowledge-intensive industries. Intellectual Capital (IC) is generally one of the critical resources in developing the banks' performance. The purpose of this study is to investigate empirically the relation between the intellectual capital and firms' financial performance by capturing its perception in the banking industry and identifying perceived value of this organizational variable in the commercial banks. Further, it is aimed to confirm that the existence of Intellectual Capital enhance the productivity in the Banking Industry in Thailand.

In the intellectual capital measurement model, elements of intellectual capital are defined in such dimensions as human capital and structural capital. Using data drawn from Bank of Thailand and the Stock Exchange of Thailand, the Pulic's Value Added Intellectual Coefficient (VAIC ™) are employed as the efficiency measure of capital employed and intellectual capital. The focus is on the used human capital (HC), structural capital (SC) and physical capital (CA) of the selected Thai commercial banks

The study estimates and compares cost efficiency of domestic and foreign banks in Thailand by using bank-panel data on quarterly financial statements of the selected Thai commercial banks between 2000 and 2007. The stochastic frontier (SFA) model is used for the reason that it allows for measurement error, which is an important feature in light of the fact that measuring bank production can be difficult due to data availability and the choice of a. set of inputs and outputs. In addition, it generates firm-specific efficiency estimates, which is able to test for differences in efficiency among banks. It is found that incomes from bank products including loans, fees and commission and labor costs are significant as factors determining the cost efficiency. In addition, the *VAIC* and *Ownership* coefficient are significantly negative, which supports the effects of Intellectual Coefficient and the different ownership structure.

Keywords: Banks; Cost efficiency; Productivity, Stochastic Frontier Analysis

JEL Classification Codes: C33; G21; M21.

[1] Mr.Sarayuth Saengchan, Ph.D. Student, Faculty of Economics, Chulalongkorn University, Thailand email:sssaengchan@yahoo.com

1. Introduction

1.1. Rationale

Globalization, which is essentially a process driven by economic forces, has brought the increasing division of production into separate stages carried out in different locations. It is becoming increasingly effective in integrating goods and services markets at the global level. What has provided attractive force for this process is a liberalization of capital inflow. Progress has been made in the deregulation and liberalization of both visible and invisible or services trades.

The globalization of market economies may conceivably require the following factors to exist: people, goods, foreign exchange, and information. Globalization leads to transactions in financial products through the relaxation of capital movements and integration of financial markets, thus enhancing the competition among the financial institutions, especially commercial banks. In order to allocate resources effectively, they should have to perform efficiently to keep their costs competitive.

2. Literature Review

2.1. Literature concerned with the effects of efficiency

G.E. Battese and T.J. Coelli (1995) define a stochastic frontier production function for panel data on firms, in which the non-negative technical inefficiency effects are assumed to be a function of firm-specific variables and time. The inefficiency effects are assumed to be independently distributed as truncations of normal distributions with constant variance, but with means which are a linear function of observable variables. This panel data model is an extension of recently proposed models For inefficiency effects in stochastic frontiers for cross-sectional data.

Simon H. Kwan and Robert A. Eisenbeis (1996) measured the inefficiency of individual banking firms in the United States by using the stochastic efficient frontier methodology. In this method, a banking firm's observed total cost is modeled to deviate from the cost-efficient frontier due to random noise and possibly X-inefficiency. To specify the cost function, they employed total operating costs (including interest costs) and input prices. Five measures of banking outputs are included: book value of investment securities, book value of real estate loans, book value of commercial and industrial loans , book value of consumer loans , and off-balance sheet commitments and contingencies which include loan commitments, letters of credit (both commercial and standby), futures and forward contracts, and notional value of outstanding interest rate swaps. Three input prices are utilized: the unit price of capital measured as total occupancy expenses divided by fixed plant and equipment, the unit cost of funds defined as total interest expenses divided by total deposits, borrowed funds, and subordinated notes and debentures, and the unit price of labor, defined as total wages and salaries divided by the number of full-time equivalent employees.

Jacob A. Bikker (1999) applied the stochastic cost frontier approach to the European banking industry in an attempt to measure its efficiency in 9 European countries. Bank cost efficiency analysis was based on the assumption that the technology of an individual bank could be described by a production function, which links banking outputs to available input factors. Loans, savings accounts and demand deposits were distinguished as production factors. The number of branches had been included in the multi-product cost function, as an indicator of additional service of a bank to its clients. Most bank services were related to traditional balance sheet items, such as loans and deposits, but to an increasing extent banks provide other services such as trade in securities, asset management and investment funds.

Richard Kneller and Philip Andrew Stevens (2003) investigated whether differences in absorptive capacity help to explain cross-country differences in the level of productivity. They utilized stochastic frontier analysis to investigate two potential sources of this inefficiency: differences in human capital and R&D for nine industries in twelve OECD countries over the period 1973-92. They examined the effect of human capital and of research and development (R&D), as determinants of absorptive capacity. Inefficiency in production indeed exists and it depends upon the level of human capital of the country's workforce. Differences in the level of absorptive capacity help explain deviations from this frontier through differences in inefficiency. The use of R&D and human capital as determinants of absorptive capacity allows for the possibility that one or both have a dual effect on production: a direct effect and an effect through inefficiency.

2.2. Literature concerned with Intellectual Capital

Pulic (1998) proposed the Value Added Intellectual Coefficient (VAIC^{TM}) to provide information about the value creation efficiency of tangible and intangible assets within a company. VAIC ^{TM} is an analytical procedure designed to enable management, shareholders and other relevant stakeholders to effectively monitor and evaluate the efficiency of VA by a firm's total resources and each major resource component. Instead of valuing the intellectual capital of a firm, the VAIC method mainly measures the efficiency of firms' three types of inputs: physical and financial capital, human capital, and structural capital, namely the Capital Employed Efficiency (CEE) — indicator of VA efficiency of capital employed, the Human Capital Efficiency (HCE) — indicator of VA efficiency of human capital, and the Structural Capital Efficiency (SCE)— indicator of VA efficiency of structural capital. The sum of the three measures is the value of VAIC. The higher VAIC value results in better companies' value creation potential.

The subordinate concept of VAIC^{Im}, Intellectual Capital Efficiency (ICE), describes the efficiency of Intellectual Capital (IC) within a company. Actually, VAIC^{TM} indicates the total efficiency of value creation from all resources employed and ICE reflects the efficiency of value created by the IC employed. The better a company's resources have been utilised the higher the company's value creation efficiency will be. (See e.g. Pulic, 2000) The method is based on two resources: capital employed (CE) and intellectual capital (IC). Both resources play a significant role in the value adding of a company and are considered as investments. Capital employed consists of equity, the accumulation of profit-adjusting entries and liabilities with interest. IC consists of human and structural capital (defined this way in the context of VAIC^{TM}). Intellectual capital efficiency (ICE) is calculated by summing together the human capital efficiency *HCE* and the structural capital efficiency (*SCE)* . The following equation explains the relationship algebraically:

$VAIC^{TM}{}_i = CEE_i + HCE_i + SCE_i$ where

$VAIC^{TM}$ = VA intellectual coefficient for firm i;

CEE_i = VA_i / CE_i VA capital employed efficiency for firm i;

HCE_i = VA_i / HC_i; human capital efficiency for firm i;

SCE_i = SC_i / VA_i; structural capital efficiency VA for firm i;

ICE_i = $HCE_i + SCE_i$ Intellectual capital efficiency for firm i;

VA_i = Output – Input (Total Sales (Revenue) – cost of brought in materials, components and services or Operating profits + Employee costs+ Depreciation + Amortization

CE_i = book value of the net assets for firm i

HC_i = total salary and wages for firm i;

SC_i = $VA_i - HC_i$ structural capital for firm i.

2.3. Literature concerned with the Thai Banking Industry

Hidenobu Okuda and Suvadee Rungsomboon (2004) investigated the impact of foreign bank entry on Thai domestic banks by using panel data on 17 domestic commercial banks from 1990 to 2002. The paper examined different factors affecting bank performance, including changes in the foreign ownership of banks, financial regulations, and market structure. They find that an increase in foreign bank presence leads to a rise in overhead expenses, a decline in profits, and an increase in the interest spreads of domestic banks. In the short run, increased competition from foreign banks negatively affects domestic banks. However, in the long run, domestic banks' performance should improve.

Saovanee Chantapong (2005) estimated and compared cost efficiency of domestic and foreign banks in Thailand by using bank-panel data between 1995 and 2003. It also examines the effect of foreign bank entry on banking efficiency in Thailand since the significant acquisitions by foreign banks after the 1997 financial crisis. The widely used translog functional form specification is statistically tested by pooled regressions. The estimated results suggest that the unit costs of production of domestic and foreign banks are indistinguishable, although the two types of banks focus on different areas of the banking business. The findings suggest that based on bank operating efficiency, if foreign banks represent the best-practice banks in the industry, to a large extent, domestic banks in Thailand have caught up to the best-practice standards through out 1995-2003, significantly after the 1997 financial crisis . This may be due to greater foreign participation through acquisitions, which increases the competitive pressure in the banking industry, and also to financial restructuring of domestic banks, which increases the cost efficiency of domestic banks.

Koji Kubo (2006) analyzed the influence of the East Asian crisis and the subsequent reforms on the oligopolistic nature of the Thai banking industry. Since the crisis, there have been substantial changes in competitive environment, including a decline in the family ownership of banks as well as the arrival of new entrants. How did these changes affect a banking industry in which the six largest local banks accounted for over 70 percent of market share? The estimated Lerner index from

Bresnahan's [1989] conjectural variation model indicates the possibility of a decline in the degree of competition.

3. Statement of Problem

The Banking industry was hardly hit by the economic crisis during 1997 – 1999. Its financial performance has been turned into profit since 2001. All banks were found to have reduced their credit exposure during the crisis years. The group of Thai banks and the group of foreign-owned banks have gradually improved, which have the interesting points to study on how the efficiency plays the role on the different financial performances.

4. Research Objective

To measure the efficiency of individual firms in the industry, the model of efficiency is constructed in such a way that it reflects the cost-efficient frontier. To examine differences in efficiency among Thai local firms and Foreign-owned firms, which operate their business activities in Thailand, the research will study the effects of *Ownership* and *Time* effects on the cost performance of the firms. Ownership and Dynamic movement of the industry, which are the exogenous ones, lead to changes in the industry structure and then results in the difference in cost positions and difference in position advantages.

5. Research Methodology

In order to obtain profit inefficiency indexes of sample banks, a stochastic frontier approach, which becomes a common approach in bank efficiency research, will be employed. The stochastic frontier (SFA) model is used for the reason that it allows for measurement error, which is an important feature in light of the fact that measuring bank production can be difficult due to data availability and the choice of a. set of inputs and outputs. In addition it generates firm-specific efficiency estimates, which is able to test for differences in efficiency among banks According to Battese and Coelli (1995), the analysis of the stochastic frontier production function for panel data is defined by equation (1),

$$Y_{it} = exp(x_{it}\beta + V_{it} - U_{it})$$

Or

$$Y_{it} = X_{it}\,\beta + (V_{it} - U_{it}) \qquad (1)$$

Where Y_{it} = the (logged) output obtained by the i-th firm in the t-th time period;

X_{it} = a (1 x k) vector of (transformation of the) known input quantities associated with the i-th firm in the t-th time period of observation;

β = a (k x 1) vector of unknown parameters to be estimated; and

V_{it} = assumed to be iid $N(0, \sigma_v^2)$ random errors, and independently distributed of the U_{it}'s;

U_{it} = non-negative random variables, associated with technical inefficiency of production , which are assumed to be independently distributed as truncations at zero of the normal distribution with mean, $z_{it}\sigma$ and varianceσ_u^2

z_{it} = a (1 x m) vector of firm—specific variables which may vary over time;

σ = an (m x 1) vector of unknown coefficients of the firm—specific inefficiency variables.

Equation (1) specifies the stochastic frontier production function (e.g., of cobb—Douglas or transcendental—logarithmic form) in terms of the original production values. However, the technical inefficiency effects, the U_{it} 's, are assumed to be a function of a set of explanatory variables, the zit's and an unknown vector of coefficients, σ. The explanatory variables in the inefficiency model may include some input variables in the stochastic frontier, provided the inefficiency effects are stochastic.

The technical inefficiency effect, U_{it} in the stochastic frontier model (1) could be specified in equation (2),

$$U_{it} = \quad z_{it}\sigma + W_{it} \tag{2}$$

where the random variable, W_{it}, is defined by the truncation of the normal distribution with zero mean and variance, σ^2, such that the point of truncation is — $z_{it}\sigma$, i.e., $W_{it} \geq — z_{it}\sigma$. These assumptions are consistent with U_{it}, being a non-negative truncation of the N($z_{it}\sigma$, σ^2)-distribution. The assumption that the $U_{it}\,s$ and the $V_{it}s$ are independently distributed for all t = 1,2,..., T, and i =1,2,...,N, is a simplifying, but restrictive, condition.

The method of maximum likelihood is used for simultaneous estimation of the parameters of the stochastic frontier and the model for the technical inefficiency effects. The likelihood function is expressed in terms of the variance parameters, $\sigma^2_s = \sigma^2_s + \sigma^2$ *and* $\gamma\ \Xi\sigma^2 \ / \ \sigma^2_s$. The technical efficiency of production for the i-th firm at the t-th observation is defined by equation (3),

$$TE_{it} = exp(—U_{it}) = exp(- z_{it}\sigma\ W_{it}) \tag{3}$$

The prediction of the technical efficiencies is based on its conditional expectation, given the model assumptions.

5.1. Model Estimation

With regards to the literature review on efficiency, which names several factors, the stochastic frontier function to be estimated for the bank cost efficiency is

$$\begin{aligned} ln\ C_{it} = \quad & \beta_0 + \beta_1\, ln\ INC_{it} + \beta_2\, ln\ LFD_{it} + \beta_5\, ln\ OPS_{it} \\ & + \beta_3\, ln\ WAG_{it} \quad + V_{it} + U_{it} \end{aligned} \tag{4}$$

Technical inefficiency effects due to Global economic integration:

$$U_{it} = \sigma_0 + \sigma_1 VAIC_{it} + \sigma_2 OWN_{it} + W_{it} \quad (5)$$

where *ln* is the natural logarithm (i.e. logarithm to the base e);

C_{it}	=	Total administrative cost of bank unit i at time period t except for salaries and employee benefits
INC_{it}	=	Total income from net interest income and income from bank products excluding loans i.e. fees and commissions
LFD_{it}	=	Loanable funds including deposits, due to financial institutions and money market, liabilities payable on demand, securities sold under repurchase agreements and borrowings
OPS_{it}	=	All Assets used in operating banks' transactions i.e. loans and all other assets
WAG_{it}	=	Price of Labor i.e. salaries and employee benefits
$VAIC_{it}$	=	Valued added intellectual coefficient for firm i;
OWN_{it}	=	Dummy variables for Thai and Foreign-owned banks, 0= Foreign Banks, 1=Thai Banks including Kasikorn Bank, Siam Commercial Bank, Bangkok Bank, Bank of Ayudhaya and Krung Thai Bank

The stochastic frontier production function in (4) can be viewed as a linearized version of the logarithm of the Cobb-Douglas production of function. The inefficiency frontier model i.e. the equations (4) and (5) accounts for both technical change and time-varying inefficiency effects.

5.2. Data

The study of Thai banking industry will include investigating an evolutionary 8-year path of the industry from 2000 until 2007, which is the period that there are events, leading to changes in banks' competitiveness. The data used in the model consist of quarterly bank-level data which are acquired from the published statistics by the Bank of Thailand, which classifies the data on foreign banks' branches. The data for selected Thai banks, including Kasikorn Bank, Siam Commercial Bank, Bangkok Bank, Bank of Ayudhaya and Krung Thai Bank comes from the Stock Exchange of Thailand. Kasikorn Bank, Siam Commercial Bank and Bangkok Bank are in the same group, which Bangkok Bank has the largest asset size where as Krung Thai Bank is the state enterprise bank. The variables are selected from the banks' balance sheet and income statements. However, the treatment of data has been done by omitting the data in quarter 4, 2001, quarter 2, 2003 and quarter 4, 2005 which cannot be transformed into logarithm value.

6. Empirical Results

The maximum-likelihood estimates of the parameters of the model are obtained using a the computer program, FRONTIER 4.1 (see Coelli, 1996). These estimates, together with the estimated standard errors of the maximum-likelihood estimators, given to three significant digits, are as follows:

$\ln C_{it}$ =	-3.101968	$+\ 1.6544 * \ln INC_{it}$	$+\ 0.0652 \ln LFD_{it}$	
SE	(16.3607)	(0.0665)	(0.0627)	
t-ratio	(-0.1895)	(24.8771)	(-1.0404)	

	$+\ 0.0048 \ln OPS_{it}$	$-0.7726 * \ln WAG_{it}$
SE	(0.0933)	(0.0669)
t-ratio	(0.0514)	(-11.5472)

Technical inefficiency effects:

U_{it} =	1.9910	$-0.2354 * VAIC_{it}$	$-\ 0.0894 * OWN_{it\ t}$
SE	(16.340128)	(0.0101)	(0.0369)
t-ratio	(0.1218)	(-23.2948)	(-2.4201)

log likelihood function = 131.9663

LR test of the one-sided error = 242.5596

with number of restrictions = 4

N = 174

* … significant at the 5% critical level

The signs of the coefficients of the stochastic frontier are mostly positive except the negative sign for Price of Labor. The estimated coefficients for income from bank products including loans and fees and commissions, all Assets used in operating banks' transactions and salaries and employee benefits variables and Price of Labor are significant at 5% critical level. From the equation it is implied that the banks will increase the operating costs when they grow their incomes, assets and salaries. In addition, the more income from loan and fees the banks have, the more costs related to those activities incurred. For the inefficiency model (*U)*, the estimated coefficients are of particular interesting in that there are significant effects of ownership of the banks on the cost efficiency model at 5% critical level. Both of the Valued added intellectual coefficient and *ownership* are negative, which indicate that different ownership have the impact on the cost efficiency. The foreign banks have better position in cost efficiency. In addition, the dynamic competition of industry results in better cost efficiency.

7. Conclusions

An application of the model for panel data is presented using data from 2 groups of the commercial banks in Thailand by quarterly over an eight-year period. The result implies that the model for the technical inefficiency effects, involving a constant term and ownership are significant component in the stochastic frontier cost function. In terms of intellectual capital index, VAIC and globalization factors, the ownership show highly significant factors in the cost efficiency model. This application has a limitation in that the data for foreign banks employed in the model is a consolidated one. So, the model is not able to specify the performance of each particular commercial bank due to the limitation on the published data by the government agency. However, that the model specification permits the estimation of both technical change and time-varying technical inefficiency, given that inefficiency effects are stochastic and have a known distribution. It would be better if the model can incorporate the more specific data for the model of stochastic frontiers and the technical inefficiency effects can be effectively associated with the analysis of panel data.

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Appendix

Output from the program FRONTIER (Version 4.1c)
instruction file = terminal
data file = tv-dta.txt

Tech. Eff. Effects Frontier (see B&C 1993)
The model is a cost function
The dependent variable is logged
the ols estimates are :

	coefficient	standard-error	t-ratio
beta 0	0.54515811E-01	0.10713582E+01	0.50884766E-01
beta 1	0.39081023E+00	0.70769109E-01	0.55223280E+01
beta 2	-0.37554334E+00	0.91730683E-01	-0.40939774E+01
beta 3	0.62704902E+00	0.15883617E+00	0.39477722E+01
beta 4	0.14001348E+00	0.95992398E-01	0.14585892E+01
sigma-squared	0.53314170E-01		

log likelihood function = 0.10686444E+02

the estimates after the grid search were :

beta 0	-0.17731185E+00
beta 1	0.39081023E+00
beta 2	-0.37554334E+00
beta 3	0.62704902E+00
beta 4	0.14001348E+00
delta 0	0.00000000E+00
delta 1	0.00000000E+00
delta 2	0.00000000E+00
sigma-squared	0.10552622E+00
gamma	0.80000000E+00

the final mle estimates are :

	coefficient	standard-error	t-ratio
beta 0	-0.31019680E+01	0.16360736E+02	-0.18959832E+00
beta 1	0.16544238E+01	0.66503784E-01	0.24877138E+02
beta 2	0.65240093E-01	0.62701867E-01	0.10404809E+01
beta 3	0.47980907E-02	0.93296359E-01	0.51428488E-01
beta 4	-0.77265749E+00	0.66912888E-01	-0.11547215E+02
delta 0	0.19910214E+01	0.16340128E+02	0.12184858E+00
delta 1	-0.23542199E+00	0.10106193E-01	-0.23294824E+02
delta 2	-0.89447175E-01	0.36959952E-01	-0.24201107E+01
sigma-squared	0.12845887E-01	0.13473203E-02	0.95343976E+01
gamma	0.19211665E+00	0.91190990E+01	0.21067503E-01

log likelihood function = 0.13196625E+03
LR test of the one-sided error = 0.24255962E+03
with number of restrictions = 4
[note that this statistic has a mixed chi-square distribution]
number of iterations = 40
(maximum number of iterations set at : 100)
number of cross-sections = 6
number of time periods = 29
total number of observations = 174
thus there are: 0 obsns not in the panel