EDICIONES
COMPLUTENSE

¿Cómo de eficientes y productivas son las cooperativas en Indonesia? Evidencia empírica del análisis envolvente de datos

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Resumen. El artículo 33 de la Constitución de Indonesia de 1945 posicionó a la cooperativa como un pilar y columna vertebral de la economía nacional. Para funcionar de manera óptima como el pilar y la columna vertebral de la economía, las cooperativas deben ser administradas de manera eficiente y productiva. Teniendo en cuenta su papel fundamental en la economía de Indonesia, este estudio tiene como objetivo medir empíricamente la eficiencia y la productividad de las cooperativas en 33 provincias de todo el país. Se analizan tres entradas (es decir, capital propio, financiamiento externo y tamaño de la junta) y una salida (superávit cooperativo) durante el período 2010-2015 utilizando el Análisis Envolvente de Datos (AED) con el Índice Malmquist. El estudio documentó que las cooperativas eran altamente ineficientes, indicadas por el nivel promedio de ineficiencia del 47.6%. De las 33 provincias, el 42.42% registra un nivel de eficiencia de menos del 50% y solo el 12.12% de ellas era completamente eficiente. Además, el estudio también documentó que, de 33 provincias, solo las cooperativas en 14 provincias experimentaron un aumento en la productividad total de sus factores. Las cooperativas en la provincia de Nusa Tenggara Oriental registraron el mayor progreso de productividad en un 49.9%, mientras que la Cooperativa en la provincia de Bangka Belitung registró el mayor retroceso de productividad en un -24.4%. En general, el nivel de productividad de las cooperativas aumentó solo ligeramente en un 9,9% durante el período de estudio en todo el país, lo que se debe principalmente a un aumento en la eficiencia técnica. Estos hallazgos implicaron que para mejorar aún más el nivel de productividad de las cooperativas, se debe priorizar la mejora de su eficiencia pura, seguido por la mejora de la eficiencia de escala y la eficiencia técnica. Las cooperativas deben proporcionar capacitación periódica para su personal, administración profesional, adoptar tecnología avanzada y ampliar su tamaño fusionando pequeñas cooperativas para convertirse en una entidad más grande.
Palabras clave: Eficiencia; Factor total de productividad; Cooperativa; Análisis Envolvente de Datos; Índice de Malmquist.
Claves Econlit: C14; D24; J54; P31.

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[en] How efficient and productive are co-operatives in Indonesia? Empirical evidence from data envelopment analysis

Abstract. Article 33 of the 1945 Constitution of Indonesia positioned co-operative as a pillar and backbone of the national economy. To optimally function as the pillar and backbone of the economy, the co-operatives should be managed efficiently and productively. Considering their pivotal roles in the Indonesian economy, this study is aimed at empirically measuring efficiency and productivity of the co-operatives across 33 provinces nationwide. Three inputs (i.e., own capital, external financing, and board size) and one output (co-operative surplus) over the period 2010-2015 are analyzed using Data Envelopment Analysis (DEA) with Malmquist Index. The study documented that the co-operatives were highly inefficient, indicated by the average level of inefficiency of 47.6%. Out of the co-operatives in 33 provinces, 42.42% were found to record efficiency level of less than 50% and only 12.12% of them were fully efficient. In addition, the study also documented that, of 33 provinces, only the co-operatives in 14 provinces were found to experience an increase in their total factor productivity. The co-operatives in the province of East Nusa Tenggara recorded the highest productivity progress by 49.9%, while the co-operative in the province of Bangka Belitung recorded the highest productivity regress by -24.4%. Overall, the productivity level of the co-operatives only slightly increased by 9.9% over the study period nationwide, which was mainly contributed by an increase in technical efficiency. These findings implied that to further enhance the productivity level of the co-operatives, improving their pure efficiency should be prioritized, followed by enhancing their scale efficiency and technical efficiency. The co-operatives should provide regular training for their staff, professional management, adopt advanced technology, and enlarge their size by merging small co-operatives become a larger entity.
Keywords: Efficiency; Total Factor Productivity; Co-operative; Data Envelopment Analysis; Malmquist Index.

1. Introduction

One in every six citizens on the globe is co-operators. The world's top 300 co-operatives has offered partial or full-time employment for no less than 280 million people internationally, making a contribution to a global turnover of USD2.1 trillion. In the last decade, more than 800 million people have been members of co-operatives globally (International Co-operative Alliance, 2016). This indicates that co-operatives are pertinent to the social-economic expansion of many countries, including Indonesia. Co-operatives have been mandated by the 1945 Constitution of Indonesia as pillar and backbone of the national economy. Due to their relevancy to promote people's economy in Indonesia, thus it is utmost important to assess the performance of the co-operatives.

Historically, co-operatives in Indonesia have started since 1896 with the establishment of a Savings and Loan Co-operative in Purwokerto (Nasution, 1990). Initially, the co-operative was established by a Mayor in Purwokerto City in the Central Java province to free the employees from moneylenders. In later years, the co-operative has expanded into the agricultural sector for the sake of ensuring the

welfare of farmers. Since then, the number of co-operatives has increased tremendously. In 2005, there were 212,135 co-operatives in Indonesia (Ministry of Co-operatives and SMEs, 2016). Although the government has provided several strong legal protections to oversee the Co-operative, such as the 1945 Constitution and the 1992 Co-operative Act, No. 25, about 30% of the co-operatives have been inactive due to various reasons. Mismanagement, lacking capital, unskilled staff, and inefficiency were among the major determinants contributing to their inactivity (Ministry of Co-operatives and SMEs, 2017).

As the important pillar of the national economy (The 1945 Constitution of Indonesia, Article 33), co-operative has played an important role in the Indonesian economy. The amount of surplus (so-called *Sisa Hasil Usaha* in the Indonesian term) earned by the co-operatives in Indonesia has increased from IDR5.6 billion in 2010 to IDR17.3 billion in 2015, recording an average increase by 5-7% annually over the period 2010-2015. The Co-operatives have provided job opportunity for 574,451 citizens. In 2015, 37.9 million of Indonesian registered as the members of the co-operatives (Ministry of Co-operatives and SMEs, 2016). In totality, the co-operatives have contributed about 2% to the Indonesia's national economy (Azhari et al., 2017).

Although the co-operatives have contributed positively to the national economy, but their contribution is far less than expected. As the backbone of the economy, Burhanuddin (2013) stated that the co-operatives have not successfully played their pivotal role to enhance the national economy. Co-operatives should promote people's welfare by reducing unemployment and poverty rates (DeVille et al., 2007). The contribution of co-operatives to the national economy of Indonesia was too small if compared to the contribution of the co-operatives overseas. For example, the co-operatives have contributed to the economies of Sweden (13%), Switzerland (16.4%), Finland (21%), New Zealand (22%), and even in a newly developing country of Kenya (45%).

Additionally, of the 300 best co-operatives in the world, only one co-operative from Indonesia, which was the Kisel (Telkomsel Co-operative), ranked in the top 123 and the Semen Gresik Co-operatives ranked in the top 232. Meanwhile, most of the co-operatives from the US were listed in the top 100 (Minister of Co-operatives and Small-Medium Enterprises of Indonesia, 2016). The International Co-operative Alliance (2016) reported that the Zenykoren from Japan was in the first rank, followed by the ACDLEC from France in the second rank, and the State Farm from the US in the third rank.

The above facts show that, as the backbone of the national economy, the co-operatives have not successfully played a pivotal role to ensure the just economy in Indonesia. In Indonesia, the primary objective of co-operatives, which is to assist people in the rural areas to combat pervasive rural and urban indebtedness in the country, as mandated by the Article 33 of the 1945 Constitution of Indonesia, has yet to be fully achieved. This has motivated more researchers to evaluate the contribution of the co-operatives in the Indonesian economy (Azhari et al., 2017) and their efficiency (Sulikah, 2010; Wirnoto, 2011; and Syamni and Majid 2016). In their study, Azhari et al. (2017) described qualitatively that the co-operatives in Indonesia have failed to function as the pillar and backbone of the national economy as their contributions have been small and far from expected. Meanwhile,

Sulikah (2010) measured the efficiency of the co-operatives in the District of Klaten in the Special Province of Yogyakarta, whereas Wirnoto (2011) and Syamni and Majid (2016) measured efficiencies of co-operatives in the Pekalongan City of Central Java and Lhokseumawe City of Aceh, respectively. These studies documented that the co-operatives in these selected districts in Indonesia were highly inefficient.

Additionally, comparing to their enormous potentials in assisting the poor and their important roles in the economy, previous studies investigated efficiencies of the co-operatives have been meagre worldwide, both in the advanced and emerging economies. For the cases of developed countries, Rebelo et al. (2017), Doumpos and Zopounidis (2012) and Akinsoyinu (2015) conducted studies on efficiencies of co-operatives in the European countries, Candemir et al. (2011) in Turkey, Ludena (2010) in the Latin America, Ariyatne et al. (2006) in the US, Gomez (2006) in Spain, and Fandel (2003) in Slovakia, while studies for the cases of developing economies conducted by Marwa and Aziakpono (2014) in Tanzania, Tesfay and Tesfay (2013) in Ethiopia, Khan et al. (2010) in Pakistan, Jayamaha and Mula (2010) in Sri Lanka, Sigh et al. (2010) in India, Lavado (2004) in the Philippines, and Dong and Featherstone (2004) in China.

Previous studies on the efficiency of the co-operatives in Indonesia only focused on certain specific sectors and districts. Sulikah (2010) measured the efficiency of the savings and loan co-operatives in the District of Klaten in the Special Province of Yogyakarta, while Wirnoto (2011) and Syamni and Majid (2016) measured efficiencies of co-operatives in the Pekalongan City of Central Java and Lhokseumawe City of Aceh, respectively. Thus, these limited studies could not provide a comprehensive picture of the co-operatives' performance nationwide. To the best of our knowledge, this present study is the first attempt to fill this gap by assessing the efficiency of co-operatives in the entire provinces of Indonesia nationwide.

Additionally, to provide detailed sources of inefficiencies of the co-operatives in the country, this study utilizes the most commonly approach of the generalized output-oriented Malmquist Index of the Data Envelopment Analysis (DEA) to empirically measure their Total Factor Productivity change (TFPch) by decomposing it into the Efficiency change (EFch) and Technical change (TEch). Additionally, this approach further decomposes the Efficiency change (EFch) into two sub-components, namely: Pure Technical efficiency change (TEch) and Scale Efficiency change (SEch). The use of this approach is not only able to identify the input or output of the co-operatives as a reference to identify the sources of inefficiency (Hadad et al., 2013), but it also considers all inputs-outputs as well as differences in technology, capacity, competition, and demographics, and then compares the individual co-operative's efficiency with the best-practice frontier. Thus, this study intends to enrich the existing empirical evidence globally from the perspective of Indonesia.

The findings of the study are hoped to shed some lights for the co-operatives to enhance their productivity level, for the public to identify the co-operatives with the better performance, and for the regulators or the government, in particular the relevant institutions such as the Ministry of Co-operatives and Small Medium

Enterprises Republic of Indonesia, to design the effective policies to promote the co-operatives as the pillar and backbone of the national economy of Indonesia.

The remaining parts of this study are organized as follows. Section 2 reviews the selected relevant and recent studies on the productivity and efficiency of the co-operatives. Section 3 highlights the data utilized and empirical model of the DEA and Malmquist Index. Section 4 discusses the empirical results and their implications. Finally, Section 5 concludes the paper.

2. Literature review

Operationalization of co-operatives is rooted in the values of self-help, self-responsibility, equity, equality, solidarity, and democracy. Co-operatives are a user-owned and user-controlled venture that benefits their members on the basis of use (Zeuli and Cropp, 2004). Traditionally, the members of co-operatives have faith in the ethical values of truthfulness, openness, social responsibility, and caring for others (International Co-operative Alliance, 1995). In Indonesia, the 1945 Indonesian Constitution of Article 33 positioned co-operative as a pillar and backbone of the national economy. In general, its establishment is aimed to promote the welfare of their members in particular, and society at large.

Co-operatives are unique, where members are users of their services (Marwa and Aziakpono, 2014). The members are both owners and users of services of the co-operatives. The dual concept of the co-operative as a business venture and a social group was first introduced by Draheim (1952), extended further by Henzler (1957; 1960), Holger (1986), Michelsen (1994), Zamagni (2010), and Puusa et al. (2013). This implied that the presence of co-operatives is hoped to enhance both the welfare of their members and society as well.

According to Royes and Smith (2007), if the co-operative earns surpluses or losses, it would be shared among their members, or its surpluses would be retained and added to the existing capital structure. Basically, the co-operative is not mainly intended to seek profit, but to ensure its business sustainability (Wahyuning 2013), the co-operative needs to gain profit. The Indonesian Co-operative Act, No. 25, Section 45, Paragraph 1 stated that the surplus of a co-operative is an income obtained within one fiscal year after deducting costs, depreciation and other liabilities. Its level is highly dependent on both financial and non-financial factors.

The financial factors determining performance of the co-operatives include its access to capital (savings, mandatory savings, reserves and grants), external capital (debt) sourced from savings of members, other co-operatives or their members, banks and other financial institutions, bonds and other securities, and from their legal sales of business goods and services. Meanwhile, the non-financial factors affecting the performance of co-operatives are the number of employees, members, and business units. Thus, although the co-operative has adequate financial support, but without the support of professional staff, pro-active members, and business diversification, the co-operative would fail to achieve its objectives and maximize co-operative surplus, which in turns, cause the co-operative to bankrupt (Syamni and Majid, 2016). With the support of professional management and capital

adequacy, to maximize co-operative surplus and ensure their sustainability, the co-operatives should be run efficiently and productively.

There have been limited studies investigated the productivity and efficiency of the co-operatives. Their efficiency is mainly measured by two approaches, comprising the parametric and non-parametric methods. The most commonly used parametric approaches are the Stochastic Frontier Approach (SFA), the Thick Frontier Approach (TFA), and Distribution-Free Approach (DFA). Meanwhile, the most commonly used non-parametric approach is the DEA and the Free Disposable Hull (FDH) (Berger and Humphrey, 1997).

Previous studies investigated the efficiency and productivity of co-operatives worldwide has widely used the non-parametric approach of the DEA as compared to the parametric approach. Using parametric approach, Glass et al. (2014) examined the relative efficiency of Japanese co-operative banks between 1998 and 2009. They found that the co-operatives operated with both technical progress and a decrease in technical inefficiency although they have been restricted in offering their products, membership base, and their markets. Lavado (2004) measured the efficiency of 119 co-operatives in the Philippines from 1990 to 2002 using the SFA and DEA. Based on the SFA, the study found that, on the average, the co-operatives were inefficient, whereas the total factor productivity level was slightly increase based on the DEA over the study period.

Due to its superiorities, the non-parametric of the DEA has been used by previous studies to measure the efficiency of the co-operatives across the globe, both in the advanced and emerging economies. Fandel (2003) analyzes the efficiency of 1,147 Slovak agricultural co-operatives and commercial farming companies and found that the farms of the size group below 100 ha and above 1.000 ha and between 500 – 1.000 ha showed the highest technical efficiency and scale efficiency, respectively. Gomez (2006) examined total factor productivity and efficiency of the Andalusian Horticultural Co-operatives during the period 1995-2004. The study documented a significant increase in efficiency of the co-operatives over the period.

Furthermore, Ariyatne et al. (2006) investigated productivity of wheat marketing and farm supply co-operatives in the United States from 1990 to 1998. The study found that their productivity was mainly contributed by the technology change than the pure efficiency change or scale change. Ludena (2010) investigated total factor productivity level of the agricultural sector in Latin America and the Caribbean between 1961 and 2007 using the Malmquist Index of the DEA. The study documented that growth of the agricultural productivity was due to efficiency and technical progress. Candemir et al. (2011) measured the efficiencies of Hazelnut Agricultural Co-operatives in Turkey during the period 2004-2008 using the Malmquist Index. They found that the co-operatives experienced a slightly decreases in their total factor productivity.

In the European countries, Doumpos and Zopounidis (2012) investigated performances of cooperative banks from Italy, Spain, Germany, France, and Austria over the period 2005–2010 using DEA. Overall, the study found that the co-operatives in Austria recorded the highest level of efficiency, while the lowest one was the co-operatives from Italy. Similarly, Akinsoyinu (2015) explored the efficiency of co-operatives in the financial sector in the European countries (i.e.,

Germany, Netherlands, Italy, Spain, England, France, Austria, Denmark, Finland, and Portugal) during a period of 2008–2013. The study recorded that overall efficiency of the Co-operatives were both efficient and stable over the study period.

Next, in African countries, Marwa and Aziakpono (2014) examined the performance of savings and credit co-operatives in Tanzania using the DEA and found that majority of them were categorized under the low efficiency. Using similar approach, Tesfay and Tesfay (2013) explored the efficiency of the 329 rural financial cooperatives in Tigray region of Ethiopia. The studies revealed that only minority of the co-operatives were relatively efficient. The highest efficient co-operatives were located in the southern and western areas of the country.

In Asian countries, Dong and Featherstone (2006) investigated the efficiency of rural credit Co-operatives in 29 provinces and regions of mainland China over the period 1991-1995. The efficiency of the co-operatives showed a relatively similar level across the provinces due to their engagement in the same technology and scales of production. Jayamaha and Mula (2010) investigated the efficiency of savings and credit co-operatives in Sri Lanka for the period 2003 to 2005. The study documented that several financial practices have significant associations with the efficiency of co-operatives. Sigh et al. (2010) investigated the efficiency of dairy co-operatives in India over the period 1992-1997 and found that their level of technical efficiency has declined from 1992 to 1997.

Finally, the studies on co-operatives efficiency in Indonesia were conducted by Sulikah (2010), Wirnoto (2011), and Syamni and Majid (2016). In her study, Sulikah (2010) measured the efficiency of the co-operatives in the District of Klaten in the Special Province of Yogyakarta, whereas Wirnoto (2011) and Syamni and Majid (2016) measured efficiencies of co-operatives in the Pekalongan City in the Central Java province and Lhokseumawe City in the Aceh province, respectively. These studies documented that co-operatives in the selected districts in Indonesia were highly inefficient.

In summary, most of the studies have widely used the DEA to investigate the efficiency of the co-operatives worldwide. Majority of those studies focused more their analysis on the co-operatives from the advanced economies than the emerging economies. In the context of Indonesia, the limited studies of co-operatives' efficiency were conducted on specific saving and loan co-operatives in selected districts in the country, whereas none of them has entirely investigated their efficiencies nationwide. Thus, this study is aimed to fill the existing gap by exploring the efficiency of the co-operatives across 33 provinces in Indonesia.

3. Empirical framework

3.1. Data Envelopment Analysis (DEA)

Studies on efficiency measurement have used three major approaches. Earlier studies on efficiency have measured it using traditional approaches based on financial ratios (Farrell, 1957). Later studies on measuring efficiency have adopted the frontier analysis, comprising parametric and non-parametric approaches. The parametric approaches that have been commonly used to measure efficiency

consist of the Stochastic Frontier Approach (SFA), the Thick Frontier Approach (TFA), and Distribution-Free Approach (DFA). Meanwhile, the non-parametric approaches that have been widely adopted include the Data Envelopment Analysis (DEA) and the Free Disposable Hull (FDH) (Berger and Humphrey, 1997). This study uses the DEA approach to measure co-operatives in the 33 provinces in Indonesia.

As a non-parametric method, the DEA that was firstly introduced by Charnes et al. (1978) is based on the linear programming, analyzing the functions of production frontier mapping (Ramanathan, 2003; Anderson et al., 2004; and Saad et al., 2006). The DEA is the most widely adopted approach to measure productivity in a wide array of scientific disciplines and diverse operational activities (Cooper et al., 2011). In the last decade, more than 400 studies have measured efficiency and productivity of the Decision-Making Units (DMUs) worldwide (Ali and Seiford, 1993; Majid and Maulana, 2012; and Ismail et al., 2013). Comparing to other approaches, the DEA is a superior method to measure productivity. It is not only able to recognize the input or output of the DMUs using as a reference to discover the sources of inefficiency (Omar et al., 2006; and Hadad et al., 2013), but it also considers all inputs or outputs, differences in technology, capacity, competition, and demographics to measure efficiency. It then compares the level of efficiency of a DMU with the best-practice (efficiency) frontier among the investigated DMUs.

Specifically, this study utilizes the generalized output-oriented Malmquist index or so-called Total Factor Productivity (TFP), introduced by Fare et al. (1989). This index is calculated using the DEA and estimated using the DEA program (Coelli, 1996). The selection of the index to measure efficiency is due to a number of desirable features suited to this study. The DEA does not only require prices of input and output in measuring efficiency, making the method more useful in situations where prices are non-existent or publicly unavailable, it also does not necessitate a behavioural assumption, for instance, cost minimization or profit maximization, in the case where the objectives of the DMUs differ, are unachieved or unknown.

Referring to the study by Fare et al. (1994) Omar et al. (2007), Majid and Hartomi (2010), and Majid et al. (2017), this study measures changes in productivity using the output-oriented Malmquist Index with the following formula:

$$M_o\left(x^t, y^t, x^{t+1}, y^{t+1}\right) = (a) x (b) \tag{1}$$

where:

$$a = \frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)}; \text{and } b = \left[\left(\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^{t+1}, y^{t+1})}\right)\left(\frac{D_o^t(x^t, y^t)}{D_o^{t+1}(x^t, y^t)}\right)\right]^{1/2}$$

where M_o is the Malmquist Index of TFP, D_o is the distance function, x and y correspond to input and output for t and $t+1$ periods, respectively. a is the technical change and b is the efficiency change. In this context, efficiency change (EFch)

shows how well is the conversion of inputs into outputs between *t* and *t+1* periods, while the technical change (TEch) signifies the progress of the adopted technology in the production process, between *t* and *t+1* periods.

Referring to Equation (1), if the values of Malmquist Index are greater than 1.000, thus it indicates an increase in efficiency and technical efficiency levels, whereas the decrease in efficiency and technical efficiency levels, are shown by the value of the indexes of less than 1.000.

Using the Malmquist Index allows us to further decompose the TFP index of the EFch into two sub-components, namely: pure technical efficiency change (PEch) and scale efficiency change (SEch). PEch shows how well the managerial performance in converting the inputs into outputs; while SEch designates the management's capability to select the best possible production scale that is able to attain expected production level. The best possible scale is connected to the size of the DMUs, if the scale of a DMU is too large or too small, it can lead to inefficiencies in the DMUs. In view of this, thus components of the TFP of the Malmquist Index might be further rewritten as follows:

$$M_o\left(x^t,y^t,x^{t+1},y^{t+1}\right) = (a)x(b)$$
$$= (a)x(cxd) \qquad\qquad (2)$$

where:

$$a = \left[\left(\frac{D_o^{t+1}(x^t,y^t)}{D_o^t(x^t,y^t)}\right)\left(\frac{D_o^{t+1}(x^{t+1},y^{t+1})}{D_o^t(x^{t+1},y^{t+1})}\right)\right]^{1/2} \quad ; c = \left(\frac{D_o^t(x^t,y^t)}{D_o^{t+1}(x^{t+1},y^{t+1})}\right); \text{and}$$

$$d = \left(\frac{D_{oc}^{t+1}(x^t,y^t)}{D_o^{t+1}(x^t,y^t)} \frac{D_o^{t+1}(x^{t+1},y^{t+1})}{D_{oc}^{t+1}(x^{t+1},y^{t+1})} \frac{D_{oc}^t(x^t,y^t)}{D_o^t(x^t,y^t)} \frac{D_o^t(x^{t+1},y^{t+1})}{D_{oc}^t(x^{t+1},y^{t+1})}\right)^{1/2}$$

a is the technical change (TEch), *b* is the efficiency change, *c* is the pure efficiency change (PEch), and *d* is the scale efficiency change (SEch).

Furthermore, this study calculates the efficiency of the co-operatives across 33 provinces in Indonesia using the Variable Returns to Scale (VRS) model due to its flexible assumption in the production process. The model helps to assess efficiencies whether an increase or decrease in inputs or outputs does not produce a proportional change in the outputs or inputs, respectively (Cooper et al., 2011). In other words, the addition of inputs *x* times does not necessarily cause the output to increase by *x* times, it can be smaller than *x* times (decreasing returns to scale) or larger than *x* times (increasing returns to scale) (Banker et al., 1984). Thus, this model adds a convexity condition for the λ weight values, by including in the following boundary model:

$$\sum_{j=1}^{n} \lambda_j = 1 \qquad\qquad (3)$$

Since the DEA approach considers a set of *n* observations on the DMUj ($j = 1, ..., n$) that uses *m* inputs *xij* ($i = 1, ..., m$) to produce s outputs *yrj* ($r = 1, ...,s$), thus the efficient frontier is determined by the *n* observations. If $\theta^* = 1$ is based on the input-oriented efficiency score of DMUj, thus this indicates that DMUj is on the

efficient frontier. On this basis, the Equation (3) could then be further re-written as follows:

$$\theta^* = \text{Min } \theta$$

s.t.

$$\sum_{i=1}^{n} xij \ \lambda ij \geq \pi io \qquad i = 1,2,\ldots,m \qquad (4)$$

$$\sum_{i=1}^{n} yrj \ \lambda j \geq yio \qquad r = 1,2,\ldots,s$$

$$\sum_{j=1}^{n} \ \lambda j \geq 1 \qquad \quad (VRS)$$

$$\sum_{j=1}^{n} \ \lambda j \geq 0 \qquad \quad j = 1,2,\ldots,n$$

where π is the VRS' efficiency of a DMU, n is the number of DMUs, m is the number of inputs, s is the number of output, and xij and yrj are the respective inputs and outputs of the jth DMU.

3.2. Input-output specification

Three inputs and one output are used in this study to measure the efficiency of the co-operatives across 33 provinces in Indonesia. To date, there are 34 provinces in Indonesia, where the province of North Kalimantan is the youngest one, officiated in 25th October 2012. Of these provinces, this study only measures the efficiency of the co-operatives in 33 provinces across Indonesia. Due to data unavailability of the co-operatives in the youngest province of North Kalimantan over the period 2010-2015, thus the co-operatives from this province are excluded from the analysis.

As for inputs and output selection, this study uses three inputs and one output. The inputs comprise own capital, external capital, and managerial board, while the surplus of the co-operatives is used as the output. The selection of the inputs and output is based on the Indonesian Co-operative Act, No. 25 (1992). The act describes that, in the principles, the co-operative is operated using own capital and external capital, supported by its managerial committee to produce co-operative surplus. In addition, the selection of these inputs and output follows the previous studies of Gomez (2006) for the case of Spain, Jayamaha and Mula (2010) for the case of Sri Lanka, Sulikah (2010), Wirnoto (2011), and Syamni and Majid (2016) for the cases of Indonesia. These annual data are obtained from the Annual Report of Ministry of Co-operatives and SMEs of the Republic of Indonesia for the period 2010 to 2015.

Own capital is the most important capital in the co-operative because it is sourced from the contribution of their members as the business owners, while external capital comes from outside to strengthen the existing capital of co-operatives as a whole to produce maximum output. In addition, the management is an individual who runs the co-operative business, mandated by the annual members' meeting. Finally, the co-operative surplus is the net business earnings of the co-operative or in the Indonesian term so-called as the "*Sisa Hasil Usaha*". Table 1 illustrates the inputs and output as well as their definitions.

Table. 1. Inputs-Output of the Indonesian Co-operatives

Variable	Definition	Description
Own Capital	The amount of capital owned by co-operatives sourced from internal co-operatives in the form of principal savings, mandatory savings, reserves, and grants.	Input
External Capital	The amount of capital sourced from outside the co-operative in the form of loans derived from members, other co-operatives, banks, financial institutions, the issuance of bonds, and other securities.	Input
Management	Individual with the trust given by co-operatives to run the organization through the mechanism of the Annual Member Meetings.	Input
Co-operative Surplus	Difference between revenues and cost of the co-operatives within a fiscal year period.	Output

4. Results and discussion

4.1. Descriptive statistics

This study explores the efficiency of co-operatives across 33 provinces in Indonesia. According to the Ministry of Co-operatives and SMEs of the Republic of Indonesia report, there were 212,135 co-operatives in the country in 2015. Of these co-operatives, 61,912 units of them were inactive due to various reasons. Mismanagement, lacking capital and inefficiency are among the major determinants contributing to their inactivity (Ministry of Co-operatives and SMEs, 2016). Table 2 reports Descriptive Statistics of Inputs and Output of Co-operatives in Indonesia over the period 2010-2015.

Table. 2. Descriptive Statistics of Inputs and Output of Co-operatives in Indonesia

Descriptive Statistics	Output	Input		
	Surpluses (IDR in millions)	Own Capital (IDR in millions)	External Capital (IDR in millions)	Number of Boards
Mean	297.808	2,193,390.153	2,059,269.359	1,493
Median	0.099	0.582	0.668	923
Std. Deviation	0.684	0.500	0.430	1.751
Minimum	1,326.000	7,418.340	9,108.000	174
Maximum	6,755,911.000	32,882,917.000	28,459,029.000	7,795

As observed from Table 2, on the average, the co-operatives in Indonesia recorded IDR297.808 million of surpluses, IDR2,193,390.153 million of own

capital, IDR2,059,269.359 million of external capital, and 1,493 of board's members. The highest co-operative surplus is recorded by the co-operatives from the province of East Java by IDR6.755 trillion, while the lowest is recorded by the co-operatives from the province of West Sulawesi by IDR1.33 billion. Meanwhile, the highest own capital is recorded by the co-operatives from the West Java province by IDR32.88 trillion and the lowest one is documented by the co-operatives from Bangka Belitung province by IDR7.42 billion.

In terms of external capital, the co-operatives from the Central Java province recorded the highest amount by IDR28.46 trillion, whereas the co-operatives from the West Sulawesi province documented the lowest value by IDR9.11 billion. Finally, the largest co-operatives boards' members are documented by the co-operatives from the province of East Java (7,796 members), while the smallest one is recorded by the co-operatives from the West Sulawesi province (174 members).

4.2. The efficiency of co-operatives in Indonesia

Table 3 reported the level of relative efficiency of the co-operatives in 33 provinces in Indonesia, calculated based on the assumption of Return to Scale Variable (VRS). The value of 1.000 indicated that the co-operative is on the frontier line (efficient), while the value of less than 1.000 indicated technically inefficient.

As observed from Table 3, the study found that only the co-operatives from four provinces in Indonesia have been operated consistently efficient during the study period, indicated by the VRS value of 1.000 over the years 2010-2015. These provinces comprised Bangka Belitung, Jakarta Special Capital Region, East Java, and West Sulawesi. This could be due to their larger market size. The co-operatives from these provinces contributed 70% to the national co-operatives. Jakarta Special Capital Region as the capital city of Indonesia and East Java are the two largest and most developed provinces in the country, where their co-operatives have been running more progressively as compared to other co-operatives nationwide.

On the other hand, the study documented that the co-operatives from the province of North Sulawesi to be the least efficient with 0.055 value of VRS, followed by the co-operatives from West Kalimantan (0.242), Southeast Sulawesi (0.289), and Maluku (0.295). These indicated that these co-operatives could improve their efficiency level by 94.5%, 75.8%, 7.11%, and 70.5%, respectively to be at the best frontier.

Overall, the level of efficiency of co-operatives has been unstable over the period 2010-2015. For instances, the co-operatives in the Central Java province recorded the index value of 1.000 in 2010 and 2012, but in 2011, 2013, 2014, and 2015 the index values have declined to below 1,000. This finding implied that the level of efficiency of the co-operatives has changed from being fully efficient to become inefficient. Unlike the co-operatives in the Central Java province, the co-operatives in East Nusa Tenggara and Lampung have shown an increase in their level of efficiency. On average, their efficiency levels have increased by 49% over the period 2010-2015. Similarly, the co-operatives in the provinces of West Papua, Riau Islands, and South Sumatera have an average increase of their efficiency levels about 30% during the study period. Changes in inputs of own capital,

external capital, and members of the co-operatives contributed to the changes in their level of efficiency.

Table. 3. The Efficiency of Co-operatives in Indonesia (VRS Oriented)

No.	Province	2010	2011	2012	2013	2014	2015	Average
1.	Aceh	1.000	0.440	0.193	0.380	0.385	0.601	0.500
2.	North Sumatra	0.667	0.648	0.597	0.749	0.354	1.000	0.669
3.	West Sumatra	0.593	0.440	0.465	0.665	0.198	0.277	0.440
4.	Riau Islands	0.344	0.578	0.299	0.407	0.191	0.351	0.362
5.	Jambi	0.502	0.447	0.309	0.180	0.231	0.550	0.370
6.	South Sumatra	0.422	0.417	0.346	0.378	0.536	1.000	0.517
7.	Bengkulu	0.878	0.664	0.397	0.495	0.228	0.761	0.571
8.	Lampung	0.372	0.936	0.833	0.216	0.314	1.000	0.612
9.	Bangka Belitung	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10.	Riau Islands	0.872	0.901	0.361	0.206	1.000	1.000	0.723
11.	Jakarta Special Capital Region	1.000	1.000	1.000	1.000	1.000	1.000	1.000
12.	West Java	1.000	1.000	0.821	1.000	0.440	0.326	0.765
13.	Central Java	1.000	0.244	1.000	0.383	0.153	0.111	0.482
14.	Special Region of Yogyakarta	0.512	0.449	0.376	0.303	0.119	0.451	0.368
15.	East Java	1.000	1.000	1.000	1.000	1.000	1.000	1.000
16.	Banten	0.689	0.504	0.390	1.000	1.000	0.469	0.675
17.	Bali	1.000	1.000	0.335	0.364	0.184	0.360	0.541
18.	West Nusa Tenggara	0.202	0.107	0.163	0.183	0.100	0.234	0.165
19.	East Nusa Tenggara	0.217	0.669	0.511	0.435	0.267	0.576	0.446
20.	West Kalimantan	0.376	0.258	0.278	0.237	0.117	0.187	0.242
21.	Central Kalimantan	1.000	0.453	0.219	0.202	0.154	0.183	0.369
22.	South Kalimantan	0.458	1.000	0.652	0.378	0.233	0.358	0.513
23.	East Kalimantan	0.620	0.769	0.446	0.314	0.214	0.745	0.518
24.	North Sulawesi	0.076	0.048	0.037	0.063	0.028	0.079	0.055
25.	Central Sulawesi	0.280	0.238	0.209	0.184	0.092	0.192	0.199
26.	South Sulawesi	0.780	0.414	0.506	0.627	0.445	0.647	0.570
27.	Southeast Sulawesi	1.000	0.194	0.070	0.025	0.186	0.261	0.289
28.	Gorontalo	0.538	0.523	0.143	0.096	0.132	0.481	0.319
29.	West Sulawesi	1.000	1.000	1.000	1.000	1.000	1.000	1.000
30.	Maluku	0.572	0.097	0.383	0.018	0.200	0.503	0.296
31.	Papua	1.000	1.000	0.383	0.149	0.206	0.499	0.540
32.	North Maluku	0.460	0.761	0.288	0.101	0.156	0.379	0.358
33.	West Papua	0.226	1.000	0.756	1.000	0.968	1.000	0.825
Weighted Mean		**0.656**	**0.612**	**0.478**	**0.447**	**0.389**	**0.563**	**0.524**

Over the period 2010-2015, only the co-operatives in 14 provinces recorded efficiency level above the average of the co-operatives industry (i.e., 52.4%) in Indonesia. These included the co-operatives in the provinces of North Sumatra (66.9%), Bengkulu (57.1), Lampung (61.2%), Bangka Belitung (100%), Riau

Islands (72.3), Jakarta Special Capital Region (100%), West Java (76.5%), East Java (100%), Banten (67.5%), Bali (54.1%), South Sulawesi (57.0%), West Sulawesi (100%), Papua (54.0%), and West Papua (82.5%). Meanwhile, the co-operatives in the rest 19 provinces in the countrywide recorded the lower rate of efficiency ranging from 5.50% (co-operatives in the province of North Sulawesi) to 51.8% (co-operatives in the province of East Kalimantan). These lower level of efficiency of the co-operatives in Indonesia supported the earlier studies by Sulikah (2010) Wirnoto (2011) and Syamni and Majid (2016) who documented lower levels of efficiency of the co-operatives in the District of Klaten in the province of Special Region of Yogyakarta, Pekalongan City in the province of Central Java, and Lhokseumawe City in the province of Aceh, respectively.

This indicates that the co-operatives in Indonesia showed different efficiency level across provinces. The co-operatives across 33 provinces in the country recorded different performances from one to another. This empirical evidence contradicts the finding by Dong and Featherstone (2006) who documented a relatively similar level of efficiency among the rural credit co-operatives in 29 provinces and regions of mainland China over the period 1991-1995. Thus, it is extremely important for the government through the Ministry of Co-operatives and SMEs of Indonesia to design proper policies to promote entire co-operatives to have a similar level of performance, which in turns, contribute to the just national economy.

In so doing, more focus should be given by the government to boost the co-operatives in the provinces that experienced the lower level of efficiency by supporting more funds and providing professional managerial training for their staff, thus the co-operatives could be run professionally and productively. The co-operatives that were inefficient could benchmark the fully efficient co-operatives, in their efforts, to enhance their productivity level. Alternatively, the government could provide training for the staff of co-operatives from the provinces that recorded lower level of efficiency by demonstrating to them the best practices of co-operatives that experienced fully efficient over the period 2010-2015.

As observed from Table 3, the co-operatives in Indonesia are found to be inefficient nationwide with the levels of the inefficiency of 34.4% in 2010, 38.8% in 2011, 52.2% in 2012, 52.3% in 2013, 61.1% in 2014, and 43.7% in 2015. In totality, the co-operatives in 33 provinces in Indonesia recorded 47.6% level of inefficiency. This indicates that strong efforts need to be taken strategically to improve roughly 52.4% of their level of efficiency to become fully efficient. Own capital should be allocated to productive business activities supported by enhancing the capital sources from externals and encouraged the members of co-operatives to be pro-actively engaged to fully support the activities of the co-operatives.

4.3. Total Factor Productivity of the Indonesian co-operatives

In this section, the study reported findings of the Malmquist Index of Total Factor Productivity change (TFPch) of the co-operatives in 33 provinces in Indonesia over the period 2010-2015 and its components. The TFPch comprises two components, namely Technical Efficiency change (TEch) and Efficiency change (EFch). Furthermore, the findings from EFch, which is further decomposed into Pure

Efficiency change (PEch) and Scale Efficiency change (SEch) are also reported. It should be noted here that the TFP index of less than 1.000 denotes a decrease in the productivity level, while the TFP indices of 1.000 and greater than 1.000 indicate no changes and an increase in the productivity level of the co-operatives, respectively. Table 4 reported the findings of the TFP index and its components.

Table. 4. Total Factor Productivity Malmquist Index of Co-operatives in Indonesia

No.	Province	TFPch	EFch	TEch	PEch	SEch
1.	Aceh	1.025	0.877	1.169	0.903	0.971
2.	North Sumatra	1.215	1.058	1.148	1.084	0.976
3.	West Sumatra	1.047	0.855	1.225	0.859	0.996
4.	Riau Islands	1.076	0.995	1.081	1.004	0.991
5.	Jambi	1.107	1.012	1.094	1.018	0.994
6.	South Sumatra	1.319	1.189	1.109	1.188	1.000
7.	Bengkulu	1.119	0.989	1.132	0.972	1.018
8.	Lampung	1.496	1.227	1.219	1.219	1.007
9.	Bangka Belitung	0.756	0.854	0.885	1.000	0.854
10.	Riau Islands	1.334	1.063	1.255	1.028	1.034
11.	Jakarta Special Capital Region	1.304	1.000	1.304	1.000	1.000
12.	West Java	1.103	0.846	1.304	0.799	1.058
13.	Central Java	1.063	0.700	1.518	0.645	1.086
14.	Special Region of Yogyakarta	1.107	0.926	1.195	0.975	0.950
15.	East Java	1.310	1.047	1.251	1.000	1.047
16.	Banten	1.066	0.934	1.142	0.926	1.008
17.	Bali	0.988	0.815	1.211	0.815	1.000
18.	West Nusa Tenggara	1.079	1.016	1.062	1.030	0.986
19.	East Nusa Tenggara	1.499	1.208	1.241	1.216	0.994
20.	West Kalimantan	1.046	0.855	1.223	0.869	0.984
21.	Central Kalimantan	0.820	0.710	1.155	0.712	0.997
22.	South Kalimantan	1.073	0.943	1.138	0.952	0.991
23.	East Kalimantan	1.095	1.042	1.051	1.037	1.004
24.	North Sulawesi	1.066	0.961	1.109	1.007	0.954
25.	Central Sulawesi	1.032	0.928	1.112	0.927	1.001
26.	South Sulawesi	1.125	0.963	1.169	0.963	0.999
27.	Southeast Sulawesi	0.820	0.746	1.098	0.765	0.976
28.	Gorontalo	0.930	0.929	1.001	0.978	0.950
29.	West Sulawesi	1.040	0.855	1.216	1.000	0.855
30.	Maluku	1.156	0.940	1.231	0.975	0.964
31.	Papua	1.021	0.838	1.218	0.870	0.963
32.	North Maluku	1.066	0.924	1.154	0.962	0.961
33.	West Papua	1.395	1.363	1.023	1.347	1.012
	Weighted Mean	**1.099**	**0.948**	**1.160**	**0.961**	**0.986**

As observed from Table 4, the weighted average of the co-operatives industry in Indonesia across the provinces over the period 2010-2015 was 1.099, indicating an increasing trend of the performance of the co-operatives in the country by only 9.9%. The co-operatives in the province of Bangka Belitung recorded the lowest performance by 24.4% of TFP regress, while the highest performer was the co-operatives in the province of East Nusa Tenggara by 49.9% TFP progress. In addition, the co-operatives from five provinces (i.e., Bangka Belitung, Central Kalimantan, Southeast Sulawesi, Gorontalo, and Bali) in Indonesia recorded a negative value of TFP, indicating a deterioration of their performances during the study period.

Furthermore, the co-operatives from 19 provinces recorded their TFP to be lower than the average of industry performance. These included the co-operatives from the provinces of Bangka Belitung, Central Kalimantan, Southeast Sulawesi, Gorontalo, and Bali, Papua, Aceh, Central Sulawesi, West Sulawesi, West Kalimantan, West Sumatra, Central Java, Banten, North Sulawesi, North Maluku, South Kalimantan, Riau Islands, West Nusa Tenggara, and East Kalimantan. Meanwhile, the rest co-operatives from 14 provinces (i.e., East Nusa Tenggara, Lampung, West Papua, Riau Islands, South Sumatra, East Java, Jakarta Special Capital Region, North Sumatra, Maluku, South Sulawesi, Bengkulu, Special Region of Yogyakarta, Jambi, and West Java) recorded the TFP to be higher than the average of industry performance. While only one co-operative from the province of Bangka Belitung showed negative trends of TFP and its components, the other five co-operatives from the provinces of Lampung, Riau Islands, East Kalimantan, and West Papua experienced positive trends of TFP and its components.

To further identify which components of TFP contributed to the changes in the entire performances of the co-operatives, the levels of Efficiency change (EFch) and Technical change (TEch) are, in turn, reported here. In terms of the Efficiency change (EFch), the co-operatives from the provinces of Central Java and West Papua were recorded to experience the worst efficiency regress and highest efficiency progress by -30.0% and 36.3%, respectively. Across the provinces, the co-operatives in Indonesia showed a negative efficiency change, on the average, by -5.2%. This indicates that the TFP of the co-operatives' industry in Indonesia has been deteriorated by the negative trend of the efficiency changes. The inability of the co-operative management to use and combine properly mixed inputs to produce maximum output was the main attributable to the low performance of co-operatives during the period 2010-2015 nationwide.

In a more detail, about 67% of the co-operatives experienced deteriorating efficiency level. The study documented that the co-operatives from 22 provinces experiencing negative trends of their EFch. These co-operatives are located in the provinces of Central Java, Central Kalimantan, Southeast Sulawesi, Bali, Papua, West Java, Bangka Belitung, West Sumatra, West Kalimantan, West Sulawesi, Aceh, North Maluku, Special Region of Yogyakarta, Central Sulawesi, Gorontalo, Banten, Maluku, South Kalimantan, North Sulawesi, South Sulawesi, Bengkulu, and Riau Islands. Only co-operatives from the province of Jakarta Special Capital Region are found to have no changes in its efficiency level. Meanwhile, the co-operatives from the rest 10 provinces (i.e., West Papua, Lampung, East Nusa

Tenggara, South Sumatra, Riau Islands, North Sumatra, East Java, East Kalimantan, West Nusa Tenggara, and Jambi) showed positive changes in their efficiency levels. In short, of 33 co-operatives, only 15 of them recorded efficiency changes of being higher than the entire industrial average performance, while the rest 18 co-operatives experienced efficiency changes of being lower than the overall co-operatives' performance in the country.

In order to further identify which sub-components of EFch [i.e., Pure Efficiency change (PEch) or Scale Efficiency change (SEch)] contributed more to changes in efficiency, the findings of the changes both in pure- and scale-efficiency changes are, in turn, reported here. The study found that both PEch and SEch contributed to deteriorating the EFch of the co-operatives in Indonesia by -3.9% and -1.4%, respectively. This indicates that the inability of the co-operatives to rightly mixed the inputs to produce maximum surplus and smaller sizes of the majority of the co-operatives have worsened their efficiency levels. The co-operatives in Indonesia experienced diseconomies of scale, thus they should consider merging few smaller co-operatives into a bigger one, as an effort to reduce their operating costs.

In a more detail, as for their PEch, the study found that the co-operatives from the provinces of Central Java recorded to have the lowest and highest changes in PEch by -35.5% and 34.7%, respectively. Co-operatives from 18 provinces (i.e., Central Java, Central Kalimantan, Southeast Sulawesi, West Java, Bali, West Sumatra, West Kalimantan, Papua, Aceh, Banten, Central Sulawesi, South Kalimantan, North Maluku, South Sulawesi, Bengkulu, Special Region of Yogyakarta, Maluku, and Gorontalo) recorded negative changes in PEch, while the co-operatives from the rest 11 provinces (West Papua, Lampung, East Nusa Tenggara, South Sumatra, North Sumatra, East Kalimantan, West Nusa Tenggara, Riau Islands, Jambi, North Sulawesi, and Riau Islands) recorded positive changes in their PEch. However, the co-operatives from three provinces (i.e., Bangka Belitung, Jakarta Special Capital Region, East Java, and West Sulawesi) their PEch were found to be unchanged, indicated by the value of PEch of 1.000.

Overall, the co-operatives from 12 provinces (i.e., Central Java, Central Kalimantan, Southeast Sulawesi, West Java, Bali, West Sumatra, West Kalimantan, Papua, Aceh, Banten, Central Sulawesi, and South Kalimantan) performed worse than the average of the industrial performance, while the co-operatives from the rest 21 provinces (i.e., West Papua, Lampung, East Nusa Tenggara, South Sumatra, North Sumatra, East Kalimantan, West Nusa Tenggara, Riau Islands, Jambi, North Sulawesi, Riau Islands, West Sulawesi, East Java, Jakarta Special Capital Region, Bangka Belitung, Gorontalo, Maluku, Special Region of Yogyakarta, Bengkulu, South Sulawesi, and North Maluku) are found to performed better than the average of industrial PEch.

Furthermore, the last sub-component of EFch (i.e., SEch) is also found to deteriorate the changes in the efficiency of the co-operatives in Indonesia over the period 2010-2015 with the average -1.4%. Co-operatives from the province of Bangka Belitung recorded the largest scale inefficiency (-14.6%), while the co-operatives from the Central Java provinces documented the largest scale efficiency (8.6%). In addition, co-operatives from 20 provinces showed negative changes in their SEch, three were unchanged, and the co-operatives from the rest 10 provinces experienced positive changes in their SEch. The co-operatives with negative

changes in their SEch were from the provinces of Bangka Belitung, West Sulawesi, Special Region of Yogyakarta, Gorontalo, North Sulawesi, North Maluku, Papua, Maluku, Aceh, North Sumatra, Southeast Sulawesi, West Kalimantan, West Nusa Tenggara, Riau Islands, South Kalimantan, Jambi, and East Nusa Tenggara, West Sumatra, Central Kalimantan, and South Sulawesi. The co-operatives that recorded no changes in their SEch are located in the provinces of South Sumatra, Jakarta Special Capital Region, and Bali. Finally, the co-operatives that experienced positive changes in their SEch were from the Central Java, West Java, East Java, Riau Islands, Bengkulu, West Papua, Banten, Lampung, East Kalimantan, and Central Sulawesi.

Comparing to the mean value of SEch, the Indonesian co-operatives located in 12 provinces (i.e., Bangka Belitung, West Sulawesi, Special Region of Yogyakarta, Gorontalo, North Sulawesi, North Maluku, Papua, Maluku, Aceh, North Sumatra, Southeast Sulawesi, and West Kalimantan) are found to have higher scale inefficiency, while the co-operatives from the rest 20 provinces (i.e., Central Java, West Java, East Java, Riau Islands, Bengkulu, West Papua, Banten, Lampung, East Kalimantan, Central Sulawesi, Bali, Jakarta Special Capital Region, South Sumatra, South Sulawesi, Central Kalimantan, West Sumatra, East Nusa Tenggara, Jambi, South Kalimantan, and Riau Islands) are found to experience higher scale efficiency. However, the co-operatives from the West Nusa Tenggara province is found to be only co-operatives experienced no changes in its SEch, indicated by the SEch value of 1.000.

The next component of TFP changes is the Technical Efficiency changes (TEch). As observed from Table 4, the study found that, on the average, the co-operatives in Indonesia have recorded technical progress by 16.0% over the period 2010-2015. This indicates that the technical progress was found to be the main contribution to the improvements of TFP of the co-operatives nationwide. Adoption of the information and communication technological advancement by the co-operatives, such as online sales and the online transaction has contributed to an improvement of the co-operatives' TFP.

The co-operatives in the province of Bangka Belitung is found to have the highest technical regress (-11.5%), while the co-operatives in the province of Central Java is found to have the highest technical progress (51.8%). Overall, with the exception of co-operatives from the Bangka Belitung province that recorded the negative TEch, all other co-operatives from 31 provinces are found to record positive TFPch. In addition, the co-operatives from 17 provinces (i.e., Bangka Belitung, Gorontalo, West Papua, East Kalimantan, West Nusa Tenggara, Riau Islands, Jambi, Southeast Sulawesi, South Sumatra, North Sulawesi, Central Sulawesi, Bengkulu, South Kalimantan, Banten, North Sumatra, North Maluku, and Central Kalimantan) are found to perform worse than the industrial average performance (16.0%), while the co-operatives from the rest 16 provinces performed better than the industrial average performance. These provinces comprise Central Java, West Java, Jakarta Special Capital Region, Riau Islands, East Java, East Nusa Tenggara, Maluku, West Sumatra, West Kalimantan, Lampung, Papua, West Sulawesi, Bali, Special Region of Yogyakarta, South Sulawesi, and Aceh.

The results of this study are in harmony with previous studies by Syamni and Majid (2016) that the savings and loan co-operatives in the City of Lhokseumawe, Aceh were efficient, and their changes in the TFP level is contributed mainly by the technical changes as opposed to their changes in efficiency level. The findings of different level of co-operatives' TFP across the provinces are in line with the studies by Akinsoyinu (2015), Marwa & Aziakpono (2014), Asawaruangpipop and Suwunnamek (2014), Tesfay and Tesfay (2013), Doumpos and Zopounidis (2012), Candemir et al. (2011), Khan et al. (2010), Jayamaha and Mula (2010) and Sigh et al. (2010), Ariyatne et al. (2006), Gomez (2006), Lavado (2004), Dong and Featherstone (2004), and Fandel (2003) who found that the efficiency level of the co-operative was different from one to another.

The findings of the low level of TFP of the co-operatives across the provinces in Indonesia are not surprising as their scale was generally small. As a result, the co-operatives in the country become vulnerable to the national, regional and international economic turbulences (Hasan, 2010). In addition, inefficient business culture and lacking managerial and entrepreneurial skills among managers has hindered efforts of the make co-operatives become an efficient business entity (Ropke, 2000). Thus, serious and continuous efforts deemed necessary to be taken to further enhance the TFP of the co-operative sector in Indonesia. The remuneration scheme for the co-operatives' management personnel needs to be re-evaluated and upgraded to a performance-based compensation and attractive promotion packages (Othman et al., 2014). Improving the managerial and entrepreneurial skills of the co-operatives human recourses (co-operative entrepreneurship) through ongoing professional training should be regularly conducted. They should be educated to execute their roles and comprehend the governance structure of co-operatives. The members' active participation and public perception on the role of cooperatives should be enhanced. The co-operatives should further adopt the information and communication technological advancements into their daily business activities. The co-operatives should consider merging few small sizes of co-operatives into a bigger one (Syamni and Majid, 2016).

In addition, the government should support the co-operatives to become the real pillar and backbone of the national economy, as mandated by the 1945 Constitution of Indonesia, by both financial and managerial assistance. The government might review its policy to enhance the existing co-operatives in all provinces nationwide to be more efficient and profitable. Stringent enforcement of co-operative act to ensure co-operative conformity towards existing principles and regulation of co-operatives should be implemented to further improve co-operative activities, enhance sustainability, and increase their likelihood of success. The private sector of the economy should be encouraged by the government to work hand in hand with the co-operatives. Finally, the academician is also hoped to positively contribute towards enhancing the performance of the co-operatives and their contributions to the national economy by forwarding research-based policy recommendation.

5. Conclusion

This study empirically measured total factor productivity level of the co-operatives in 33 provinces nationwide. To identify the sources of TFP changes, the study also measured the components of TFP (i.e., efficiency change and technical change) and the sub-components of the efficiency change (i.e., pure efficiency change and scale efficiency change) using Data Envelopment Analysis (DEA) with Malmquist Index. Three inputs (i.e., own capital, external financing, and board size) and one output (co-operative), gathered from the database of the Ministry of Co-operatives and SMEs over the 2010-2015 period were used to measure the productivity and efficiency levels of the co-operatives in Indonesia

The study documented that the co-operatives were enormously inefficient, indicated by the lower average value of indices of efficiency and productivity. Of 33 provinces, only co-operatives in 14 provinces were found to experience an increase in their total factor productivity. The co-operative in the province of East Nusa Tenggara recorded the highest productivity progress by 49.9%, while the co-operative in the province of Bangka Belitung recorded the highest productivity regress by -24.4%. Overall, the productivity level of the co-operatives merely slightly increased by 9.9% over the study period nationwide, which is solely contributed to an increase in technical efficiency. Wasted resources in co-operatives' operations in Indonesia that caused by poor governance is believed as the main factor contributing to high level of co-operatives' inefficiency in Indonesia.

Thus, these findings implied that to further enhance the productivity level of the co-operatives, improving their pure efficiency through better governance should be prioritized, followed by enhancing their scale efficiency and technical efficiency. The co-operatives should provide training for their staff, professional management, adopt advanced technology, and enlarge their size by merging small co-operatives become a larger entity.

The findings of this study are based on the aggregated data of the co-operatives at the provincial level. Thus, to further enhance findings of this study and provide a better picture on the productivity and efficiency of the co-operatives in Indonesia, future researchers on this issue are hoped considering utilizing the data of individual co-operatives nationwide. Measuring efficiency and productivity of the co-operatives in Indonesia might also be conducted based on the sectoral economy and their types. Finally, combining both parametric and non-parametric approaches to measure efficiency and productivity levels of the co-operatives in Indonesia could also provide a comprehensive picture of their efficiency and productivity levels, and thus strengthening the policy recommendation to make the co-operatives become the real pillar and backbone of the national economy of Indonesia, as mandated by Article 33 of the 1945 Constitution of Indonesia.

6. References

Akinsoyinu, A. C. (2015) Efficiency evaluation of European financial co-operative sector. A data envelopment analysis approach. *International Journal of Academic Research in Accounting, Finance and Management Sciences,* Nº 4, Vol. 5, pp. 11–21.

Ali, A. I. & Seiford, L. M. (1993) Computational accuracy and infinitesimals in data envelopment analysis. *INFOR: Information Systems and Operational Research*, Nº 4, Vol. 31, pp. 290-297.

Anderson, R. I., Fok, R. & Scott, J. (2000) Hotel industry efficiency: An advanced linear programming examination. *American Business Review*, Nº 1, Vol. 18, pp. 40–48.

Ariyaratne, C. B., Featherstone, A. M. & Langemeier, M. R. (2006) What determines productivity growth of agricultural cooperatives? *Journal of Agricultural and Applied Economics*, Nº 1, Vol. 38, pp. 47-59.

Asawaruangpipop, P. & Suwunnamek, O. (2014) Analysis on savings and credit cooperatives efficiency in Thailand: a data envelopment analysis (DEA) approach. *Research Journal of Business Management*, Nº 3, Vol. 8, pp. 242-253.

Azhari., Syechalad, M. N., Hasan, I. & Majid, M. S. A. (2017) The Role of Co-operative in the Indonesian Economy. *International Journal of Humanities and Social Science Invention*, Nº 10, Vol. 6, pp. 43–46.

Banker, R. D., Charnes, A. & Cooper, W. W. (1984) Some Models for Estimating Technical and Scale Efficiencies in Data Envelopment Analysis. *Management Science*, Nº 9, Vol. 30, pp. 1078-1092.

Berger, A. N. & Humphrey, D. B. (1997) Efficiency of financial institutions: International survey and directions for future research. *European Journal of Operational Research*, Nº 2, Vol. 98, pp. 175-212.

Burhanuddin, B. (2013) *Koperasi syariah dan pengaturannya di Indonesia.* Malang: UIN-Maliki Press. ISBN: 978-602-958-462-2.

Candemir, M., Özcan, M., Güneş, M. & Deliktaş, E. (2011) Technical efficiency and total factor productivity growth in the Hazelnut agricultural sales cooperatives unions in Turkey. *Mathematical and Computational Applications*, Nº 1, Vol. 16, pp. 66-76.

Charnes, A., Cooper, W. W. & Rhodes, E. (1978) Measuring the efficiency of decision making units. *European Journal of Operational Research*, Nº 2, Vol. 6, pp. 429-444.

Coelli, T. (1996) A guide to DEAP version 2.1 data envelopment analysis (computer) program. *CEPA Working Paper* 96/98. Armdale: University of New England, CEPA.

Cooper, W.; Seiford, L. M.; Zhu, J. (ed.). (2011) *Handbook on data envelopment analysis*. Boston, MA: Springer Science & Business Media. ISBN: 978-1-4419-6150-1.

Deville, K. C.; Penn, J. E.; Eversull, E. (2007) *Farmer cooperative statistics*, 2006. Washington, DC: RD United States Department of Agriculture, Editor.

Dong, F. & Featherstone, A. M. (2006) Technical and scale efficiencies for Chinese rural credit cooperatives: A bootstrapping approach in data envelopment analysis. *Journal of Chinese Economic and Business Studies*, Nº 1, Vol. 4, pp. 57-75.

Doumpos, M. & Zopounidis, C. (2012) *Efficiency and Productivity Growth: Modelling in the Financial Services Industry*, pp. 237-252.

Draheim, G. (1952) *ie Genossenschaft als Unternehmungstyp (2nd edition 1955). Goettingen: Vandenhoeck & Ruprech.*

Fandel, P. (2003) Technical and scale efficiency of corporate farms in Slovakia. *Zemedelska Ekonomika-Praha-*, Nº 8, Vol.49, pp. 375-384.

Fare, R., Shawna, G., Bjorn, L. & Ross, P. (1989) Productivity development in Swedish hospitals: A Malmquist output index approach. *Mimeo*.

Fare, R., Shawna, G., Mary, N. & Zhongyang, Z. (1994) productivity growth, technical progress and efficiency change in industrialized countries. *American Economic Review*. Nº 1, Vol. 84, pp. 66-83.

Farrell, M. J. (1957) The measurement of productive efficiency. *Journal of the Royal Statistical Society*. Series A (General), Vol. 120, pp. 253–290.

Glass, J. C., McKillop, D. G., Quinn, B. & Wilson, J. (2014) Cooperative bank efficiency in Japan: A parametric distance function analysis. *The European Journal of Finance*, Nº 3, Vol. 20, pp. 291-317.

Gómez, E. G. (2006) Productivity and efficiency analysis of horticultural Co-operatives. *Spanish Journal of Agricultural Research*, Nº 3, Vol. 4, pp. 191-201.

Haddad, J., Ramezani, M. & Geroliminis, N. (2013) Cooperative traffic control of a mixed network with two urban regions and a freeway. *Transportation Research Part B: Methodological*, Vol. 54, pp. 17-36.

Hasan, I. (2010) Analisis daya dukung UMKM dan koperasi berbasis agrobisnis pasca konflik Aceh dalam menghadapi ACFTA (Survey pada UMKM dan koperasi Kabupaten Aceh Tengah Propinsi Aceh. *Jurnal Pengkajian Koperasi dan UKM,* Vol. 5, pp. 145-174.

Henzler, R. (1957) Die genossenschaft im wandel: Versuch einer typologie. *Kyklos*, Nº 2, Vol. 10, pp. 156-171.

Henzler, R. (1960) *Osuuskunta yritysmuotona ja jäsentensä tukena*. Helsinki: Helsingin Yliopiston osuustoimintainstituutti.

Holger, B. (1986) The Co-operative association as a business enterprise: A study in the economics of transactions. *Journal of Institutional and Theoretical Economics*, Vol. 142, pp. 310–339.

INTERNATIONAL CO-OPERATIVE ALLIANCE (1995) *Statement on the co-operative identity*. Accessed 24 October 2011. http://www.ica.coop/coop/principles.html ().

INTERNATIONAL CO-OPERATIVE ALLIANCE. (2017) *The 6th annual world co-operative monitor. International Co-operative Alliance's 2017 global conference and general assembly*, Kuala Lumpur, 16 November.

Ismail, F., Majid, M. S. A & Rahim, R. A. (2013) Efficiency of Islamic and conventional banks in Malaysia. *Journal of Financial Reporting and Accounting*, Nº 1, Vol. 11, pp. 92-107.

Jayamaha, A. & Mula, J. M. (2010) *Financial Practices and Efficiency of Co-operative Rural Banks In Sri Lanka*. Sri Lanka: ICBI 2010-University of Kelaniya.

Khan, Z. (2010) Commercial verses cooperative microfinance program: An investigation of efficiency, performance and sustainability. *Dialogue (1819-6462)*, Nº 2, Vol. 5, pp. 166-180.

Lavado, R. F. (2004) Benchmarking the efficiency of Philippines Electric Co-operatives using stochastic frontier analysis and data envelopment analysis, *Working Papers*, Nº 8, East-West Center: International Graduate Student Conference Series.

Ludena, C. E. (2010) Agricultural productivity growth, efficiency change and technical progress in Latin America and the Caribbean. *Inter-American Development Bank. Research*, Dept. II. Title. III. Series. No.IDB-WP-186.

Majid, M. S. A. & Hartomi, M. (2010) Assessing performance of mutual funds in Indonesia. *Journal of Economic Cooperation and Development*, Nº 4, Vol. 31, pp. 49-76.

Majid, M. S. A. & Maulana, H. (2012) A comparative analysis of the productivity of Islamic and conventional mutual funds in Indonesia: Data envelopment analysis (DEA) and generalized least square (GLS) approaches. *Gadjah Mada International Journal of Business*, Nº 2, Vol. 14, pp. 183-208.

Majid, M. S. A., Hamid, A. & Faradilla. (2017) Assessing the productivity of insurance companies in Indonesia: A nonparametric approach. *Journal of Applied Economic Sciences*, XII, Nº 6, Vol. 52, pp. 1593 – 1605.

Marwa, N. & Aziakpono, M. (2014) Efficiency and profitability of Tanzanian saving and credit co-operatives: Who is a Star? *Journal of Economics and Behavioral Studies,* Nº 8, Vol.6, pp. 658-669.

Michelsen, J. (1994) The rationales of Co-operative organizations. Some suggestions from Scandinavia. *Annals of Public and Co-operative Economics*, Vol. 65, pp. 13–34.

MINISTRY OF CO-OPERATIVES & SMES (2016) *Revitalisasi Koperasi Dan UKM Menuju kesejahteraan Rakyat. Performance of Ministry of Co-operatives and SMEs Year 2015*. Jakarta: Kemenkop.

MINISTRY OF CO-OPERATIVES & SMES. (2017) Annual Report. Retrieved from http://www.depkop.go.id/berita-informasi/data-informasi/laporan-tahunan/.

MINISTRY OF CO-OPERATIVES AND SMES (2017) *Number of Co-operatives, Investment, Labor, SHU, Turnover of Cooperatives*. Jakarta: Kemenkop.

Nasution, M. (2007). *Demokrasi Ekonomi Koperasi*. Jakarta: PIP Publishing.

Omar, M. A., Majid, M. S. A. & Rulindo, R. (2007) Efficiency and productivity performance of the national private banks in Indonesia. *Gadjah Mada International Journal of Business*, Nº 1, Vol. 9, pp. 1-18.

Omar, M. A., Rahman, A. R. A., Yusof, R. M., Majid, M. S. A. & Rasid, M. E. S. (2006) Efficiency of commercial banks in Malaysia. *Asian Academy of Management Journal of Accounting and Finance*, Nº 2, Vol. 2, pp. 19-42.

Othman, A., Mansor, N. & Kari, F. (2014) Assessing the performance of co-operatives in Malaysia: an analysis of co-operative groups using a data envelopment analysis approach. *Asia Pacific Business Review*, Nº 3, Vol. 20, pp. 484-505.

Puusa, A., Mönkkönen, K. & Varis, A. (2013) Mission lost? Dilemmatic dual nature of co-operatives. *Journal of Co-operative Organization and Management*, Nº 1, Vol. 1, pp. 6-14.

Ramanathan, R. (2003) *An Introduction to Data Envelopment Analysis: A Tool for Performance Measurement*. New Delhi: Sage.

Rebelo, J.F., Leal, C. T. & Teixeira, Â. (2017) Management and financial performance of agricultural cooperatives: A case of Portuguese olive oil cooperatives. *REVESCO. Revista de Estudios Cooperativos, Primer Cuatrimestre*, Nº 123, pp. 225-249. DOI: 10.5209/REVE.53243.

THE REPUBLIC OF INDONESIA (1992) *Co-operative Act, No. 25 on Co-operatives*. Jakarta: State Secretariat.

THE REPUBLIC OF INDONESIA (1995) *The 1945 Constitution of the State of the Republic of Indonesia*. Jakarta: State Secretariat.

Ropke, J. (1992). *Co-operative Entrepreneurship*. Philips Marburg. Germany

Royer, J. S. & Smith, D. B. (2007) Patronage refunds, producer expectations, and optimal pricing by agricultural co-operatives. *Journal of Co-operatives*, Vol. 20, pp. 1-16.

Saad, N. M., Majid, M. S. A., Yusof, R. M., Duasa, J. & Rahman, A. A. (2006) Measuring efficiency of insurance and Takaful companies in Malaysia using data envelopment analysis (DEA). *Review of Islamic Economics*, Nº 2, Vol. 10, pp. 5-26.

Singh, S., Fleming, E. & Coelli, T. (2000) Efficiency and productivity analysis of co-operative dairy plants in Haryana and Punjab States of India, *Working Paper Series in Agricultural and Resource Economics,* Nº 2000-2, pp.1-18.

Sulikah, S. (2010) Analisis Efisiensi Koperasi Pegawai Negeri Republik Indonesia Kabupaten Klaten. *Skripsi.* Universitas Sebelas Maret.

Syamni, G. & Majid, M. S. A. (2016) Efficiency of saving and credit co-operative units in North Aceh Indonesia, *Signifikan: Jurnal Ilmu Ekonomi,* Nº 2, Vol.5, pp. 99 – 118.

Tesfay, H. & Tesfay, A. (2013) Relative efficiency of rural saving and credit cooperatives: An application of data envelopment analysis. *International Journal of Cooperative Studies*, Nº 1, Vol. 2, pp. 16-25.

Wahyuning, T. (2013) Beberapa faktor yang mempengaruhi sisa hasil usaha (SHU) di KPRI "Bina Karya" Balongpanggang-Gresik. *Jurnal Ekonomi Bisnis*, Nº 1, Vol. 1, pp. 1-18.

Wirnoto, W. (2011) Analisis efisiensi koperasi pegawai negeri Republik Indonesia Kota Pekalongan pada tahun 2011 dengan metode data envelopment analysis. *Skripsi* Surakarta: Universitas Sebelas Maret

Zamagni, S. & Zamagni, V. (2010) *Co-Operative Enterprise: Facing the Challenge of Globalization*. Cheltenham, UK: Edward Elgar Publishing.

Zeuli, K. A. & Cropp, R. (2004) *Cooperatives: Principles and Practices in the 21st Century*. Retrieved from http://learningstore.uwex.edu/assets/pdfs/A1457.pdf.