Financial Inclusion and Bank Efficiency

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Abstract: This paper uses stochastic frontier analysis to examine whether the impact of financial inclusion on bank efficiency. Using an international sample of 2,207 banks in 70 countries over period 2008-2016. We found that increasing financial inclusion using technology more effective in terms of cost for banks comparable to conventional methods. More specifically, we find that financial inclusion on access dimension proxied by ATM per 1,000 km^2 have a negative relationship with cost inefficiency, while branch per 100,000 adults has a positive relationship with cost inefficiency. Moreover, we find evidence that financial inlusion on used dimension proxied by deposit accounts per 1,000 adults show that positive effect on cost efficiency. These findings show that financial products and services are innovation based on technology must be improved. Technological innovation is key implication for policy makers, bank regulators, and industry players to create more financial inclusiveness for people.

1 INTRODUCTION

Expanding formal financial access to low-income has become an important concern for many countries worldwide, World Bank state on Demirguc-Kunt et al., (2015), more than two-thirds of regulatory and supervisory institutions have been tasked with encouraging financial inclusion in more than 50 countries. It makes sense because many studies state that the financial sector has a positive impact on the economic growth and stability of developing countries (Paşali, 2013) Other studies found that by removing barriers to access to formal finance would increase funding. (Allen, 2012). This can be a source of financing for people who have not accessed to finance for consumption activities or business purposes, which will increase the economy due to the creation of employment (Guiso, Sapienza and Zingales, 2004; Allen et al., 2012; Banerjee et al., 2015). Hence, reduce income inequality and indirectly decrease poverty (Burgess and Pande, 2005; Beck, Demirgüç-Kunt and Levine, 2007; Bruhn and Love, 2014)

In the other perspective, banks as financial institutions also required maintaining sustainability and efficiency in order to cover the costs has been incurred, especially increasing competition and technological developments encourage banks to change their behavior and to expand their services and activities. Furthermore, the question that arises is how to affect financial inclusion on bank efficiency.

We use Stochastic Frontier Analysis to analyses impact financial inclusion on bank efficiency in 70 countries period 2008-2016. For measure financial inclusion, we used two dimensions: the first concerns the outreach or access to financial services while the second relates to the use of financial services The findings show that ATM density and deposit bank accounts have a positive impact on cost efficiency while Branches have negative relations with cost efficiency. This suggests that increasing financial inclusion using technology more effective in terms of cost for banks comparable to conventional methods.

This study contributes to both the existing literature by providing new evidence on the impact of financial inclusion on bank cost efficiency using an international sample. Many studies have been done on the effect of financial inclusion on economic growth(Paşalı, 2013), poverty (Bruhn and Love, 2014), unemployment (Beck, Demirguc-Kunt and Martinez Peria, 2007). A Very limited study has been done on the relationship between financial inclusion and bank performance. We suggest improving financial inclusion using technology will

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improve bank efficiency. This study examine impact financial inclusion on banks' efficiency, thus adding a new perspective and enrich upon earlier works on relative efficiencies determinant and financial inclusion literature. We highlight the impact of financial inclusion on the relative bank cost. This paper structured as follows, Section 2 provides a brief overview of financial inclusion, Section 3 presents the data and methodology, Section 4 provides Result and last section 5 Conclusion.

2 THEORICAL FRAMEWORK

2.1 Financial Inclusion

There are several concepts offers in defining financial inclusion, for example, Amidžić, Massara and Mialou (2014), state financial inclusion is an economic environment where individuals and firms are not denied access to basic financial services. Sarma (2016) defines the process that ensures the ease of access, availability and usage of the formal financial system for all members of an economy. Many studies suggest that financial inclusion have positive impact on economic development and poverty reduction. For instance Beck, Demirguc-Kunt and Martinez Peria (2007), find that Increasing degree of financial inclusion have social and economic benefit.Supported by Bruhn and Love, (2014) showing that greater financial inclusion reduces poverty, income inequality and unemployment. This confirmed by Allen *et al.*, (2012), found that increased bank penetration of commercial banks has a positive and significant impact on household's use of bank accounts and bank credit particularly those with low income, no salaried job, and less education in Kenya

For measurement studies, financial inclusion can be understood through two broad dimensions: The first concerns the outreach or access to financial services while the second relates to the use of financial services (Beck, Demirguc-Kunt and Martinez Peria, 2007; Amidžić, Massara and Mialou, 2014). Focusing on outreach dimension refers to ability customer to easily reach access to bank physical outlet. Data from the World Bank's Global Financial Inclusion Index (Findex) survey reveal that of the 2.5 billion individuals excluded from financial systems globally, about 20 percent cite the long distances to reach access financial service as the prime reason for not having an account with a formal financial institution (Allen *et al.*, 2012). The literature suggests some proxies that commonly to capture outreach or access dimension are Automated Teller Machines (ATM) per million people and a number of bank Branches per million people. other indicators of banking sector outreach have been used geographic Automated Teller Machines (ATMs) per 1,000km2 and number of bank Branches per 1,000km2 (Beck, Demirgüç-Kunt and Levine, 2007; Ahamed *et al.*, 2017; Sarma, 2016; Gopalan and Rajan, 2018). Higher branch and ATM intensity in demographic and geographic indicate that greater access to financial services by households and enterprises (Gopalan and Rajan, 2018). Viewed from the perspective cost, ATMs are much more cost-effective and require the least amount of investment commitment relative to establishing bank branches or allowing deposit-taking functions (Damar, 2006).

We use ATM per 1,000km^2 and bank branch 100,000 adult to capture outreach dimension (Beck, Demirgüç-Kunt and Levine, 2007; Allen *et al.*, 2016; Sarma, 2016; Gopalan and Rajan, 2018). For usage dimension of financial inclusion we employs a number of deposit accounts per capita defined as the number of deposit account per 1,000 people.

2.2 Bank Efficiency and Financial Inclusion

The existing literature on the performance analysis of banks classified into several types: financial ratio(Ou *et al.*, 2009) , SFA approach ((Fries and Taci, 2005; Abdul-Majid, Saal and Battisti, 2011; Alexakis *et al.*, 2018), DEA approach (Berger, Hasan and Zhou, 2010; Mobarek and Kalonov, 2014; Giordani and Floros, 2015). We use SFA measure efficiency. This model allows us to control for environmental factors by simultaneously estimating the parameters of the stochastic frontier and the inefficiency model, based on the assumption that efficiency differences between banking industries are determined by financial inclusion, macro indicator and bank-specific characteristics variables. We found that there was lack literature that discussed financial inclusion and efficiency, even though the literature that discussed directly analyzing costs efficiency and financial inclusion did not yet exist, but there were several studies that had examined them separately. (Ou *et al.*, 2009) investigating impact of ATM intensity on cost efficiency in Taiwan show that ATM intensity shows that ATM intensity positively impacts banks' cost efficiency. But different result also evidence by (Damar, 2006) Using a Data Envelopment Analysis (DEA) approach The find that participation in shared ATM networks has failed to increase efficiency of small and medium-size banks in turkey. However, these studies do not include for any financial inclusion with many dimension directly in the estimated costs function or as directly influencing inefficiency. Our model below will improve on this earlier study by including for such usage and service

or outreach dimension of financial inclusion and considering their impact on cost efficiency.

3 RESEARCH METHOD

The study uses unbalanced panel data included 70 countries from 2008-2016, which consist of 14091 observations, obtained from 2606 CBs and 55 IBs. All data on the bank's financial statements collected from Bureau van Dijk and Fitch Ratings (Abdul-majid, Saal and Battisti, 2010; Ahamed *et al.*, 2017).The macro data compiled from the World Development Indicators (WDI) World Bank. The variables used to measure financial inclusion compiled from the IMF FAS database (Sarma, 2016; Kim, Yu and Hassan, 2017).

In our analysis, we estimate cost efficiency and measure impact financial inclusion on cost efficiency. For cost efficiency, the frontier is defined by the potential minimum cost, and the actual cost lies above the minimum frontier owing to inefficiency, inefficiencies are measured in comparison with an efficient cost frontier. Most studies on cost efficiency use data envelopment analysis (DEA) or stochastic frontier analysis (SFA) to calculate this frontier. As a significant number of previous bank studies have adopted a cost function approach (Ferrier and Lovell, 1990; Fries and Taci, 2005; Abdul-Majid, Saal and Battisti, 2011). A single equation stochastic cost function model described as:

$$\ln C_{it} = \ln C(Y_{it}, W_{it}, \delta_{it}; B) + u_{it} + v_{it}, \; i = , \dots . , N, \mathrm{t} = , \dots , \mathrm{time}$$

Where C is the observed cost of bank$i$ time t, Y_{it} is a vector of output, W_{it} is a vector of input prices i, B is a vector of parameters to be estimated and δ_{it} is a vector of control variables that include bank-specific variables which are added to the model as they may explain part of the efficiency differences between banks. Next, v_{it} is a two-sided error term representing the statistical noise, while u_{it} represents non-negative variables that account for inefficiency, for both assumed to be independently and identically distributed.

Maximum-likelihood estimates are obtained by estimating a multiproduct translog cost function. The specified cost function including environmental variables can be written as:

$$\begin{aligned}\ln TC_{it} = \; & \alpha_0 + \sum_{m=1}^{M} \alpha_m \ln y_{mit} + \sum_{n=1}^{N} \beta_n lnw_{nit} \\ & + \frac{1}{2}\sum_{m}\sum_{k} \alpha_{mk} \ln y_{mit} \ln y_{kit} \\ & + \frac{1}{2}\sum_{m}\sum_{k} \beta_{nj} lnw_{nit} lnw_{jit} \\ & + \sum_{m}\sum_{k} ln\, \chi_{mn} lny_{mit} lnw_{nit} \\ & + \theta_0 t + \frac{1}{2}\theta_{00} t^2 \\ & + \sum_{m} \varphi_{mt} \ln y_{mit} t \\ & + \sum_{m} \rho_{nt} lnw_{nit} t + \sum_{m} \zeta_{nt} Z_{qit} \\ & + \varepsilon_{it}(u_{it} + v_{it})\end{aligned}$$

Where,

$$w_{nit} = \frac{P_{nit}}{w_{nit}} \text{ and } TC_{nit} = \frac{TC_{nit}}{w_{nit}}$$

Where $\ln TC_{it}$ is is the observed total cost of firm i, y_{mit} is the m-th output, ln w_{nit} is n-th input price, Z_{qit} represent other explanatory variable that effect the total cost, T is a time trend that capture for technological change and $\alpha, \beta, \chi, \theta, \varphi, \rho$ and ζ is parameter to be estimated . The components of composite error term $\varepsilon_{it}(u_{it} + v_{it})$ u_{it} capture cost inefficiency and v_{it} is a random error. The cost function is assumed to be non-decreasing, linearly homogenous and concave in input prices, which is satisfied if each of the β_n is non negative they combine to satisfy the homogeneity constraints, $\sum_{n=1}^{N} \beta_n = 1$ We simplify by imposing symmetry constraints, $\alpha_{mk} = \alpha_{km}$ and $\beta_{nj} = \beta_{jn}$.

Measurement of cost efficiency requires data on total costs, outputs and input prices. The dependent variable is total cost (TC), which includes both interest and operating costs, bank outputs as loans for conventional banks or financing for Islamic banks (Y_1) and other earning assets (Y_2) . While input included price of funds (w_1) equals total interest expenses on deposit and non-deposit funds divided by total deposit, price of labour (w_2) equals total expenditure on employee, such as salaries and allowances over total asset. Price of capital (w_3) equal other operating expenses over fixed asset.

Furthermore, we included bank specific variable, used profitability measured by the Return on Average Equity (ROAE) (ζ_1), loan quality (ζ_2) measured by the ratio of non-performing financing or loans to total financing for Islamic bank and total

loan for conventional bank (Abdul-majid, Saal and Battisti, 2010). Furthermore, we use Islamic bank dummy (ζ_3) to capture differences in bank characteristics and operating environment that may influence costs.(Abdul-Majid, Saal and Battisti, 2011; Alqahtani, Mayes and Brown, 2016)

To investigate the factors that are correlated to bank inefficiencies(u_{it}) , we use the single step estimation of the cost function and inefficiency function. The inefficiency component (u_{it}) is assumed to be a function of set of explanatory variables δ_{it} and a vector of coefficients (λ) to be estimated. In other words:

$$u_{it} = \lambda\delta_{it} + \omega_{it}$$

There are several variables included in our model that variables grouped into two categories. The first category is the macroeconomic condition and consists measured by GDP growth(δ_1) and individual using internet per % of Population (δ_2). This variable explains the macro conditions under which the bank operates. We suggest that it will help facilitate financial inclusion, in general play a critical role in improving efficiency.(Thompson and Garbacz, 2007; Gopalan and Rajan, 2018). We expect to help to reduce cost inefficiency.

The second category is financial inclusion, included two dimensions: the first concerns the outreach or access to financial services measured by automated teller machines (ATMs) per 1,000km^2 (δ_3) and a number of bank branches 100,000 adult (δ_5) (Beck, Demirgüç-Kunt and Levine, 2007; Amidžić, Massara and Mialou, 2014) We suggest that ATM density have negative impact on bank inefficiency

Next, several studies have identified branch expansion as a negative factor for bank efficiency as it can lead to cost increases, particularly with respect to employees and fixed assets (Bernini and Brighi, 2017). Further, geographical distance between branches and head office is also identified in the literature as a negative factor for the efficiency of banks due to higher informational and agency costs (Bikker and Bos, 2008).We expect branch density have positive impact on cost inefficiency.

While the second relates to the use of financial services proxied by deposit account per 1,000 adult (δ_7) (Sarma, 2016; Gopalan and Rajan, 2018) . Bank collects deposits and makes it a source of funding to loans and investment. Han and Melecky (2014) found that financial inclusion will provide banks new sources of funds more cheaper and more insensitive to risk.Poghosyan and Čihak (2011) also confirm that banks depending extensively on wholesale funding are more exposed to distress than those banks that are mostly depending on retail deposits.

Table 1: Descriptive statistics for sample Bank, Macro and Financial Inclusion Indicator, 2008–2016

Symbol	Variable	Mean	SD	Min	Max
TC	Total Cost (US $,million)	2503.484	11064.68	0.09	169702
	Bank Output				
Y_1	Loans (US$, million)	38448.9	190276	0.84	2700000
Y_2	Other earning Asset (US$, million)	21077.5	94348.9	0.45	1600000
	Cost of bank inputs				
W_1	Price of deposit (US$, million)	0.062	0.0977	0.000091	0.985
W_2	Price of labor (US$, million)	0.0207	0.029	2.30E-06	0.802
W_3	Price of physical capital (US$, million)	0.064	0.0923	0.0054	1.26
	Bank-Specific Variable				
ζ_1	ROAE (US$,	0.063	0.375	-26.34	6.49

	million)				
ζ_2	Islamic Bank dummy	0.132	0.114	0	1
ζ_3	Loan quality (US $, million)	0.074	0.102	0	1
	Macro Indicator				
δ_1	GDP growth	2.74	3.556	-12.71	25.56
δ_2	Individual Using Internet per % of Population	51.56	24.74	1.26	97.3
	Financial Inclusion Indicator				
δ_3	Bank branches per 100,000 adults	68.6	42.236	2	168
δ_5	ATM per 1,000 km^2	24.45	28.6	0	112
δ_7	Deposit accounts per 1,000 adults	55.79	36.17	5	187

Source : data bank scope and Fitch rating

Number of observation	14,091	
LR test	737.1***	

4 FINDING

Table 2: Maximum Likelihood Estimates : 2008-2016

Coefficient	Estimated Value	SE
GDP growth	-0.083***	0.010
Ln Individual Using Internet per % of Population	-0.495***	0.079
Bank branches per 100,000 adults	0.006***	0.002
Country with Islamic Bank (Dummy) * Bank branches per 100,000 adults	0.031***	0.011
ATM per 1,000 km^2	-0.092***	0.007
Country with Islamic Bank (Dummy) * ATM per 1,000km^2	-0.123**	0.052
Deposit accounts per 1,000 adults	-0.840***	0.093
Country with Islamic Bank (Dummy) * Deposit accounts per 1,000 adults	-0.045***	0.009
Constant	2.585***	0.365
Log likelihood	-6861.07	

Table 2 shows the maximum likelihood in analyzing the effect of financial inclusion on bank efficiency, for GDP growth (δ_1), has a negative and significant impact on banks' inefficiency. Our results are in line with previous studies (Fries and Taci, 2005) who has a negative relation on banks' cost inefficiency. Higher GDP growth stimulates investment which increase the volumes of banking business in terms of traditional loan-deposit services and non-interest generating activities reduces bank costs and leads to an improvement in bank efficiency. Internet (δ_3) has negative sign, this result indicate technology shift reduce cost and make operational activities more efficient.

Bank branches per 100,000 adult (δ_3), has positive with bank cost inefficiency its means the growth in the number of branches in the banking network will significantly increase costs. In line with (Ou *et al.*, 2009; Bernini and Brighi, 2017).Indicate establishing a full-service branch requires more costs for work and operating activities, besides that a branch has a limited time for operations

The coefficient of ATM per 1,000 km^2 (δ_5) is negative significant to bank inefficiency. A higher ATM per 1,000 km^2 indicates greater substitution effect onto the labor force. Strengthen by previous finding(δ_3) ATMs may overcome the restrictions of traditional branch offices such as limited hours,

finite banking sites, lower productivity, and slow processing speed. Thus, banks with a considerable human capital are facing pressures to improve operating efficiency and reduce cost. Support by Berger, Hasan and Zhou (2010), examines the economic effects on technological progress of the US banking industry. He argues that advances in IT appear to have increased productivity and economies of scale in processing electronic payments and reduce cost significantly.

Deposit account per 1,000 adults (δ_7), have negative correlation with bank inefficiency because an inclusive financial sector banks will have greater access to a large pool of customer deposits, leading to less volatile customer deposit funding for banks. More stable customer deposit funding should have a positive effect on bank operating efficiency. Supported by (Han and Melecky, 2014), inclusive finance will provide banks with the opportunity to get cheaper funding from previously untouched sources of funds, in addition to retail funding cheaper and more insensitive to risk. The lower coefficient Deposit account per 1,000 adults in Islamic banks-countries (δ_6 δ_8) indicate an increase in deposit accounts expanding with Branch is relatively more costly than other banks. This happens because Islamic banks are new in the market and have limited equity to make expansion beside that Islamic bank are limited in term investment and expertized make costly. Similar with Alqahtani, Mayes and Brown (2016), who empirically reviewed the operational activities of the Islamic Finance. The IF institutions operate cost efficiently, whereas conventional banking is more cost efficient in dual banking countries where there is no significant difference between business orientation and stability

5 CONCLUSIONS

This study uses Stochastic Frontier Analysis to investigate the impact of financial inclusion on bank cost efficiency using an international sample of 2,207 banks in 70 countries for the period 2008-2016. The results show that the dimensions of services proxied by ATMs per 1,000 km2 have a negative relationship with the efficiency of bank costs, while branches of 100,000 adults have a positive relationship with the inefficiency of bank costs. this is because for establishing a full-service branch requires more costs for employee and operations. furthermore, a Negative relationship between ATMs and inefficiencies shows a greater substitution of the effect of labor use. For the dimensions of use proxied by deposit accounts per 1,000 adults shows a negative relationship with this inefficiency indicates the higher use of financial services can reduce bank costs due to increased bank funding sources

Greater financial inclusive environment give more opportunities banks have access to funding that is cheaper and more stable from customer deposits that were previously untouched. This gives an advantage to banks to run efficient operational activities, besides the use of technology such as ATM is helpful in increasing productivity so that further technological innovation is needed to further optimize the bank's performance.

Considering the evidence that impacts financial inclusion on cost efficiency. there are two important goals for the governments and financial institutions. First, policymakers should introduce more competition in the banking system, raising financial infrastructure and enhancing the efficiency of the legal system to promote better financial inclusion considering the numerous benefits that can be obtained. Second, financial products and services are innovations based on technology must be improved which improves productivity and cost efficiency. These steps will have a positive impact on financial inclusion, which in turn can promote economic development. For future research, we recommended using a multidimensional index of financial inclusion to measurement financial inclusion and using more dimension to view on another perspective to continue this research.

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