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Putu Natih

Trinity College, Oxford University., putu.natih@trinity.ox.ac.uk

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Technical Efficiency Levels of Rural Banks (BPRs) in West Java: A Stochastic Frontier Approach

Putu Geniki Lavinia Natih^{a,*}

^aTrinity College, Oxford University

Abstract

There is considerable evidence from around the world to support the idea that access to formal financial services is a key factor towards achieving poverty alleviation. The government of Indonesia has placed high importance on the issue of improved access to financial services and one feels that it would be appropriate to begin the process of analyzing effective financial inclusion initiatives with the existing *Bank Perkreditan Rakyat* (BPR) system. BPRs have long been an integral part of Indonesia's financial, economic, and social development. This research is focused on BPRs in West Java. In this research, the writer evaluates BPR performance within twenty-five districts in West Java, by measuring the technical efficiency levels of the BPRs through employing the Stochastic Frontier Approach (SFA). The district that has the highest BPR average inefficiency score is Bandung city and the district with the lowest average BPR inefficiency score is the district of Ciamis. Increases in bank concentration (indicated by the Hirschman-Herfindahl Index) and income per capita are shown to decrease BPR inefficiency levels. Increases in the percentage of the population under the poverty line, the percentage of the labor force with a high school education, the percentage of road length per area, and the amount of bank offices per district, increase the inefficiency levels of BPRs. Overall, it is found that BPRs cannot operate efficiently in areas which are too underdeveloped; neither can they operate efficiently in areas which are too well developed.

Keywords: Bank Perkreditan Rakyat (BPR); West Java; Technical Efficiency; Stochastic Frontier Approach (SFA)

Abstrak

Terdapat bukti substantif pengalaman berbagai negara di dunia bahwa akses pada jasa finansial formal adalah faktor kunci dalam upaya pengentasan kemiskinan. Pemerintah Republik Indonesia telah menempatkan upaya peningkatan mutu dan akses jasa finansial bagi masyarakat Indonesia, sebagai salah satu kebijakan utama dalam pengentasan kemiskinan. Tulisan ini bertujuan untuk membahas dan menganalisa efektivitas badan-badan penyedia jasa finansial di Indonesia, sebagai starting-point dengan memulai analisa efektivitas jasa finansial yang diberikan oleh Bank Perkreditan Rakyat (BPR). Penelitian ini difokuskan kepada BPR di Jawa Barat. Penulis mengevaluasi performa BPR pada 25 kabupaten/kota di Jawa Barat, dengan mengukur tingkat efisiensi teknis melalui metode Stochastic Frontier Approach (SFA). Kota tempat BPR yang memiliki rata-rata in-efisiensi tertinggi adalah Kota Bandung dan Kabupaten dengan in-efisiensi rata-rata BPR-nya yang terendah adalah Kabupaten Ciamis. Peningkatan dalam konsentrasi perbankan di sebuah kabupaten/kota (terindikasi Hirschman-Herfindahl Index) dan peningkatan pendapatan per kapita pada kabupaten/kota tersebut terbukti menurunkan tingkat inefisiensi BPR. Sebagai kesimpulan utama, ditemukan bahwa BPR tidak dapat beroperasi secara efektif pada area yang sangat underdeveloped dan juga tidak dapat beroperasi efektif pada area yang sangat developed.

Kata kunci: Bank Perkreditan Rakyat (BPR); Jawa Barat; Efisiensi Teknis; Stochastic Frontier Approach (SFA)

JEL classifications: D; L1; L2; G; G2

1. Introduction

* Corresponding Address: Broad Street OX1 3BH, Oxford
Telephone: +447447 591015. E-mail: putu.natih@trinity.ox.ac.uk.

There is considerable evidence from around the world to support the idea that access to formal

financial services is a key factor towards achieving poverty alleviation. With reference to Indonesia, Yoko Doi (2010), a financial specialist at the World Bank in Jakarta, said 'The G20 recently stressed the importance of financial inclusion and Indonesia, as a member of the G20, has an opportunity to lead the world in demonstrating how financial inclusion can change millions of lives'.

Boudreaux & Cowen (2008) state that, through microcredit operations, the world's poor could have easy access to loans and many other financial services, thus enabling them to take control and have power over their own lives. Micro-finance institutions would give their borrowers, who are mostly people with incomes under the poverty line, the experience of being trusted and valued by a formal institution. By empowerment through availability of credit services, the poor would go from being invisible actors in the economy to being included as valuable economic agents of their countries.

The concept of microfinance is not new to Indonesia, but is in fact, a part of life in this country. Indonesia's history of rural finance institutions dates back to the 19th century when the early Volksbank (People's Bank) and Afdeelingsbank (District Bank) were introduced by the Dutch colonial administration. After independence, different kinds of rural financial institutions continued and many new ones were developed – rural banks, village banks, market banks, people's banks etc. (Robinson 2002). Such banks were known as *Bank Perkreditan Rakyat* (People's Credit Bank or BPR).

As we can see from this brief historical survey, the BPRs have long been an integral part of Indonesia's financial, economic, and social development. The government of Indonesia has placed high importance on the issue of improved access to financial services and one feels that it would be appropriate to begin this process with the existing BPR system (World Bank 2010). By fine-tuning the BPRs we would also be honouring the legacy of our forefathers.

Surveys conducted by the World Bank show the latest statistics (2009) on the share of the Indonesian population with formal financial access. This is expressed in Figure 1.

In Indonesia, those who have access to formal financial services represent approximately half of the population. As we can see from Figure 1, In-

donesia's position is better than countries such as China, Pakistan, the Philippines and Bangladesh. However, countries such as Sri Lanka, Thailand, and Malaysia, are clearly in a better position. This data shows that Indonesia still needs much improvement.

When we look at Figures 2 and 3, with regard to Savers' Financial Inclusion and Borrowers' Financial Inclusion, we see that there is great potential for development in the area of improved financial access for Indonesia's population. Figure 2 shows that less than half of Indonesians save at banks. Excluding savers within 'other formal institutions' and 'informal institutions', 32% of potential savers are still 'financially excluded'. Figure 3 below shows that only 17% of Indonesians borrow from banks. Excluding the population using services from 'semi-formal' and 'informal' credit options, approximately 40% of the population is completely 'financially excluded' from credit (Nenova, Niang, & Ahmad 2009).

Following this brief overview of financial inclusion within Indonesia, we will now turn to West Java and the reasons for choosing this particular province as the focus of the writer's research.

West Java is the province in which, Indonesia's capital city of Jakarta, is situated. This may result in spillovers from the capital city, particularly in relation to banking activities in West Java; i.e. there will be areas in West Java where there is likely to be an active banking system that could be of value for the writer's research. Other than this, there exists a significant dichotomy between low income and high-income districts in West Java. This may provide a useful reflection of the overall situation in Indonesia, a nation where the gap between low and high-income citizens is clearly evident. Other supporting arguments for choosing West Java are presented below.

From the recent Central Bureau of Statistics (*Badan Pusat Statistik, BPS*) 2010 survey, we find that 57.48% of Indonesia's total population lives in Java and that 31.5% of the population in Java lives in West Java. More specifically, 18.12% of Indonesia's total population live in West Java. From these statistics, we can see that nearly 20% (one fifth) of Indonesia's vast population of nearly 230 million people in 2010 is concentrated in the province of West Java.

Regarding statistics on poverty levels, in 2010, we

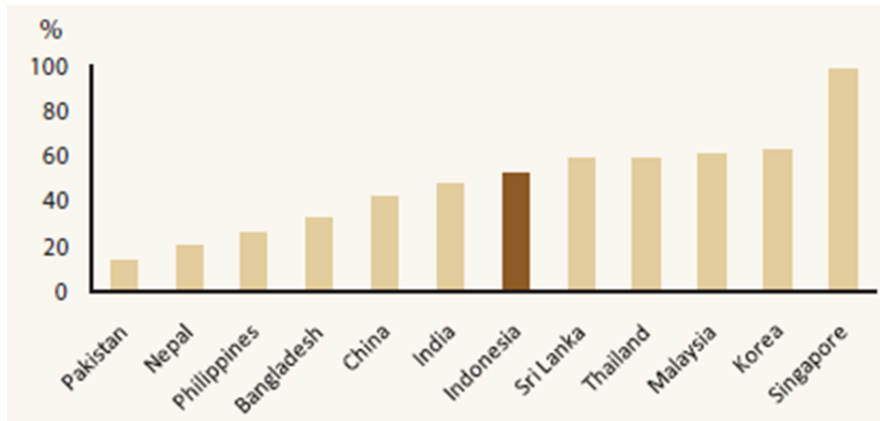


Figure 1: Share of the Population with Formal Financial Access

Source: Nenova, Niang, & Ahmad (2009)

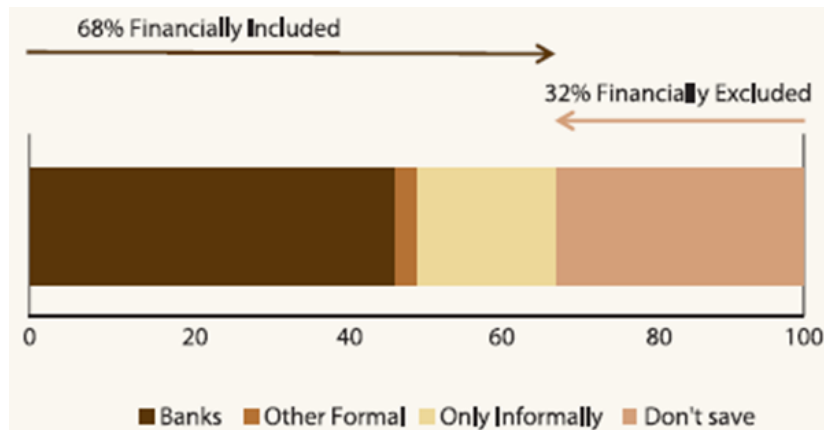


Figure 2: Savers' Financial Inclusion

Source: Nenova, Niang, & Ahmad (2009)

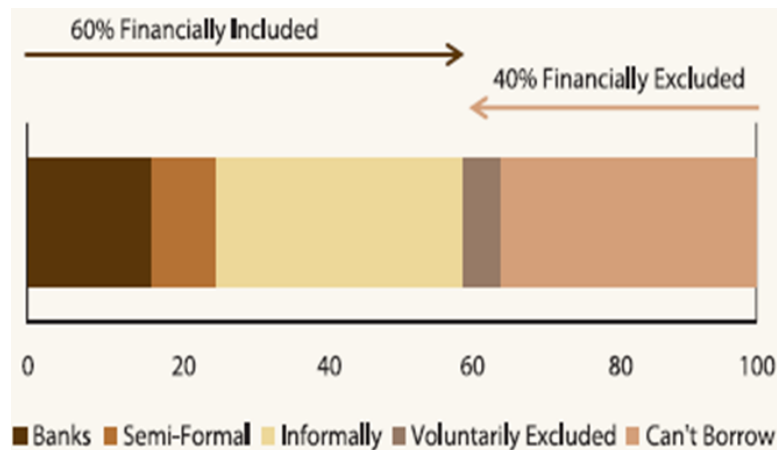


Figure 3: Borrowers' Financial Inclusion

Source: Nenova, Niang, & Ahmad (2009)

find that 55.83% of the Indonesian population under the poverty line live in Java and specifically, 15.39% of the total population under the poverty line in Indonesia live in West Java. This seems ironic, as West Java is a relatively small area when compared to the vastness of Indonesia, with West Java covering only 1.83% of Indonesia's total area¹.

Although these statistics paint a bleak picture of the composition of the population in Indonesia, specifically West Java, perhaps this situation can be seen as an opportunity for the BPRs; the people of West Java clearly need the services provided by the BPRs.

It is precisely because of the population density in the province of West Java that the writer has chosen it for the focus of this research. With limited time and resources, the writer has chosen West Java as a starting point and hopes that further research on other provinces of Indonesia will develop out of this initial research project.

The BPRs and other small financial institutions offer great potential and promise to borrowers and savers in the near- to medium-term. These types of institutions are often on the frontline of the delivery of financial services to medium small enterprises and to poorer households, including those in very remote parts of Indonesia.

BPRs play an important role in providing access to financial services for lower income clients. In recent years, much progress has been made in consolidating information on the role of BPRs. However, a great deal still needs to be done to improve the operation of these institutions. It is with this in mind that the writer of this paper seeks to examine the factors effecting the efficiency of BPR operations and how best to make improvements.

When we look at a firm or an organization, private or public, we are often interested to know how well it is doing. One of the ways of evaluating the performance of a firm or productive entity is through benchmarking, the systematic comparison of the performance of one firm against other firms which transform the same type of resources to the same type of products and services (Coelli et al. 2005). The term 'production entities' can refer to firms, organizations, industries, projects, decision-making

¹Indonesia's total area comprises 1,890,754 km² and of that West Java accounts for 34,597 km² (Central Bureau of Statistics 2005)

units, individuals, or in the case of this research, banks (BPRs).

Benchmarking can be used to make longitudinal, panel, or dynamic comparisons, where the performance of one or more firms in different time periods can be compared. It is a method that is particularly appropriate for the writer's research, as comparisons of BPR performance within districts of West Java and within the time period of 2006 to 2010 form the main body of the research on BPR efficiency levels in the said province.

The benchmarking method that will be used in this research is the Stochastic Frontier Approach (SFA). By employing the SFA, the writer will be able to find individual BPR inefficiency scores and compare them to each other. Inefficiency measures are indicators of success by which the performance of individual BPR branches and the program of the BPR as a whole can be evaluated.

Farrell (1957) proposed that the efficiency of a firm consists of two components: 'technical efficiency', which reflects the ability of a firm to obtain maximal output from a given set of inputs, and 'allocative efficiency', which reflects the ability of a firm to use the inputs in optimal proportions, given their respective prices and the production technology. In this research, the writer will choose to measure technical efficiency, because the focus of the research is to analyse internal managerial decisions made by BPRs. Allocative efficiency measures the effects of external macroeconomic factors and regulations that affect BPR production decisions and the availability of inputs to the BPRs. The writer wishes to focus on the micro aspects of BPR operations, as opposed to macro concerns, and the measure of technical efficiency serves this purpose. Technical efficiency level comparisons of BPRs in West Java will be of considerable interest to economists and politicians since the development of productivity and the inducement of cost-efficiency are key factors in bringing about welfare improvements.

It is hoped that the results of this paper will enable us to determine which factors are important in improving the efficiency of such financial institutions, and under what conditions such institutions are sustainable. The information obtained from this study can be used to aid bank managers, government regulators, and investors. Policy makers may draw conclusions about how to make inefficient institutions economically viable.

Through analysing the BPR's cost function and technical inefficiency levels, the writer hopes to shed light on the areas which the government can learn from and support. If not providing funds, the government could implement policies to protect and promote the livelihood of the BPRs. Ultimately, it is hoped that this cost efficiency analysis of BPRs as micro-finance institutions, will lead to significant policy implications and towards government and organizational support.

The next section, Section 2, of this paper will cover the data and methodology used within this research. Section 3 will then discuss the results of the analysis. The fourth and final section will conclude with a summary of the regression results, policy recommendations and a sub-section on the limitations of this research.

2. Method

2.1. Data

This research will analyse quarterly data on financial statements from a sample of 93 BPRs in West Java, which are reported to the Bank of Indonesia and are available on the Bank of Indonesia website. The analysis will be conducted for the period of 2006–2010. West Java environmental data will be taken from various reports made available by the Indonesian Central Bureau of Statistics (*Badan Pusat Statistik*, BPS).

In this research, the intermediation approach will be used to represent banking activities and to determine bank inputs and outputs. In the intermediation approach, outputs are considered as 'banking activities that produce a flow of banking services connected to labour or physical capital expenditure' (Fries & Taci 2005, p. 55-81). Elyasiani & Mehdi (1990) argue that the intermediation approach is more inclusive of total banking costs because the interest expenses associated with deposits are not excluded.

With the considerations above in mind, the writer uses the sum of non-operational expenses and operational expenses (including interest expenses) as total costs, and total credit disbursed by the BPRs, as the output resulting from BPR intermediary activities.

Ideally, both labour and capital input prices should be considered in determining the total cost function of BPRs in West Java, but since bank-level data from financial reports of the BPRs does not include comprehensive data on the number of employees working in each bank, it is not possible to determine the price of labour employed by the BPRs in West Java. Therefore, the writer will use the ratio of personnel cost expenses to total assets, as the best available proxy of the price of labour. For the price of physical capital, the writer will use the ratio of other operating expenses to total assets, as a proxy. This proxy for the price of labour was also formerly used by Hasan & Marton (2003), Fries & Taci (2005), and Jiang & Zhang (2009) in their research papers on banks in transitional economies.

2.2. Methodology

The empirical analysis of this research will proceed in two steps. First, the writer will specify and estimate a composite error model. This model separates firm-specific effects, reflected by the one-sided error term (U_{BPR}), from random shocks and statistical noise, reflected by the symmetric error term (V_{BPR}), and permits the estimation of firm-specific, deviations using the method of Aigner, Lovell, & Schmidt (1977), which was later perfected by Jondrow et al. (1982).

In the second step, the writer will evaluate the role of some non-discretionary observable inputs (for example, the total population and district income) by specifying an econometric model that regresses the inefficiency scores resulting from the cost frontier estimation in the first step of the analysis, onto a set of non-discretionary inputs or their proxies. By including non-discretionary variables in the second stage of the regression, the writer hopes to be able to somewhat parameterize policy factors effecting BPR technical efficiency levels.

2.2.1. The First Stage Model: Measuring Technical Inefficiency Scores

To measure the technical inefficiencies of individual BPR branches in West Java, the writer of this research will use the stochastic cost frontier, first developed by Aigner, Lovell, & Schmidt (1977), and Meuseen & Broeck (1977). The writer will calculate

and measure inefficiency levels for each BPR in the sample. These technical inefficiency scores will then be used as dependent variables in the second step of the regression model in order to analyse the determinants of BPR inefficiency.

Following Aigner, Lovell & Schmidt (1977) and Meuseen & Broeck (1977), a firm's (in this research, a BPR's) observed total cost is modelled to deviate from the cost-efficient frontier due to random noise and possible inefficiency. For BPRs referred to in this research, the total cost function per bank can be written as,

$$TC_{it} = f(Q_{it}, P_{jit}) + e_{it}, \text{ where } i, t = 1, \dots, n \quad (1)$$

where:

TC_{it} : BPR i 's total costs at time t ,

Q_{it} : BPR i 's total output at time t ,

P_{jit} : the price of the input j used by BPR i in the production of the products or services at time t ,

e_{it} : a random disturbance term which allows the cost function to vary stochastically; it reflects uncertainty regarding the level of total costs that will be incurred for given levels of production, and is broken down into the following equation:

$$e_{it} = V_{it} + U_{it} \quad (2)$$

where:

V_{it} : representing the random uncontrollable factors that affect the Total Cost of the BPRs (such as weather, luck, machine performance, and the economic or political business environment). These factors and their impact on costs are assumed to be independent of each other. They are identically distributed as normal variables and the value of the error term in the cost relationship is, on average, equal to zero (Hassan & Tufte 2001).

U_{it} : representing the BPR specific cost deviations which are due to factors that are controllable by the BPR management. Such factors include the quantity of labour, capital, or other inputs employed by the BPRs in their production process. Managerial controllable factors also include the amount of products and services that the BPRs have chosen to produce.

The writer uses a cost function, as opposed to a profit function because some of the BPRs included

in this research recorded negative profits. This is of concern because negative profits would be problematic as the natural logarithms of the dependent and independent variables are needed for specification.

The Stochastic Cost Frontier model maintains that managerial or controllable inefficiencies only increase costs above the frontier or best practice levels, and that the random fluctuations or uncontrollable factors can either increase or decrease costs. Since uncontrollable factors are assumed to be symmetrically distributed, the frontier of the cost function, $f(Q_{it}, P_{jit}) + e_{it}$, is clearly stochastic. Thus, the Stochastic Frontier Approach, incorporates a two-component error structure – one being a controllable factor and the other a random uncontrollable component.

All monetary variables have been deflated by their corresponding per month, per district CPI to the 2007 price levels, to control for inflation effects².

To estimate the error term in the cost function represented by Equation (2), and to calculate each BPR branch's efficiency index, the writer estimates a stochastic frontier Cobb-Douglas cost function. Instead of choosing a more flexible functional form, the writer has chosen the Cobb-Douglas cost function because it is found to fit firm data from developing countries (Hassan & Tufte 2001). The simplicity of the Cobb-Douglas cost function that assumes Constant Returns to Scale production, rightly summarizes the characteristics of production within an organization in a developing country (Hassan & Tufte 2001).

2.2.1.1 Estimating the Stochastic Cost Frontier and BPR Technical Inefficiency Levels

BPR inefficiency scores will be estimated using the Stata 11 statistical program. To estimate the cost frontier of the BPRs according to the cost function expressed by Equation (1), the writer will use the *xtfrontier* statistical command. *xtfrontier* can fit both production- and cost-frontier models (Stata Corp LP 2009). As previously stated, the writer will use

²Complete data on per district CPIs was only available for three major towns in West Java, these are, Bandung, Ciamis, and Tasikmalaya. In view of this, the writer arranged the other districts into three groups based on the proximity of each district or town in relation to Bandung, Ciamis and Tasikmalaya city.

the cost-frontier model to estimate BPR technical inefficiency levels.

To interpret the estimation results correctly for a stochastic frontier cost model, the natural logarithm transformation of the data must be performed before estimation (Hassan & Tufta 2001).

With this in mind, the BPR frontier cost model that fits the *xtfrontier* estimation, based on Equation (1) in the previous section, is transformed into the cost equation below:

$$\ln TC_{it} = \ln CREDIT_{it} + \ln P_LABOR_{it} + \ln P_CAPITAL_{it} + v_{it} - su_{it}, \quad (3)$$

where $i, t = 1, \dots, n$

where:

TC_{it} : BPR i 's total costs at time t ,

$CREDIT_{it}$: BPR i 's total output (total credit disbursed) at time t ,

P_LABOR_{it} : the price of labour used by BPR i in the production of the products or services at time t ,

$P_CAPITAL_{it}$: the price of capital used by BPR i in the production of the products or services at time t ,

v_{it} : the idiosyncratic error,

u_{it} : the error caused by BPR inefficiencies.

The expected signs or relationships between the dependent variable (total BPR costs) and the independent variables (total credit disbursed, the price of labour, and the price of capital incurred by the BPRs) are presented in Table 1.

In the hypothesis Table 1, we can see that total BPR costs and expenses are expected to increase as the BPR increases its level of output, i.e. total credit disbursed. Increases in the price of labour and the price of capital are also expected to increase total BPR costs.

Frontier estimation using panel data allows for two different specifications of the inefficiency scores (u_{it}), the time-invariant and the time-variant decay model. In the empirical analysis of this paper, the writer will regress the panel cost function using the time-variant decay model specifications because the writer expects BPR managers to learn from experience and for their technical efficiency levels to improve over time. One also notes that, the time-invariant inefficiency models are more restrictive, because they do not allow the inefficiency levels to

vary or improve over time (Coelli et al. 2005).

2.2.2. Second Step of the Regression: Estimating the Determinants of BPR Inefficiency Scores

In the second step of the empirical analysis, the relationship between BPR inefficiency scores and specific environmental characteristics (proxies of nondiscretionary variables effecting BPR inefficiency levels) where the BPRs operate, will be estimated using the following regression model:

$$u_{it} = f(\text{HHI, POV, SMA, HigherEd, PDRBpercapita, ROADperarea, BANKS}) \quad (4)$$

where:

u_{it} : estimated BPR inefficiency scores (derived from cost frontier regressions in the first step of the empirical analysis, in section 2.1.1),

HHI : measure of BPR concentration,

POV : percentage of the population under the poverty line per district or town,

SMA : the percentage of the labour force with high school education per district or town,

HIGHERed : the percentage of the labour force with a one year diploma, three year diploma and a university level of education per district or town (this variable represents the amount of the labour force with a higher education level),

PDRBpercapita : the level of per capita district income,

ROADperarea : the total length of roads divided by district area per district,

BANKS : the total amount of bank offices per district.

In the second stage regression above, the right-hand variables are exogenous, and they test how market structure and economic conditions impact BPR inefficiency levels. The variables *HHI*, *POV*, *SMA*, *HIGHERed*, *PDRBpercapita*, and *ROADperarea*, are control variables, since these variables may affect the production technology and cost structure of BPR operations. A hypothesis table of the expected signs and relationships between the dependent variable (BPR inefficiency scores) and independent variables (*HHI*, *POV*, *SMA*, *HIGHERed*, *PDRBpercapita*, and *ROADperarea*) in model 2.6 is presented below. Regression model 5.6 will be

Table 1: Hypothesis Table for Variables in the First Stage Regression Model for the Determination of the BPRs Inefficiency Scores

No	Variable	Description	Source	Hypothesis	Expected Relationship of the independent variables with the dependent variable
1	TC_{it}	total BPR expenses or cost (dependent variable)	Bank Indonesia		
2	$CREDIT_{it}$	Total Credit disbursed	Bank Indonesia	H_0 : Total Credit disbursed is insignificant in the BPR total cost function H_a : Total Credit disbursed is significant in the BPR total cost function. Decision rule: Reject H_0 , if p -value < α	+
3	P_LABOR_{it}	Price of Labour (the ratio of personnel cost expenses to total assets)	Bank Indonesia	H_0 : Price of labour is insignificant in the BPR total cost function H_a : Price of labour is significant in the BPR total cost function Decision rule: Reject H_0 , if p -value < α	+
4	$P_CAPITAL_{it}$	Price of Capital (the ratio of total operating expenses minus personnel expenses and interest expenses to total assets)	Bank Indonesia	H_0 : price of capital is insignificant in the BPR total cost function H_a : price of capital is significant in the BPR total cost function Decision rule: Reject H_0 , if p -value < α	+

Table 2: Hypothesis Table for Variables in the Second Stage Regression Determining Factors that Affect BPRs Inefficiency Scores

No.	Variable	Description	Hypothesis	Expected Relationship of the independent variables with the dependent variable
1.	u_{it}	BPR inefficiency score (dependent variable).		
2.	<i>HHI</i>	Measure of BPR industry concentration per district <u>Source:</u> BPS	→ H_0 : BPR industry concentration is insignificant in the model of bank inefficiency → H_a : BPR industry concentration is significant in the model of bank inefficiency Decision rule: Reject H_0 , if $p - \text{value} < \alpha$	-
3.	<i>POV</i>	Percentage of population per district under the poverty line. <u>Source:</u> BPS	→ H_0 : percentage of population under the poverty line is insignificant in the model of bank inefficiency → H_a : percentage of population under the poverty line is significant in the model of bank inefficiency Decision rule: Reject H_0 , if $p - \text{value} < \alpha$	+
4.	<i>SMA</i>	Percentage of total labor force with high school education level over total population. <u>Source:</u> BPS	→ H_0 : Percentage of total labor force with high school education level over total population is insignificant in the model of bank inefficiency → H_a : Percentage of total labor force with high school education level over total population is significant in the model of bank inefficiency Decision rule: Reject H_0 , if $p - \text{value} < \alpha$	-
5.	<i>HIGHERed</i>	The percentage of the labor force with a one year diploma, three year diploma and a university level of education per district or town This variable represents the amount of the labor force with a higher education level. <u>Source:</u> BPS	→ H_0 : Percentage of total labor force with a higher education level over total population is insignificant in the model of bank inefficiency → H_a : Percentage of total labor force with a higher education level over total population is significant in the model of bank inefficiency Decision rule: Reject H_0 , if $p - \text{value} < \alpha$	-
6.	<i>PDRBpercapita</i>	Total per district per capita income per year. <u>Source:</u> BPS	→ H_0 : Total per district per capita income per year is insignificant in the model of bank inefficiency → H_a : Total per district per capita income per year is significant in the model of bank inefficiency Decision rule: Reject H_0 , if $p - \text{value} < \alpha$	-
7.	<i>ROADperarea</i>	Total road length per total district area. <u>Source:</u> BPS	→ H_0 : Total road length per total district area is insignificant in the model of bank inefficiency → H_a : Total road length per total district area is significant in the model of bank inefficiency Decision rule: Reject H_0 , if $p - \text{value} < \alpha$	-
8.	<i>BANKS</i>	Total number of bank offices per district per year. <u>Source:</u> BPS	→ H_0 : Total number of bank offices per district per year is insignificant in the model of bank inefficiency → H_a : Total number of bank offices per district per year is significant in the model of bank inefficiency Decision rule: Reject H_0 , if $p - \text{value} < \alpha$	-

estimated using the Ordinary Least Square (OLS) method.

A significant HHI score within the regression is expected to result in lower inefficiency levels, as it indicates the presence of agglomeration benefits for the BPRs and that the BPRs take advantage of these agglomeration spillovers.

High poverty levels are expected to increase inefficiency as people under the poverty line are more prone to default on loans, thus increasing operational costs for the BPRs. The levels of education are expected to have negative coefficients, as the higher the level of education, the community is expected to be more financially literate. High district income, per capita district income, and district income growth are also expected to decrease inefficiency levels, as high district income stimulates economic activities that potentially need more services offered by the BPRs. High total road length per district area is also expected to decrease inefficiency, as the higher the availability of roads, the better access that the community has to BPR services.

According to research conducted by Berger & Hannan (1998), managerial negligence is generally evident in banks with higher degrees of market power. Therefore, banks operating in concentrated markets are expected to be less efficient than those operating in very competitive markets. With this in mind, the coefficient of the BANKS variable is expected to be negative; that is, the higher the number of bank offices per district, the higher the competition level, and the lower the inefficiency scores of the BPRs.

In the second stage regression, the right-hand variables are exogenous, and they test how market structure and economic conditions impact BPR inefficiency levels. The variables *POP*, *HHI*, *POV*, *SMA*, *HIGHERed*, *PDRBpercapita*, and *ROADperarea*, are control variables, since these variables may affect the production technology and cost structure of BPR operations.

3. Result and Analysis

3.1. First Stage Regression Results: Computing the BPR Inefficiency Scores

As stated in the sections before, the writer will use the Stochastic *xtfrontier* estimation method in order to estimate the inefficiency scores of the BPRs included in this research. The writer will use the time-variant decay model in the determination of BPR inefficiency levels, with the assumption that BPR inefficiency levels will decline as managers and BPR practitioners learn from past experience.

From Table 3, we can see that the frontier regression model is overall significant, that is, the independent variables in the regression model are able to explain the behaviour of the dependent variable. This conclusion can be drawn because the estimated chi2 value is significant ($\text{prob-chi2} < \alpha$, with $\alpha = 0.05$). From the p-values, we also know that all the independent variables do not have zero regression coefficients. From the frontier regression, we can then estimate the technical inefficiency scores of the BPRs included in this research.

Figure 4 present the mean value of the BPRs' inefficiency scores per year. As we can see, BPR inefficiency scores decline slightly per year. This is expected, because the writer employed the time-variant decay model in the specification of the inefficiency scores.

From Figure 4, we can see that the BPRs' mean technical efficiency values have steadily declined from 2006 until 2010.

Table 4 presents the mean value of the BPRs' technical inefficiency scores per district. In Table 4, the red highlighted district, the district of Ciamis (code: 3207) shows the district with the lowest average inefficiency score; the district which on average has the most efficient BPRs. The orange highlighted district shows the district with the median mean value of technical inefficiency, which is the district of Sumedang (3211). The blue highlighted district, Bandung City (code: 3273), shows the district with the highest average inefficiency scores, thus is the district that on average has the most inefficient BPRs. These results indicate that BPRs in Ciamis are relatively more efficient when compared

Table 3: *Xtfrontier* Regression Output for the Determination of BPR Inefficiency Scores

Variable	Coefficient	Standard Error	p-value	Hypothesis sign	Estimation Sign	Description
$\ln CREDIT_{it}$	0.9289265	0.0210334	0.000***	+	+	Significant and estimated sign is the same with hypothesis sign.
$\ln P_LABOR_{it}$	0.4491585	0.0182656	0.000***	+	+	Significant and estimated sign is the same with hypothesis sign.
$\ln P_CAPITAL_{it}$	0.4106768	0.0159549	0.000***	+	+	Significant and estimated sign is the same with hypothesis sign.
C	1.241358	0.1652587	0.000***		+	Significant and estimated sign is the same with hypothesis sign.
/mu	0.4498349	0.1353846	0.001***			
/eta	0.0015096	0.0025822	0.559*			
/Insigma2	-1.927.935	0.1710835	0.000***			
/lgtgamma	0.662668	0.2607455	0.011**			
sigma2	0.1454482	0.0248838				
gamma	0.6598595	0.058523				
sigma_u2	0.0959754	0.0247825				
sigma_v2	0.0494728	0.0019572				
Number of Observations				1430		
Number of Groups				93		
Wald chi2				8432.76		
Prob>Chi2				0.000		

Source: Author's computations

Note: *Insignificant

**Significant at 5% significance level

***Significant at 1% significance level

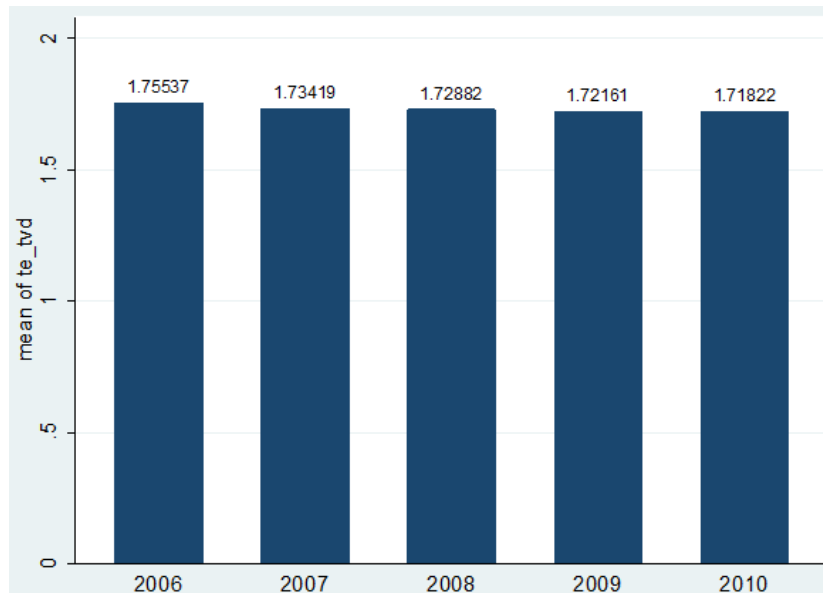


Figure 4: Mean BPR Technical Inefficiency Scores per Year

Source: Author's computations

Table 4: Mean BPR Technical Inefficiency Scores per District

District Code	District	Mean Technical Inefficiency
3201	Bogor	1.528.236
3202	Sukabumi	1.891.163
3203	Cianjur	1.366.737
3204	Bandung	177.496
3205	Garut	1.530.481
3206	Tasikmalaya	151.238
3207	Ciamis	1.265.759
3208	Kuningan	14.169
3209	Cirebon	1.671.706
3210	Majalengka	166.146
3211	Sumedang	1.647.359
3212	Indramayu	1.705.676
3213	Subang	163.174
3214	Purwakarta	1.423.191
3215	Karawang	1.679.525
3216	Bekasi	1.313.936
3217	Bandung Barat	1.546.068
3271	Kota Bogor	1.616.214
3272	Kota Sukabumi	1.772.653
3273	Kota Bandung	3.427.041
3274	Kota Cirebon	2.410.416
3275	Kota Bekasi	1.865.954
3276	Kota Depok	1.710.265
3277	Kota Cimahi	1.843.906
3278	Kota Tasikmalaya	1.628.124
	Total	1.727.747

Source: Author's computations

Note: Blue highlighted district: highest value

Orange highlighted district: median value

Red highlighted district: lowest value

to BPRs in other districts. District level development indicators in Ciamis district (for example: PDRBpercapita, percentage of poverty, and total bank offices) are not too well developed and also not too underdeveloped. But district level development indicators in Bandung City (the area with the highest inefficiency score) suggest high levels of development; this is in line with the fact that Bandung City is a cosmopolitan area.

3.2. Second Step Regression: Determinants of BPR Inefficiency Levels

Multicollinearity tests between independent variables considered in the second regression model indicates collinearity between the *HIGHERed* variable and *ROADSperarea* variable. With this in mind, the writer considers to drop one of these variables from the regression, as clearly they both represent the same indicator of district development.

After conducting the correlation analysis between BPR inefficiency scores and the specific environmental variables included in this research, three alternative regressions were conducted between BPR technical inefficiency scores (as the dependent variable) and the environmental variables considered in Table 5 (as independent variables) using the Ordinary Least Square (OLS) regression method. The first regression included all the environmental variables considered in Table 5 as independent variables within the regression. Because of the presence of multicollinearity between *HIGHERed* and *ROADSperarea*, the second regression model excluded the *HIGHERed* variable within the regression. The third model then excluded the *ROADSperarea* variable within the model. Since the coefficients of the independent variables included within all the regression were similar in value, the writer has chosen the best alternative model by selecting the model with the highest R-squared score and the lowest Variance - Inflating Factor (VIF) score. After analysing the regression results of all the alternative models, the writer chose the second model, which excludes the *HIGHERed* variable.

From Table 5, we can see that the OLS regression model is overall significant, that is, the independent variables in the regression model are able to explain the behaviour of the dependent variable. This

conclusion can be drawn because the estimated prob-F value is significant (prob-F < α , with $\alpha = 0.05$). From Table 2, we can also conclude that all six independent environmental variables that affect BPR inefficiency levels are significant. These variables are, the HHI index (*HHI*), the percentage of the population per district under the poverty line (*POV*), the percentage of labour force per district with a high school education (*SMA*), district income per capita (*PDRBpercapita*), roads per district area (*ROADperarea*), and the number of bank offices per district (*BANKS*).

From Table 5, we can see that, when the percentage of the HHI index³ increases by one percent, *ceteris paribus*, BPR technical inefficiency levels decrease by -0.0138147 percent. This conclusion supports the writer's hypothesis that an increase in the HHI index per district decreases BPR inefficiency levels, thus indicating that BPRs in West Java generally agglomerate and concentrate their operations within districts with high population numbers. High population numbers within a district will clearly benefit the BPRs as the higher the number of population, the higher the number of potential clients. Thus operating in high density areas will clearly be more profitable for the BPRs.

We can see from Table 5 that, when the percentage of the population per district under the poverty line increases by one percent, *ceteris paribus*, the BPR inefficiency score will increase by 0.0869164

³The HHI is the sum of squares of the market shares of the firms (in this research's case, the BPRs) in an industry (Martin 1988). Specifically for the measure of industry concentration within the BPR banking industry in West Java, the writer has constructed the following Hirschman-Herfindahl Index,

$$HHI_j(t) = \sum_{i=1}^I \left[\frac{BPR_{ij}(t)}{BPR_j} - \frac{P_i(t)}{P(t)} \right]^2 \quad (5)$$

With:

$BPR_{ij}(t)$: the total amount of BPR offices in district *i* at time *t*.

BPR_j : the total amount of BPR banks in the whole of West Java at time *t*.

$P_i(t)$: the total amount of population in district *i* at time *t*.

$P(t)$: the total amount of population in West Java at time *t*.

This Hirschman-Herfindahl Index is a modified index based on the index used by Kuncoro (2009) to measure industry concentration in Indonesia. Kuncoro (2008) used data on the total amount of employment in each industry per district as opposed to the total amount of industrial outlets, in this research, the total amount of BPRs per district (Kuncoro 2008). The writer chose to use the amount of banks per district because data on the total amount of employment within the BPR system in West Java was not available. Data on the total amount of BPRs per district in West Java was taken from the Bank of Indonesia website.

Table 5: Analysis of Variable Significance within the BPR Inefficiency Determinant Time Variant Decay Model with Total Credit as Output (Excluding the *HIGHERed* variable)

Variable	Coefficient	Robust Standard Error	Stan-	p-value	Hypothesis sign	Estimation Sign	Description
<i>ln HHI</i>	-0.0138147	0.0034482		0.000***	-	-	Significant and estimation sign is the same with hypothesis sign. Significant and estimation sign is the same with hypothesis sign. Significant but estimation sign is different with hypothesis sign. Significant and estimation sign is the same with hypothesis sign. Significant but estimation sign is different with hypothesis sign. Significant but estimation sign is different with hypothesis sign. Significant.
<i>ln POP</i>	0.0636461	0.0157225		0.000***	+	+	
<i>ln SMA</i>	0.1147237	0.0099188		0.000***	-	+	
<i>ln PDRPpercapita</i>	-0.0767335	0.019286		0.001***	-	-	
<i>ln ROADperarea</i>	0.047302	0.005701		0.000***	-	+	
<i>ln BANKS</i>	0.0920997	0.0114477		0.000***	-	+	
C	1.359.547	0.2885174		0.000***			
Number of observations					1346		
F(6, 1189)					47.45		
Prob>F					0.0000		
R-squared					0.2736		
Root MSE					0.23026		

Source: Author's computations

Note: *Insignificant

**Significant at 5% significance level

***Significant at 1% significance level

percentage points. The sign of the estimated coefficient of the percentage of the population per district under the poverty line (*POV*) variable is the same with its expected sign in the hypothesis. This supports the idea that an increase in poverty levels will increase BPR technical inefficiency. One clear effect of an increase in the poverty levels is the inability to repay loans, thus increasing BPR risks and operation costs.

We can also see that, when the percentage of labour force per district with a high school education (*SMA*), *ceteris paribus*, increases by one percent, the BPR technical inefficiency score will increase by 0.1086075 percentage points. Increases in the amount of the labour force with a high school level of education does not decrease BPR technical inefficiency scores, indicating the possibility that most likely, higher levels of education within the labour force are needed to support more efficient and profitable BPR activities.

The next significant variable is district income per capita (*PDRBpercapita*). The negative coefficient of the *PDRBpercapita* variable indicates that when there is an increase in district income growth, *ceteris paribus*, the technical inefficiency scores of the BPRs will decrease. This supports the writer's hypothesis, which states that the overall level of district affluence supports more efficient BPR banking activities.

The *ROADperarea* variable, indicating total road length per district area, is also significant. The positive sign of this variable's coefficient indicates that when there is an increase in total road length per district area, *ceteris paribus*, the technical inefficiency scores of the BPRs will increase. Even though the writer expected the *ROADSperarea* variable to have a negative impact on BPR technical inefficiency scores, the reverse, positive, relationship between BPR technical inefficiency scores and the length of roads per district area could indicate that BPRs that operate in highly developed areas will be more inefficient because they face more competition. Developed areas are more likely to provide other alternative financial intermediaries to their clients. For a specific look at the effect of bank competition on BPR technical inefficiency levels, the writer analyzes the *BANKS* variable.

The final significant variable is the total bank offices per district variable (*BANKS*). This variable represents the level of banking competition that the BPR

is facing per district. The coefficient of this variable is positive, indicating that when there is an increase in total bank offices per district, *ceteris paribus*, the cost inefficiency scores of the BPRs will increase. This supports the writer's previous idea; that BPRs which operate in highly concentrated and developed areas will tend to be more technically inefficient, most likely because they cannot compete with other intermediary institutions available in that particular area.

4. Conclusion

From the empirical evidence obtained through this research the following conclusions may be drawn:

1. The district with the lowest technical inefficiency score is Ciamis district (code: 3207) and the district with the highest technical inefficiency score is Bandung City (code: 3273). These results indicate that BPRs in Ciamis are relatively more efficient when compared to BPRs in other districts. District level development indicators in Ciamis district (for example: *PDRBpercapita*, percentage of poverty, and total bank offices) are not too well developed and also not too underdeveloped. But district level development indicators in Bandung City (the area with the highest inefficiency score) suggest high levels of development; this is in line with the fact that Bandung City is a cosmopolitan area. These results are supported by the second-step regression results elaborated below.
2. All six independent environmental variables that affect BPR inefficiency levels considered in this study (the HHI index (*HHI*), the percentage of the population per district under the poverty line (*POV*), the percentage of labour force per district with a high school education (*SMA*), district income per capita (*PDRBpercapita*), roads per district area (*ROADperarea*), and the number of bank offices per district (*BANKS*) are significant.
3. An increase in the HHI index per district decreases BPR inefficiency levels, thus indicating that BPRs in West Java generally agglomerate and concentrate their operations within districts with high population numbers. High population numbers within a district will clearly benefit the

BPRs as the higher the number of population, the higher the number of potential clients. Thus operating in high density areas will clearly be more profitable for the BPRs.

4. An increase in poverty levels will increase BPR technical inefficiency. One clear effect of an increase in the poverty levels is the inability to repay loans, thus increasing BPR risks and operation costs.
5. Increases in the amount of the labour force with a high school level of education does not decrease BPR technical inefficiency scores, indicating that most likely, higher levels of education within the labour force are needed to support more efficient and profitable BPR activities.
6. The negative coefficient of the PDRB per capita variable indicates that when there is an increase in district income growth, *ceteris paribus*, the technical inefficiency scores of the BPRs will decrease. The overall level of district affluence supports more efficient BPR banking activities.
7. When there is an increase in total road length per district area, *ceteris paribus*, the technical inefficiency scores of the BPRs will increase. The relationship between BPR technical inefficiency scores and the length of roads per district area could indicate that BPRs that operate in highly developed areas will be more inefficient because they face more competition. Developed areas are more likely to provide other alternative financial intermediaries to their clients.
8. When there is an increase in total bank offices per district, *ceteris paribus*, the cost inefficiency scores of the BPRs will increase. This supports the conclusion in point 6 above that BPRs which operate in highly concentrated and developed areas will tend to be more technically inefficient, most likely because they cannot compete with other intermediary institutions available in that particular area.
9. Overall, it is shown that BPRs cannot operate efficiently in areas that are too poor nor in areas that are too well developed.

The following policy implication, resulting from this empirical study, need to be considered by the Indonesian government:

1. The government should lower the cost of funds for the BPRs (reflected by high interest costs)

in order to boost BPR efficient levels. If BPR efficiency levels can be increased, BPRs may be able to operate in poor areas profitably.

2. The Bank of Indonesia should address the minimum collateral issue to ease the regulatory burden on the BPRs, especially for small BPRs in remote regions. Although the minimum paid up capital for BPRs already varies by location, five billion Rupiahs for the capital city, two billion Rupiahs for other big cities in Java and Bali, one billion Rupiahs for other cities outside Java and Bali, and 500 million Rupiahs for other areas (Nenova, Niang, & Ahmad 2009), it is still too high for some regions. The Bank of Indonesia needs to lower the minimal capital requirement for setting up BPRs in very poor and remote regions in order to encourage BPR owners to set up their banks. By lowering the minimum collateral requirement for setting up banks in remote areas, more banks will be able to provide financial access to isolated areas. On the other hand, by setting high collateral requirements to set up BPRs in well developed regions, only the BPRs that are able to compete will enter the market. In conclusion, variation in the minimum capital requirements to set up BPRs within regions, is of vital importance.

This research has certain limitations that need to be taken into account and that could be considered for further research:

1. The observation period, between the fourth quarter of 2006 until the third quarter of 2010, is relatively short. BPRs in West Java have been operating since the 1970s. Data dating from earlier periods would give a wider perspective on the development of BPR activities in West Java.
2. Individual BPRs that are included in this research (93 banks, resulting in 1430 observations throughout the years of analysis) are only a sample of the vast network of BPRs in West Java. Including more banks in the study would give a more detailed picture of the BPR banking industry in West Java.
3. A single output Cobb-Douglas cost function (with total credit disbursed as output) was employed to estimate and construct the stochastic efficiency frontier, with only two types of bank inputs considered (the price of labor and the price of capital). As we know, BPR outputs not only consist of total credit disbursed, but

of many other types of services. The inputs employed within BPR production activities are also not only limited to the two measures of labour and capital costs. A more precise cost function would encompass a wider range of BPR activities.

4. Data on the amount of per bank employees was not available. Because of this the price of labour was a proxy, which was personnel expenses divided by total assets. A more precise measure of labour prices could have been used within the research if data on the number of employees had been available.

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References

- [1] Aigner, D, Lovell, CK, & Schmidt, P 1977, 'Formulation and estimation of stochastic frontier production function models', *Journal of Econometrics*, vol. 6, no. 1, pp. 21–37.
- [2] Altunbas, Y, Evans, L, & Molyneux, P 2001, 'Bank ownership and efficiency', *Journal of Money, Credit and Banking*, vol. 33, no. 4, pp. 926–954.
- [3] Badan Pusat Statistik 2005–2010, *Jawa Barat Dalam Angka (West Java in Numbers)*, Badan Pusat Statistik, Jakarta.
- [4] Badan Pusat Statistik Indonesia 2007, *Data dan Informasi Kemiskinan*, Badan Pusat Statistik, Jakarta.
- [5] Badan Pusat Statistik Indonesia 2008, *Data dan Informasi Kemiskinan*, Badan Pusat Statistik, Jakarta.
- [6] Badan Pusat Statistik Indonesia 2009, *Master File Kabupaten*. Available from: <<http://www.bps.go.id/aboutus.php?msttkab=1>>. [9 February 2010].
- [7] Badan Pusat Statistik Indonesia 2005–2010, *Index Harga Konsumen di Ibukota Provinsi di Indonesia (Consumer Price Indices in Provincial Capital Cities in Indonesia)*, Badan Pusat Statistik, Jakarta.
- [8] Badan Pusat Statistik Jawa Barat 2006, *Penduduk Jawa Barat: Hasil Sensus Penduduk Tahun 2005*, Badan Pusat Statistik, Jakarta.
- [9] Bangladesh Krishi Bank (BKB) 2011, Available from: <<http://www.krishibank.org.bd/>>. [10 January 2009].
- [10] Bank Indonesia 2006, *Cetak Biru Bank Perkreditan Rakyat*, Direktorat Pengawasan Bank Perkreditan Rakyat Bank Indonesia, Jakarta.
- [11] Bank Indonesia 2010, *Pedoman Penyusunan Laporan Bulanan Bank Perkreditan Rakyat*, Direktorat Kredit BPR dan UMKM Bank Indonesia, Jakarta.
- [12] Benston, GJ 1965, 'Branch banking and economies of scale', *The Journal of Finance*, vol. 20, no. 2, pp. 312–331.
- [13] Berger, AN, & Hannan, TH 1998, 'The efficiency cost of market power in the banking industry: A test of the "quiet life" and related hypotheses', *Review of Economics and Statistics*, vol. 80, no. 3, pp. 454–465.
- [14] Berger, AN, Leusner, JH, & Mingo, JJ 1997, 'The efficiency of bank branches', *Journal of Monetary Economics*, vol. 40, no. 1, pp. 141–162.
- [15] Bogetoft, P, & Otto, L 2011, *Benchmarking with DEA, SFA, and R*, [International Series in Operations Research and Management Science, Volume 157], Springer, New York.
- [16] Boudreaux, K, & Cowen, T 2008, 'The micromagic of microcredit', *The Wilson Quarterly (1976-)*, vol. 32, no. 1, pp.27–31.
- [17] Camanho, AS, & Dyson, RG 2005, 'Cost efficiency, production and value-added models in the analysis of bank branch performance', *Journal of the Operational Research Society*, vol.56, no. 5, pp. 483–494.
- [18] Coelli, TJ, Rao, DSP, O'Donnell, CJ, & Battese, GE 2005, *An introduction to efficiency and production analysis*, Springer Science & Business Media.
- [19] Cole, D, Cole, DC, & Slade, BF 1998, *Building a modern financial system: The Indonesian experience*, Cambridge University Press.
- [20] Doi, Y 2010, *Financial Inclusion: A Better Tomorrow For All Indonesians*. The Jakarta Post. [Thu, December 30 2010].
- [21] Elyasiani, E, & Mehdian, S 1990, 'Efficiency in the commercial banking industry, a production frontier approach', *Applied Economics*, vol. 22, no. 4, pp. 539–551.
- [22] Farrell, MJ 1957, 'The measurement of productive efficiency', *Journal of the Royal Statistical Society. Series A (General)*, vol. 120, no. 3, pp. 253–290.
- [23] Fries, S, & Taci, A 2005, 'Cost efficiency of banks in transition: Evidence from 289 banks in 15 post-communist countries', *Journal of Banking & Finance*, vol. 29, no. 1, pp. 55–81.
- [24] Hassan, MK, & Tufte, DR 2001, 'The x-efficiency of a group-based lending institution: The case of the Grameen Bank', *World Development*, vol. 29, no. 6, pp. 1071–1082.
- [25] Hasan, I, & Marton, K 2003, 'Development and efficiency of the banking sector in a transitional economy: Hungarian experience', *Journal of Banking & Finance*, vol. 27, no. 12, pp. 2249–2271.
- [26] Investopedia.com 2011, *Loan-To-Deposit Ratio - LTD*. Available from: <<http://www.investopedia.com/terms/l/loan-to-deposit-ratio.asp>>. [9 January 2010].
- [27] Jehle, GA, & Reny, PJ 2006, *Advanced microeconomic theory*, Pearson Education India.
- [28] Jiang, C, Yao, S, & Zhang, Z 2009, 'The effects of governance changes on bank efficiency in China: a stochastic distance function approach', *China Economic Review*, vol. 20, no. 4, pp. 717–731.
- [29] Jondrow, J, Lovell, CK, Materov, IS, & Schmidt, P 1982, 'On the estimation of technical inefficiency in the stochastic frontier production function model', *Journal of Econometrics*, vol. 19, no. 2, pp. 233–238.
- [30] Kaparakis, EI, Miller, SM, & Noulas, AG 1994, 'Short-run cost inefficiency of commercial banks: A flexible stochastic frontier approach', *Journal of Money, Credit and Banking*, vol. 26, no. 4, pp.875-893.
- [31] Kuncoro, A 2009, 'Spatial agglomeration, firm productivity, and government policies' in Indonesia: concentration and deconcentration in the manufacturing sector', in *Reshaping Economic Geography in East Asia, a companion to the*

- World Development Report 2009*, eds. Y Huang & AM Bocchi, pp. 156–168.
- [32] Margono, H, Sharma, SC, & Melvin, PD 2010, 'Cost efficiency, economies of scale, technological progress and productivity in Indonesian banks', *Journal of Asian Economics*, vol. 21, no. 1, pp. 53–65.
- [33] Meeusen, W, & Van den Broeck, J 1977, 'Efficiency estimation from Cobb-Douglas production functions with composed error', *International Economic Review*, vol. 18, no. 2, pp. 435–444.
- [34] Nenova, T, Niang, CT, & Ahmad, A 2009, *Bringing Finance to Pakistan's Poor: Access to Finance for Small Enterprise and the Underserved*, World Bank, Washington, DC.
- [35] Pindyck, RS, & Rubinfeld, DL 1998, *Microeconomics*, 4th International ed., Prentice Hall International, Upper Saddle River, NJ; London.
- [36] Press, S 2009, *Stata longitudinal-data/panel-data reference manual: Release 11*, Stata Press.
- [37] Robinson, MS 2002, *The microfinance revolution: Volume 2. Lessons From Indonesia*, World Bank, Washington, DC.
- [38] Ross, S, Westerfield, R, Jaffe, J 2008, *Corporate Finance*, 8th ed., McGraw-Hill, New York.
- [39] Schmidt, P 1985, 'Frontier production functions', *Econometric Reviews*, vol. 4, no. 2, pp. 289–328.
- [40] Steinwand, D 2001, *The Alchemy of Microfinance: the Evolution of the Indonesian People's Credit Banks (BPR) from 1895 to 1999 and a Contemporary Analysis*, VWF, Berlin.
- [41] Stephen, M 1988, *Industrial Economics: Economic Analysis and Public Policy*, Macmillan.
- [42] Stiglitz, JE 1990, 'Peer monitoring and credit markets', *The World Bank Economic Review*, vol. 4, no. 3, pp. 351–366.
- [43] Varian, HR 1990, 'Monitoring agents with other agents', *Journal of Institutional and Theoretical Economics (JITE)/Zeitschrift für die gesamte Staatswissenschaft*, vol. 46, no. 1, pp. 153–174.
- [44] Warren, CS, Reeve, JM, & Fess, PE 2005, *Accounting, Edition 21*, Thomson, South Western, Ohio.
- [45] World Bank, 2010, 'Improving Access to Financial Services in Indonesia', *World Bank Working Paper, 52032*, World Bank, Washington, DC.