COST EFFICIENCY AND K-ECONOMY OF COMMERCIAL BANKS IN MALAYSIA

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ABSTRACT

This paper is a pioneer attempt to identify the significance of the K-economy variables as determinants to commercial banks cost efficiency in Malaysia. The cost efficiency of commercial banks in Malaysia which was then the dependent variable was estimated using the Stochastic Frontier Approach (SFA) on a sample of unbalanced panel data, covering 23 commercial banks, between 1995 to 2003. Hausman exogeneity specification test was done to check on the exogeneity or endogeneity of the K-economy variables considered which then determine the appropriate specification of the model used. Based on the empirical results, all the three K-economy variables, namely, efficient infrastructure, knowledged labour and information and communication technology expenditure were found to be weakly exogenous. This rejected the endogenous growth theory and favoured the neo classical theory. In the neo classical model, information communication technology (ICT) was found to be significant decreasing the cost inefficiency. However, the training expenditure and bank size were found significant and they increased the cost inefficiency.

1.0 INTRODUCTION

Apart from globalisation and liberalisation, the world economy is also being challenged by the important role of knowledge, and the capacity of the nation to utilise and generate knowledge. This will in turn create new values in the economy which will further contribute to the economic growth and wealth of the country. This challenge is known as K-economy and is defined as an economy that is based on knowledge or economy that is directly based on production, distribution and utilisation of knowledge and information (OECD, 1996). Amongst the critical factors that contribute to the development of K-economy, and which also acts as indicators to the strengths and weaknesses of a country, are computer infrastructure, information structure, education and training, research and development (R&D), and technology.

In relation to this, the new growth theory by Romer (1986, 1990) has specified technology or knowledge as an endogenous factor in the production function instead of an exogenous factor as in the neo classical theory. There are as yet no known studies on the banks' cost efficiency that is correlated to any K-economic indicators or input in Malaysia. Hence, this motivates the objective of this study, that is, to identify the significant K-economy input that can either affect the cost efficiencies of the commercial banks in Malaysia endogenously or exogenously.

The rest of the paper is organised as follows. Section 2.0 reviews existing literature on both cost efficiency and some limited K-economic studies. Section 3.0 presents the model specified and data used while Section 4.0 presents and interpretes the empirical findings, and Section 5.0 concludes this article.

2.0 LITERATURE REVIEW

Studies on bank efficiency have used parametric and non-parametric methods. The methods that were used in parametric approach were Stochastic Frontier Approach (SFA), Thick Frontier Approach (TFA) and the Distribution-free Approach (DFA). On the other hand, the non-parametric researches used Data Envelopment Analysis (DEA), Malmquist Index, Tornqvist Index and Distance Functions to measure bank efficiency.

In the parametric studies, SFA was often used. Berger and Humphrey (1997) reported that out of the 60 studies using parametric, 24 used SFA. Amongst them were Ferrier and Lovell (1990), Greene (1990), Khumbhakar (1996), Battese and Coelli (1992), Bauer and Hancock (1993), Berger (1993), Mester (1996), and Berger and DeYoung (1997). In the non-parametric, DEA was the most widely used method, such as Sherman and Gold (1985), Rangan et. al (1988), Elyasiani and Median (1990), Ferrier and Lovell (1990), English et. al (1993), Fixler and Zieschang (1999), and Brockett et. al (1997).

In terms of functions used to estimate the production, cost and profit functions in the SFA method, the translog function was the most widely used, such as Mester (1987), Berger et. al. (1987), Hunter et. al. (1990), Humphrey (1993), Battese and Coelli (1992), Kaparakis et. al (1994), Battese et al., Mohd Zaini Abd. Karim (2001), Yildirim and Philippatos (2002), and Nikiel and Opiela (2002). Besides translog function, fourier flexible function had became popular since 1990s. However, the choice of the function to use also depended on the sample size of the study as small sample size could not estimate fourier flexible function efficiently.

There were a few studies carried out in Malaysia that analysed bank efficiency. They were done by Mohd. Zaini Abd. Karim (2001) and Mariani Abdul Majid et. al (2003). Mohd. Zaini Abd. Karim (2001) investigated the differences in bank efficiency across selected countries in the ASEAN region, including Malaysia. The overall results showed that the ASEAN banks enjoyed increasing returns to scale and larger banks tended to have higher cost efficiency than smaller banks. Mariani Abdul Majid et. al (2003) found that there was no evidence that foreign banks were more efficient than local banks. However, this cost inefficiency was related to bank size, and had provided some evidence for a U-shaped average cost function.

Previous studies on financial sector efficiency and its relation to all indicators of the K-economy were not found. Nevertheless, there were some studies on financial sector efficiency with one or part of the K-economic indicators or characteristics. Most of these studies were done in US and in the developed countries with mixed empiral results. Studies by Oliner and Sichel (1994), Lichenberg (1995), Stiroh (1998), Lehr and Lichtenberg (1999), and Ten Raa and Wolff (2001) found that information technology (IT) was a significant factor affecting productivity growth. Jorgenson dan Stiroh (1999, 2000) found that one sixth of the output growth, that is, 2.4% was due to computer output via capital deepening. However, Bailey and Gordon (1988) and Parsons et. al (1993) (seen in Wolff, 2002) found otherwise. What was most puzzling was the huge investments in IT that was not contributing to productivity. Why did this IT paradox occur? Frischtak (1992) argued that it could be due to lagged factors, such as new technologies needing organisation change and employees training before the benefits of IT could be realised. In the process, some works were duplicated and redundant. Hence the benefits from IT could not be reaped immediately.

The empirical results from previous studies on education and producitivy were also mixed. Griliches (1970) found positive relationship between education attainment and economic growth (seen in Wolff, 2002). However, Wolff (1999) in US found a negative relationship between skill and productivity except for the managerial and administration level as some types of occupations were not directly related to output. Wolff (2001) also did not find any significant effect of education attainment on Gross Domestic Product (GDP) growth for Organisation for Economic Co-operation and Development (OECD) countries between 1950 to 1990. In the same study, both on the job training and off the job training were only significant after a lag of 2 years. This implied that labour needed time to learn new technologies. None of the banking studies related their efficiencies with R&D capacity. This may be due to the problem of data insufficiency in R&D indicators in banks. Therefore, this study is the first known attempt to analyse the cost efficiency of the banks in Malaysia in relation to K-economy capacity.

3.0 MODEL SPECIFICATION AND DATA

In this study, cost efficiency scores were first estimated and these scores were then correlated to the K-economy variables in the second stage of regression. Cost efficiency was estimated using the translog stochastic cost frontier approach. Cobb Douglas function was also specified to compare the appropriateness of the functions used. An unbalanced panel data was used as some of the annual reports of the banks were not available. The sample included all the existing 23 commercial banks in Malaysia from 1995 to 2003 totaling 173 observations.

In estimating the cost efficiency for banks, it was not always clear which balance sheet items should be specified as inputs versus outputs, since they often contained elements of both. Following Fixler (1993), it was found that the appropriate input-output approach was the intermediation approach.[2] This suited the function of the commercial bank as financial intermediary in channelling funds from depositors to borrowers. For the cost efficiency frontier estimates, this study used the Stochastic Frontier Approach as proposed by Battese and Coelli (1992, 1995). This approach was used as it had been well established and widely used by previous researches on efficiencies where the translog cost funcion was the most appropriate function employed in the estimation. Other studies such as Berger and Mester (1997), Mitchell and Onvural (1996), and Kraft et. al (2002) had used the fourier cost and profit functions which augmented the popular translog specification to include trigonometric terms. These terms allowed the estimation to better fit a broader range of curves. However, this study could not adopt the use of fourier function as the estimation requires a larger sample size. Hence, the translog function was used.

The models based on Battese and Coelli's (1992, 1995) Stochastic Frontier Approach assumed that the firm effects were distributed as normal random truncated variables and allowed to be changed systematically over time. The Stochastic Cost Frontier function can be written as follows:

$$\mathbf{C_{it} = x_{it}\beta + (v_{it} + u_{it}),\ \ i = 1, ..., N,\ t = 1, ..., T \qquad ....(1)}$$

where,

C_{it} = log of total cost of bank i in year t (RM'000)

X_{it} = vector k x 1 input price (w_{it}) dan output (y_{it}) of bank i

[2] Prior to this study, asset or liability user cost was calculated to determine the status of the asset or the liability. Deposits were found to be an input and loans as an output to the banks.

β = unknown vector parameter

v_{it} = random variable assumed to be normal and not dependent on,

u_{it} = random variable that represents cost inefficiency of the bank also asssumed as normal

Input price variable (w = input price vector)

w_1 = price of funds purchased (RM'000)

w_2 = price of deposits (current, savings and time deposits) (RM'000)

w_3 = price of labour (RM'000 per employee)

Quantity of output (y = Output quantity vector)

y_1 = Consumer loans (hire purchase, credit cards and related) (RM'000)

y_2 = Commercial loans (RM'000)

y_3 = Investment securities (RM'000)

In the above cost function, U_{it} defines how far the bank is operating above the cost frontier. The cost inefficiency of bank i is defined as the ratio of actual total cost to the stochastic frontier total cost. If U_{it} is zero, therefore the frontier cost function is Ci* = f (yi, wi, β) and the bank i cost efficiency (CE) can be written as:

$$CE = C_i / C_i^*$$

$$= f(y_i, x_i, \beta) \exp(U_{it}) / f(y_i, x_i, \beta)$$

$$\mathbf{CE = \exp(U_{it})} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \mathbf{(2)}$$

Hence, the cost efficiency is more than or equal to unity. If cost inefficiency is absent from the model, then the cost efficiency of all the banks will be unity. This implies that the firms are producing at the frontier cost, given the output values and the input prices. The

Cobb Douglas and translog functions that are estimated using maximum likelihood estimator in the Frontier 4.1 software are as follows:

(a) Cobb Douglas Cost Function

$$\mathbf{Ln\ C_{it} = \alpha o + \sum_{k=1}^{m} \beta_k \ln w_{kit} + \sum_{j=1}^{n} \gamma_j \ln y_{jit} + \ln u_{cit} + \ln v_{cit}} \quad \ldots \quad (3)$$

(b) Translog cost function

$$\mathbf{Ln\ C_{it} = \alpha o + \sum_{k=1}^{m} \beta_k \ln w_{kit} + \tfrac{1}{2} \sum_{k=1}^{m} \sum_{p=1}^{m} \beta_{kp} \ln w_{kit} \ln w_{pit} + \sum_{j=1}^{n} \gamma_j \ln y_{jit}}$$

$$\mathbf{+ \tfrac{1}{2} \sum_{j=1}^{n} \sum_{l=1}^{m} \gamma_{jl} \ln y_j \ln y_l + \tfrac{1}{2} \sum_{j=1}^{n} \sum_{k=1}^{m} \eta_{jk} \ln w_{kit} \ln y_{kit} + \ln u_{cit} + \ln v_{cit}} \quad \ldots \quad (4)$$

Since panel data is used, firm and time effects will be considered and the log likelihood ratio test will be used to determine the appropriateness of the model. In the Frontier 4.1 software, these options can be selected.

The second part of this paper involved the testing of endogeneity of the K-economy variables or the appropriateness of K-economy variables being specified in the neo-classical theory or the new growth theory. The neo-classical theory only recognised the labour and capital as endogenous factor in production function and other factors such as knowledge, productivity, education and intellectual capital were regarded as exogenous factors. On the contrary, the new growth theory by Romer (19986, 1990) placed technology or knowledge as endogenous input. The cost efficiency estimates would then be used as the dependent variable. The K-economy variables which are independent variables considered in this study were efficient infrastructure, knowledged labour and information, and communication technology expenditure. R&D expenditure was not included in the model because of the difficulty in obtaining the R&D data of the commercial banks. Moreover, the R&D activities in the commercial banks only started in early 2001. The locally operating foreign banks were not involved in R&D activities as they were done by their head office.

In an attempt to determine the exogeneity or endogeneity of the K-economy variables, the exogeneity Hausman specification test and Granger Causality test could be used. However, Granger Causality test involved the testing of various lagged dependent variables. As this study encountered a small sample size constraint, endogeneity or exogeneity Hausman specification test would be employed to determine the status of the K-economy variables which could also help to rule out any possibility of misspecification of the model used. This test requires the specification of the K-economy variables in a simultaneous equation system (Gujarati, 2003). A Two-Stage Least Square method was used to estimate the simultaneous equation that comprised equations (5), (6), (7) and (8). Using t-statistics, if the K-economy variables were found to be insignificant at 5% level, they are not endogenous variables and, hence, the model employed would be neo-classical model which only required an estimation of a single equation model (9). Otherwise, the simultaneous equation system would be used if the K-economy variables were found to be endogenous.

$$\mathbf{lnINF_{it} = a_o + a_1 \overset{(+)}{lnKNIT_{it}} + a_2 \overset{(+)}{ln\ KIT_{it}} + a_3 \overset{(+)}{ln\ ATM_{it}} + a_4 \overset{(-)}{ln\ Y_{it}} + u1_{it} \quad ...\ (5)}$$

where,

Y_{it} = Cost efficiency

INF_{it} = Efficient infrastructure = Total expenditure on infrastructure

= Purchase on premises, building, IT and non-IT capital stock ÷ total asset

KIT_{it} = IT stock expenditure

$KNIT_{it}$ = Non IT stock capital expenditure

ATM_{it} = Number of ATM machines of the bank

$u1_{it}$ = random error

$$\mathbf{lnL^*_{it} = b_o + \overset{(+)}{b_1 \ln TER_{it}} + \overset{(+)}{b_2 \ln TRAIN_{it}} + \overset{(-)}{b_3 \ln Y_{it}} + u2_{it}} \qquad \textbf{...(6)}$$

where,

L^*_{it} = efficient productivity of labour = Total loans/ Total number of employees

TER_{it} = Number of employees with tertiary education

= % of employees with tertiary education in financial services sector x number of bank employees

$TRAIN_{it}$= Total training expenditure per year = 2.5% x bank employees' salaries

$$\mathbf{Ln\ ICT_{it} = c_o + \overset{(+)}{c_1 \ln KIT_{it}} + \overset{(+)}{c_2 \ln ATM_{it}} + \overset{(+)}{c_3 \ln TER_{it}} + \overset{(+)}{c_4 \ln Y_{it}} + u3_{it}} \qquad \textbf{...(7)}$$

where,

ICT_{it} = ICT utilisation intensity

= Number of ATM machines in bank i in the commercial bank industry

KIT_{it} = IT Capital = Expenditure on hardware and software of computers

ATM_{it} = Number of ATM machines in bank i

TER_{it} = Number of employees with tertiary education

$$\mathbf{Y_{it} = d_o + \overset{(+)}{d_1} \ln INF_{it} + \overset{(+)}{d_2} \ln L^*_{it} + \overset{(+)}{d_3} \ln ICT_{it} + \overset{(+)}{d_4} \ln SIZE_{it} + \overset{(-)}{d_5} \ln L_{it} + \overset{(+)}{d_6} \ln K_{it} + u4_{it}} \quad \textbf{... (8)}$$

where,

$SIZE_{it}$ = Total Asset

L_{it} = Number of labour

K_{it} = Total Capital

$$\mathbf{Y_{it} = e_o + \overset{(+)}{e_1} \ln K_{it} + \overset{(-)}{e_2} \ln L_{it} + \overset{(+)}{e_3} \ln TER_{it} + \overset{(+)}{e_4} \ln TRAIN_{it} + \overset{(-)}{e_5} \ln KNIT_{it}}$$

$$\mathbf{+ \overset{(+)}{e_6} \ln KIT_{it} + \overset{(+)}{e_7} \ln ATM_{it} + \overset{(+)}{e_8} \ln SIZE_{it} + u5_{it}} \quad \textbf{… (9)}$$

Breusch and Pagan Lagrange Multiplier (LM) test was used to determine the existence of both effects (Baltagi, 2001). If LM was significant, both effects existed. As panel data was involved, Hausman (H) test was also used to determine the appropriate model which could either be the fixed effect or random effect model. If H value was significant, the fixed effect model would be appropriate. An unbalanced panel data was used which comprised of 14 commercial banks from 1995 to 2003 with a total of 91 observations. Only three foreign banks were included in the sample as most foreign banks did not record their ICT expenditure in their annual reports. Both neo-classical and new growth model would consider the firm and time effect as panel data was used. The Ordinary Least Square (OLS) method was used to estimate the fixed effect model without group effects, and the Least Square Dummy Variable (LSDV) method was used to estimate the fixed effect model either with 1-way or 2-way group effects. For random effect model, the Generalised Least Square (GLS) method was used.

4.0 EMPIRICAL FINDINGS

This section reported the results obtained from estimating the Stochastic Cost Frontier using the maximum likelihood estimator Frontier 4.1 and the K-economy variables relationship with cost efficiency using LIMPDEP 8.0.

The Maximum Likelihood estimator was used to estimate the cost function in this study and the log likelihood ratio test was used to decide which function was more appropriate. Table 1 reported the log likelihood test for 4 possible models, that is the Cobb-Douglas model, and the translog model without effects, with firm effects and time effects.

Table 1: Hypothesis Null test for Cost Efficiency Model

Model Null Hypothesis	Log Likelihood	Log Likelihood Ratio (λ)	Chi-Square Critical Value (5%)	Decision
Cobb Douglas	96.33	171.59**	32.67	Reject Ho. Translog more appropriate
Translog (μ=η=0)	12.92	4.78	43.77	Accept Ho. No firm and time effect
Translog (μ=0)	11.48	2.88	35.17	Accept Ho. No firm effect
Translog (η=0)	11.96	1.92	23.68	Accept Ho. No time effect

** 5% significance level.

From Table 1, the results showed that the translog function was better than the Cobb-Douglas function as the log likelihood ratio was higher than the chi-square value. This suggested the rejection of the null hypothesis of Cobb-Douglas function at 5% significance. For the cost translog function, all tests carried out for no firm effect, time effect or both effects failed to reject the null hypothesis thus suggesting that the best model for the cost translog function was the model without any firm or time effects. Table 2 reported the estimates of the translog cost function without any group effects. The gamma coefficient was found to be significant at 1% level indicating that cost efficiencies of the banks were very much affected by inefficient usage of input.

Table 2: SFA Cost Translog Estimates

Variables	Coefficients	t-statistics
Intercept	-11.498	-1.981*
LW1	0.375	0.844
LW2	1.588	1.659
LW3	-0.904	-0.683
LY1	-1.263	-2.363**
LY2	3.141	4.502***
LY3	0.2328	0.411
LY1SQ	0.014	0.286
LY2SQ	-0.234	-3.159***
LY3SQ	0.209	5.481***
LW1SQ	0.059	2.631**
LW2SQ	-0.142	-0.842
LW3SQ	0.201	1.155
LW2LW1	-0.032	-0.627
LW3LW1	-0.047	-0.821
LW3LW2	-0.085	-0.714
LY1LW1	0.044	0.754
LY1LW2	0.171	1.223
LY1LW3	-0.094	-0.985
LY2LW1	-0.149	-2.177**
LY2LW2	-0.652	-3.535
LY2LW3	0.244	1.522
LY2LY1	-0.0004	-0.003
LY3LW1	-0.129	-1.203
LY3LW2	-0.313	-0.343
LY3LW3	-0.003	-0.017
LY3LY1	-0.091	-2.191**
LY3LY2	-0.107	-2.718**
Log likelihood function	-12.9207	
Sigma square (σ2)	0.1402	3.497***
Gamma (γ)	0.603	5.030***

Nota: ***1% significance level, ** 5 % significance level,

- 10% significance level

Table 3: Hausman Exogeneity Specification Test for Cost Efficiency and K-economy Model

Dependent Variable	Type of Model	Group Effect	Coefficient dan t-statistics of EFCOS
LPROD	RE with no group effects	Two way	0.2778 (0.350)
LINF	FE with group effects	Two way	0.8698 (1.060)
LICT	RE with group effects	Two way	0.2436 (0.167)

Note: Values in parenthesis are t-statistics values.

RE = Random Effect Model, FE = Fixed Effect Model

Based on Table 3, the Hausman Exogeneity specification test that employed the simultaneous equation systems confirmed that all the K-economy variables are weakly exogenous as cost efficiency did not signficantly affect all the three K-economy variables.[3] This implies that all the K-economy variables should be specified in a single equation system as exogenous variables.

Table 4: Hausman and Lagrange Multiplier (LM) Test

Model	Hausman test	Lagrange Multiplier test
One way	53.82 (0.0000)***	26.42 (0.0000)***
Two way	87.91 (0.0000)***	56.03 (0.0000)***

Note: Values in parenthesis are p-values. *** 1% significance level.

[3] This result may be different if the number of observation can be increased. The ICT and other K-economy variables may need more time lag in order to realise the benefits.

Since panel data was used, the Hausman and Lagrange Multiplier tests were carried out to determine the best model. From Table 4, the Hausman test showed that the fixed effect model was appropriate for both the one and two way models as the H value was significant at 1% level. The LM test also supported a one-way and two way models with group effects. To choose the best model between the one-way and two way models, the F-statistics test and the likelihood ratio were used. The one-way model was considered as the constrained model and the two-way model was set as the unconstrained model. The results showed that the F statistics was 12.282 and higher than the F table value 2.82 (α=0.01, 8, 60). The likelihood ratio also confirmed a higher value of 88.256 as compared to the critical value of χ^2 of 21.995 (α = 0.01, 8). Hence, the unconstrained model (two-way model) was a better model at 1% significance level.

Table 5: Two-way Fixed Effect for Cost Inefficiency and K-economy

Independent Variable	Model	Bank	Firm Effect	Time	Time Effect
Intercept	79.290(0.989)	CS1	65.548(2.36)**	TS1	-2.429(0.83)
KIT	-0.048(-2.970)***	CS2	65.903(4.51)***	TS2	-5.997(0.91)
KNIT	-0.002(-0.080)	CS3	65.689(0.39)	TS3	22.812(0.99)
ATM	0.035(1.222)	CS4	65.10(11.90)***	TS4	14.008(1.00)
TER	59.454(0.978)	CS5	65.815(1.42)	TS5	8.397(1.01)
TRAIN	0.100(2.419)**	CS6	65.443(5.46)***	TS6	4.769(1.02)
SIZE	0.019(2.036)**	CS7	650.629(0.87)	TS7	14.006(0.99)
K	-0.055(-1.037)	CS8	66.769(7.75)***	TS8	19.842(0.98)
L	-59.467(-0.978)	CS9	66.132(5.15)***		
Adj. R^2	0.9784	CS10	65.694(0.42)		
Log Likelihood	143.6608	CS11	65.621(0.43)		
Akaike Criterion	-2.498	CS12	65.919(4.24)***		
RSS	0.2266	CS13	65.493 (5.04)***		

Note: Value in parenthesis are t-statistics values.

***1% significance level, ** 5% significance level

From Table 5, the high value of Adjusted R^2 and log likelihood showed that all the independent variables included in the model could explain 97.84% of the variation in the dependent variable. However, the high Adjusted R^2 was very much affected by the firm effects. Out of 14 firm effects, 8 were significant at 5% significance level. This implied that the differences in each bank from the style and management expertise aspects strongly affected the cost efficiency of the commercial banks in Malaysia. Two of K-economy variables were found to be significant, that is KIT and TRAIN. KIT was negatively related to cost inefficiency and was significant at 1% level. The estimation result showed that when KIT was increased by 1%, cost inefficiency decreased by 4.8%. This meant that the banks' investment on ICT was fruitful and had successfully reduced their inefficiency significantly. Mohd. Zaini Abdul Karim (2003) also confirmed that ICT investment reduced cost inefficiency even though it was only significant after a lagged of one year of the ICT investment. This may be due to the transition period whereby some work duplicated each other and the normal flow of work was disrupted by the utilisation of the new technology as his study was between 1991 to 1996.

Training expenditure (TRAIN) was found to be significantly positive affecting cost inefficiency at 5% significance level. The estimation showed that when TRAIN increased by 1%, cost inefficiency subsequently increased by 10%. This implied that the training conducted had not made the employees more efficient in executing their tasks, and, thus, it was unable to reduce costs. Knowledged employees or those with tertiary education also caused on increase, though insignificant in affecting cost inefficiency.

Apart from TRAIN and KIT, the bank size (SIZE) was also found to be significant affecting cost inefficiency at 5% significance level. This implied that as the bank grew bigger, it was unable to reap the economies of scale and, thus, its cost inefficiency was increased. In the case of Malaysia, this may be due to the transition period of the merger process. The banks were in the process of consolidation and there were related cost such as compensation payment to the employees who were given the option of Voluntary Separation Scheme (VSS). Hence, the initial stage of increasing the size of banks may incur cost, and, thus, increased cost ineffiency. Fadzlan S. and Muhd Zulkhilbri A.M. (2005) also confirmed that size increased technical inefficiency during this transition period.

Other variables, such as the number of ATM machines that represented the efficient infrastructure were insignificant but affected positively the cost inefficiency. Non IT stocks (KNIT), number of labour (L) and total capital (K) were also found to be insignificant.

5.0 CONCLUSIONS AND RECOMMENDATIONS

There are four main findings in this study. Firstly, constrained by the limited amount of observations, this study found that all the three K-economy variables were weakly exogenous and not weakly endogenous. Based on this empirical result, this implied that the K-economy components in the commercial banks had not reached its sufficient stage in order to reap the knowledge spillover as what Romer (1990) explained. Secondly, in the neo-classical model, training expenditure was found to be significantly increasing the cost inefficiency. Hence, the commercial banks should review the relevant training needed to upgrade the knowledge and skills of their employees in order to be able to further decrease cost inefficiency. Thirdly, ICT expenditure was also found to be significantly reducing the bank cost inefficiency. Last but not least, the bank size contributed to the increase ofcost inefficiency during the transition period of banks consolidation process. However, size factor could be a very important factor to future banking cost efficiencies as increasing SIZE, after the consolidation process has settled, would help the banks to achieve economies of scale, and, thus, enjoy improvements in cost efficiency.

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