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Researc h article Financial performance of rural banks in Indonesia: A two-stage DEA approach Wasiaturrahma a , Raditya Sukmana b , Shochrul Rohmatul Ajija a , * , Sri Cahyaning Umi Salama c , Ahmad Hudaifah d a Department of Economics, Universitas Airlangga, Indonesia b Department of Shariah Economics, Universitas Airlangga, Indonesia c Univers itas Muhammadiyah Mal ang, Indonesia d Department of Islami c Economics, Universitas Internasional Semen Indonesia, Indonesia A RTICLE IN FO Keywords: Ef ? ciency Convent ional and Islamic rural bank Data envelopmen t analysis Tobit Banking Corpor ate ?nance Econom etrics Fin ancial economics Microecon omics A BSTR ACT This study aims to analyze the ef ?ciency performan ce of convent ional and Islamic rural banks in Indonesia, speci ?cally, Bank Perkreditan Rakyat (BPR) and Bank Pembiayaan Rakyat Syariah (BPRS). Using a DEA approach, the results indicate that both BPR and BPRS are still inef ? cient in terms of the intermediation role but are ef ?cient in production.

Furthermore, the Tobit estimation show that these two ef ?ciency results are positively affected by location and the capital adequacy ratio (CAR). These rural banks operating in cities tend to have a higher level of ef ?ciency than otherwise. Moreover, the higher the capital, the more ef ?cient both Islamic and conventional rural banks in terms of production and intermediation. 1. Introduction Micro?nance institutions (MFIs) are alternative ?nancial providers for communities that are not covered by the banking sector. Most MFIs operate in developing countries (Forcella and Hudon, 2016), such as Sri Lanka (Alawattage et al.,

2018), Senegal (Scanlon et al., 2019), India (Baland et al., 2019), Indonesia (Adnan and Ajija, 2015), and other developing countries. In these countries, the existence of micro?nance institutions is very important as it affects household loans from infor-

mation sources in the village economy and provides access to new business opportunities (Islam et al., 2015). In Indonesia therefore, the potential demand in micro? nance includes the self-employed and those with no paid workers (Nashihin, 2014). There are some classi?cations of MFIs in Indonesia.

According to the principles, there are two categories of MFIs, i.e. Islamic and conventional MFIs. The difference between the two lies in the operations of Islamic MFIs that are based on sharia, such as no interest and clear contract (Aburime, 2008). Islamic MFIs in Indonesia usually promote equity and trading products (Anwar, 2016), while, interest based is utilizied by the counterpart. Moreover, based on their legal entity, according to Law No. 1 of 2013, MFIs in Indonesia can be in the form of bank supervised by Indonesia Financial Services Authority (OJK) and non bank controlled by Ministry of Cooperatives and Small and Medium Enterprises (SMEs).

Rural banks, known as Bank Perkreditan Rakyat (BPR) are one type of MFIs developed in Indonesia. With the issuance of Law No. 7 of 1992 as amended to Act No. 10 of 1998 concerning Banking, these institutions of? cially became operational. In the Act, it is explained that these are banks that carry out business activities in a conventional manner based on sharia principles (termed as Bank Pembiayaan Rakyat Syariah/BPRS) that do not provide payment traf?c services in their activities. Thus, Rural Banks have several differences with Commercial Banks. First, they have capital requirements that are much smaller than Commercial Banks.

Second, their target is to serve the credit needs of farmers, ?shermen, small traders, employees, retirees, and other layers of society that have not been reached by their counterparts to prevent them from being trapped by moneylenders (Iswandari and Anan, 2015). Therefore, the services provided by rural banks are incomplete compared to those offered by commercial banks such as insurance, credit cards, demand deposits, and foreign exchange. Accordingly, it is no doubt that rural banks both Islamic and conventional are also part of MFIs in Indonesia. * Corresponding author. E-mail addres s: shochrul-r-a@feb.u nair.ac.id (S.R. Ajija).

Contents lists available at ScienceDirect Heliyon journal homepage: www.cell.com/heliyon https:/ /doi.org/10.1016/j.heliyon.2020.e0439 0 Received 26 Februar y 2020; Received in revised form 28 April 2020; Accepted 30 June 2020
 Heliyon 6 (2020) e04390 Those institutions have important roles in driving the development of economy in Indonesia. Although credit to SMEs is still dominated by commercial banks, the contribution of BPR and BPRS continues to in- crease from 4.79 percent in 2013 to

7.5 percent in 2017.

The total SMEs loans disbursed by BPRs and BPRS continues to increase, speci? cally, from 30.65 Trillion Rupiah in 2013 to 46.68 Trillion Rupiah in 2017. Furthermore, they also have speci ?c business activities that serve SMEs and aim to help build the local economy (Wahyuni et al., 2014). According to Indonesia Financial Services Authority (OJK), there were 167 Sharia Rural Banks and 1,619 Conventional Rural Banks in 2017, and this distribution is still dominated in the western region.

The ten provinces with the highest number of BPR are in East Java, West Java, Central Java, Bali, West Sumatra, Banten, North Sumatra, D.I Yogya- karta, and Riau. While those with the lowest number are in Central Sulawesi, Bengkulu, Central Kalimantan, Nangroe Aceh Darussalam, West Papua, Gorontalo, Bangka Belitung, North Maluku, Maluku, and West Sulawesi. The tremendous development of BPR and BPRS needs to be balanced with excellent ?nancial performance. This is important due to their small market share which is based on micro businesses with high default risk (Firmansyah, 2014).

According to the Indonesia Deposite Insurance Aggency or Lembaga Penjamin Simpanan/LPS (2019), from January 2006 to August 2016, 72 units or 4.4 percent BPRs and two units or 1.2 percent BPRSs were liquidated. Moreover, there were 24 BPR and BPRS in the liquidation process from September 2016 to July 2019 due to their inability to compete in the banking industry and the numerous acts of fraud committed by the management or owner of that micro bank which lead to criminal cases (Rustiarini et al., 2016). Furthermore, similar to Islamic commercial banks that conduct their business based on Sharia principles, BPRS and BPRs are not expected to repeat the same mistakes.

Nevertheless, during that period, two BPRS were liquidated and four were in the process of liquidation. Understanding the ?nancial performance of all BPRs and BPRS in Indonesia is absolutely essential. This is because, some previous studies separately analyzed separately the BPR and BPRS, such as Fauzi (2014), Muhari and Hosen (2014), Trinugroho, et al. (2018) Paramita (2008) Hartono et al. (2008), and Septianto and Widiharih (2010). Research which comprehensively analyzes ?nancial performance has indeed been carried out for Islamic and conventional commercial banks such as those conducted by Anwar (2016) .

This research, therefore, contributes to evaluate the ef ? ciency of both conventional and Islamic rural banks in the last ? ve years especially after OJK of? cially started operation, i.e. 2013 to 2017. In the second part, this paper presents several literature reviews about ef ? ciency analysis of ? nancial institutions. Section 3 describes research data and

methods for evaluating the rural banks' ef?ciency while Section 4 provides the ? ndings and discussion. Finally, the last section summarizes the ?ndings and their implications. 2. Literature review 2.1.

Basic principles of BPR and BPRS BPR and BPRS have fundamental differences in terms of the principles utilized. Similar to other Sharia-based ?nancial institutions, BPRS runs its business processes based on Islamic values with interest free rates (Iqbal, 1997). This means that every ? nancial transaction in an SRB may not have an element of usury (riba) or in this case interest on the loan. The imposition of this usury is forbidden by Allah in accordance with Surah Al-Baqarah Ch.1: verse 275, therefore, it is a threat a threat for Muslims not to apply it in all their transactions. Accodring to Ziyadah, the term usury means additional, while Saeed (1996) de ? ned it as the pro- cess of growth.

Terminologically, usury is interpreted as an additional return from vanity of basic assets (Chaudhry, 1999 :4). Fatwa National Sharia Board number 1 of 2004 stated that the practice of interest transactions which occurs at this time has ful? lled the criteria of the Prophet mas'ah, therefore the haram law carried out by various ?nancial institutions (Majelis Ulama Indonesia, 2004). Furthermore, the SRB may not provide additional loans received or channeled to customers. BPRS provides or receives benevolent loans in the form of Qardh contracts, with no additional interest on the loans.

In contrast to the BPRS, BPRs use debt contracts with customers, when they place their funds to obtain interest on the money saved. Instead, funds are lent to customers, with interest charges on the loans disbursed (Yuwana et al., 2012). This business activity is prohibited in Islam because it is considered an element of injustice where creditors provide loans on the conditions of return accompanied by payment of interest which is ? xed and determined at the beginning of the trans- action. In running a business, the borrower does not always obtain pro ?ts (A. Ahmad, Rehman and Humayoun, 2011). BPRS implements several contracts in running its business in order to avoid usury.

In terms of fund raising, it tends to utilize wadiah yad adh- dhamanah (deposit) and mudharabah agreement. While in the wadiah yad adh-dhamanah contract, the funds are used for business with the availability of funds when neeed by the owner (Ajija et al., 2018). Mudharabah contract, provides pro ?t sharing to customers with the principle of revenue or pro ?t/loss sharing. Generally, all BPRS in Indonesia use revenue sharing according to the ratio agreed at the beginning of the contract.

Due to pro? t/loss sharing, there is a possibility that customers also bear losses and of course this affects decision to save funds in Islamic ? nancial institutions. Therefore, the pro ?t sharing ob- tained by the customer is dependent on how much income or pro ?t

the SRB acquires in that month (Beck et al., 2010). In terms of channeling funds, BPRS uses contracts based on trading (murabahah), equity (Mudharabah/Musharakah), or leasing (ijarah) (Amelia and Fauziah, 2017) due to most of its distribution in the form of trading.

Therefore, BPRS tends to bene?t from buying and selling transactions, revenue sharing from equity-based transactions, and fees (ujroh) from leasing transactions. In addition to using a Sharia-compliant agreement, the distribution of funds to the community need to pay attention to Islamic principles of morality which are regulated in the ? qh al-muamalah. Therefore, IFI is prohibited from investing in immoral or illicit businesses such as alcohol, gambling, pork, pornography, hoax or gossip news media, and others (Ika and Abdullah, 2011). 2.2.

Banking ef ? ciency Ef ?ciency is used to measure the value of output produced from a number of inputs used, and this involves measuring company perfor- mance (Al-Darrab, 2000). When the output of a company is equal to or greater than its input, it is declared ef ? cient. Two approaches are used in measuring ef ? ciency in micro?nance institutions, namely, the interme- diation and production approaches. The production approach assumes that the company as a producer generates savings and loan accounts, while the intermediation approach assumes that the company's activities transform money borrowed from surplus funds to the de ?cit (Ahmed, 2002; Khan, Amin, Khokhar, ul Hassan and Ahmad, 2018). Ef ?ciency is improved in various ways such as increasing the consolidation of MFIs and pro? tability (Hartarska et al., 2013).

Contrarily, the small size of loans reduces the level of ef ?ciency (Bos and Millone, 2015). The pro? t factor or the amount of margin used also in- ?uences the performance, including Sharia Micro?nance Institutions (Amran et al., 2014; Hudon and P_e r i l l e u x , 2 0 1 4). There are strategies to maintain the existence of micro? nance in- stitutions in the midst of the various banks currently in micro- communities, one of which is operating, ef ?ciently (Nashihin and Har- ahap, 2014).

However, there is no doubt the strategy for micro? nance industries in each country is different, as is the case in MENA which requires a strategy to develop technology to further embrace the poor and ? nancial sustainability (Bassem, 2014). So far, the technical ef ?ciency of ? nancial institutions and Islamic banking is superior compared to conventional but the average cost Wasiaturrahma et al. Heliyon 6 (2020) e04390 2 ef? ciency is much lower due to cost inef?ciencies and allocation errors (Rosman et al., 2014; Zuhroh et al., 2015).

This is as a result of the diversi? cation of the income and ownership status of ?nancial

in- stitutions which has proven to have an in?uence on their ef ?ciency. The status of state ownership does not affect the level of ef ?ciency in micro? nance institutions both in developing and developed countries, but private ownership in developing countries tends to be ef? cient especially after a crisis occurs (Doan et al., 2017). Currently, micro? nance institutions are faced with two conditions, namely, maintaining the ideology to improve the welfare of the poor and pursuing pro?ts (Kaur, 2016).

There is a trade-off between outreach to poor people and cost ef ? ciency (Abate et al., 2014). Many MFIs are more ? nancially ef ? cient than socially (Abate et al., 2014). Research on ef ?ciency is mostly carried out in developing countries because of the existence of the most active MFIs. The GCC region (Alqahtani et al., 2017), Middle Eastern and Asian countries (Rosman et al., 2014)(Rosman et al., 2014), Sri Lanka (Wijesiri et al., 2015), and Indonesia (Farida et al., 2018) most often use Data Envelopment Analysis (DEA) as a tool to measure this factor.

Other methods besides DEA include Development Economic Analysis (Hudon and P_e r i l l e u x , 2 0 1 4 ; Nashihin and Harahap, 2014), Stochastic Frontier Analysis (SFA) (Nur- boja and Ko_sak, 2017), OLS and Tobit (Bitar et al., 2017), and pro? t models (Berge et al., 2016). DEA is commonly used because it is different in terms of measure- ment. First, the measurement of ef? ciency is technical therefore it only takes into account the absolute value of a variable. The resulting values are relative, thus, they are only applicable to the tested unit (S. Ahmad, Rahim and Rahman, 2012). Previous studies may lack adequate methods or further research, hence, this study bridges the gap by using DEA and Tobit.

The variables used in this study are different from previous research, such as, only employee salary costs, operating costs and other expenses (Bibi et al., 2017), company size, gross domestic product, capital, liquidity, pro ?ts, and in?ation (Fernandes et al., 2018), micro?nance equities and daily quote prices (Bri_e r e a n d S z a f a r z , 2 0 1 7). Compared with previous research which only used one approach, this study will use two approaches simultaneously, namely, the production and intermedi- ation.

In the production approach, the output variables used are inter- est/margin receipts/pro?t sharing from loans channeled and other revenues, while the input variables are interest/margin/pro?t sharing, expenses for productive assets, administrative and general expenses as well asother expenses and non-operating expenses. The intermediation approach uses a channeled loan output, while the input variable consists of capital, liabilities that can be paid immediately, savings, deposits, bank loans, and total assets.

Furthermore, the objects of this research are BPR and BPRS which have rarely been used in other studies. 3. Data and research methods 3.1. Data The data used in this study are secondary and obtained from the ? nancial statements of BPR and BPRS for the last ?ve years starting from 2013 to 2017 which have been available on the pages of the Financial Services Authority. Rural banks and Sharia Rural Banks with incomplete ? nancial statements for the last ?ve years are not used as samples. Based on data compiled by OJK, up to 2017 there were 1,619 BPR and 167 BPRS.

After categorization, 1,271 BPR and 113 BPRS were used as research samples. Sidoarjo and Badung Regency are the districts with the highest number of BPR samples. The total number in Sidoarjo is 55 units, but only 50 units have complete ? nancial reports. In Badung Regency, Bali, the total number was 51 units but only 49 ?t sample criteria. Supposing the districts and cities in Java Island have many rural banks that meet the sample, districts and cities in Java Island have many rural banks that meet the sample criteria, while there are few in external regions, especially in Kalimantan, Maluku, and other central and eastern parts of Indonesia. Most have only one or two BPRs in existence for over ? ve years. Most regions in Indonesia only have one BPRS sample used in this study.

This is because the number of BPRS in Indonesia is still not as much as BPR. Regions that have 2 BPRS samples, namely Mataram City, Gresik Regency, Bandung City, Bandar Lampung City, Makassar City, Kediri Regency, Tangerang City, Yogyakarta City, and Agam Regency. Regions that have 3 BPRS samples, namely Semarang City, Pasuruan City, Bekasi City, Bantul Regency, Kampar Regency, Banyumas Regency, Solo City, Bekasi Regency, Depok City, Bogor Regency, Cilacap Regency, and Sidoarjo City.

While the regions that have more than three BPRS as samples are Bandung and Sleman regencies with a total sample of 5 BPRS per region and Serang Regency with 4 samples (Anwar, 2016; Ibrahim, 2019; Rustiarini et al., 2016). 3.2. Research methods Measurement of Conventional and Sharia rural bank ef ? ciency is carried out using a non-parametric Data Envelopment Analysis (DEA). The focus of this measurement is on the contribution of technical change in the scale of Total Factor Productivity (TFP). Due to the analysis con- dition not being input oriented, output-orientation is used here and in dynamic measurements.

Furthermore, the DEA CCR output models (Charnes, Cooper, and Rhodes) and BBC (Banker, Charnes, and Cooper) with Variable Return to Scale (VRS) were used to measure the ef ?ciency of MFIs. According to Holod and Lewis (2011), there are many studies measuring the ef ? ciency in the banking industry especially after the works counducted by Green (1967) and Benston (1965). There are two approaches in selecting input and

output variables, namely production and intermediation (Syamni and Abd Majid, 2016).

In the production approach, the MFI input includes all the operational costs used to produce various types of assets while the output is in the form of loans and deposits or third-party funds. When this is the case, then the input only covers operational costs and not deposits or interest paid for deposits. In the intermediation approach, the MFI is seen from its role as a liaison between savers/depositors and investors. The output is measured in money value, while total costs include operating costs and interest expenses. This study will measure the level of ef ?ciency of conventional and sharia BPR/BPRS with production and intermediation approaches.

Input and output variables called Decision Making Unit (DMU) are used as represented in the following Table 1 : In the production approach, the determination of input and output variables is based on the Cobb Douglas production function. Further- more, the output variable is the income received by the MFI while the input includes all possible costs that arise from capital and labor (Vujcic and Jemric, 2001). Speci?cally, there are fundamental differences in concepts in the input and output variables of BPR and BPRS. Revenues earned are in the form of interest income from funds loaned to customers or placed in banks, with penalties for late payments.

While income from BPRS is obtained from Sharia ?nancing and loan transactions in the form of buying and selling/murabahah , fees for services/ ujroh, and pro ?t sharing on mudharabah and musyarakah contracts. Penalties due to late payment of installments by customers are not included in the income of the BPRS but are in social funds, therefore, they are not included as output in this study. While in the input aspect, the costs of BPR are in the form of in- terest paid to customers' funds or other banks that save their money in the form of savings or time deposits.

The costs are in the form of pro? t sharing from customers' deposits, using mudharabah contracts and bo- nuses on wadiah (Anwar, 2016; Devi and Firmansyah, 2018; Ibrahim, 2019; Rustiarini et al., 2016). In the intermediation approach, input and output variables are determined to measure the ef? ciency of MFIs in collecting and chan- neling funds. Therefore, the output used channeled loans because the Wasiaturrahma et al. Heliyon 6 (2020) e04390 3 main activities of conventional and sharia BPR/BPRS involve funds for customers success rate to be measured through total revenues including interest income/margin/pro?t sharing (Khan et al., 2017; Ochola, 2016; Sebhatu et al.,

2013). The input variable includes all sources used for channeling capital and debt funds. However, there is no debt in BPRS except qard or loan virtues, therefore, to generate income, the BPRS conducts buying and selling transactions and business cooperation in

the form of mudharabah and musyarakah with customers (Devi and Firman- syah, 2018). After complete input and output data on BPR and BPRS are obtained, then we calculate ef ? ciency scores for BPR and BPRS. We do not interfere with BPR data with BPRS.

This means that the ef ?ciency score obtained by BPR is relative to other BPRs and does not involve BPRS. We also do the same thing when calculating BPRS ef ?ciency scores. The aim is so that the assessment of the ef ? ciency of BPR is not biased with BPRS considering that institutionally BPR has existed far earlier than the BPRS so that it will be unfair if the input and output components are equalized (Anwar, 2016). This research is different from Syamni and Majid (2016) in which the ef? ciency of intermediation of micro? nance institutions was measured by taking cooperative case studies in North Aceh, Indonesia.

In their study, total business volume or revenue was used as the output variable, but instead, this study uses outstanding funds because the purpose of the intermediation approach is to measure how ef ?cient a ? nancial institu- tion is. This is made more speci? c to the intermediation aspect and does not involve the success of ? nancial institutions in obtaining actual in- come, which is the focus of the production aspect. The ? nancial conditions of the two institutions analyzed by the DEA method from 2013 to 2017 can be seen in Table 2. From the aspect of intermediation, the overall performance of BPRS appears to be better than BPR.

This is evident in the average credit channeled by BPRS which tends to be higher than BPR because public funds in the form of savings and time deposits are also much greater. In addition, BPRS capital ap- pears to be larger than BPR and from the production aspect, it can be seen that BPRS revenues and costs are also greater. This is certainly reasonable considering that the funds channeled by BPRS to the community are much higher.

Furthermore, the data summarized in Table 2 are processed using the DEA model to obtain a technical ef ?ciency score with an output-oriented Table 1. Ef ?ciency measurement input and output. Approach Input Output Prod uction 1. Interest/margin/pro ?t sharing from third-party fund 2. Expenses for Allowance for Earning Assets 3. Administrative and General Expenses 4. Non-operational expenses 5. Other expenses 1. Receipt of interest/margin/pro ?t sharing from loans disbursed 2. Other revenue Intermedia tion 1. Capital 2. Savings 3. Time Deposits 4. Bank Loans Loans/ ?nancings disbursed Table 2. Descriptive statistics of input and output of DEA model (in Million IDR). Variables Mean STD Min Max BPR Loan disbursed 12,919.01 10,752.25 5,316.03 20,522.00 Capital 2,050.00 70.71 2,000.00 2,100.00 Savings 3,491.05 2,994.04 1,373.95 5,608.16 Time Deposits 5,996.58 3,419.46 3,578.65 8,414.50 Bank Loan

2,292.01 3,135.89 74.59 4,509.42 Receipt of interest from loans disburs ed 3,539.00 3,318.79 1,192.26 5,885.74 Othe r revenue 240.71 164.44 124.44 356.99 Interest from third-party fund 705.75 585.00 292.10 1,119.41 Expenses for Allowance for Earning Assets 185.42 262.22 0.00 370.83 Adminis trative and General Expenses 1,519.00 1,141.69 711.70 2,326.29 Othe r expenses 37.60 44.68 6.01 69.20 Non-opera tional expenses 46.68 55.95 7.12 86.25 BPRS Fin ancing disbursed 41,155.10 81,872.79 1,007.60 794,740.46 Capital 6,239.37 10,730.34 500.00 96,000.00 Savings 13,333.92 23,336.14 17.54 203,807.20 Time Deposits 21,374.63 47,553.15 105.00 359,322.75 Liabilities to other banks 698.81 3,644.60 0.00 41,166.03 Receipt of margin/pro ? t sharing from ?nancing disbursed 31,470.90 44,151.58 251.01 62,690.78 Othe r revenue 2,606.61 3,608.45 55.05 5,158.17 Mar gin/pro ?t sharing from third-party fund 12,229.25 17,234.53 42.60 24,415.90 Expenses for Allowance for Earning Assets 635.99 859.85 27.99 1,244.00 Adminis trative and General Expenses 13,931.01 19,146.86 392.13 27,469.89 Othe r expenses 274.67 335.06 37.75 511.59 Non-opera tional expenses 53.01 62.38 8.90 97.12 Wasiaturrahma et al. Heliyon 6 (2020) e04390 4 variable return to scale approach.

Generally, the DEA models for this research are as follows: Min F s: t : (1) X j ? j x jm _ Fx j 0 m ; m ¼ 1; 2; …M (2) X j ? j x jn _ Fx j 0 n ; n ¼ 1; 2; …N (3) ? i _ 0 ; j ¼ 1; 2; … :J (4) Where: F is DEA ef ?ciency inverse, x jm is the input m from DMU j , j 0 is DMU, y jn is the output n for DMU j , and ? j is the variable to be calculated from the data. After determining the ef ?ciency score through both production and intermediation approaches, the factors that in?uence the score will be estimated using panel Tobit.

The bank's ? nancial performance is in?u- enced by business scale, CAR, ownership structure, market share, market concentration, and NPL. Banks that have a high business scale tend to reduce production costs because they have reached a high economic scale (Bikker and Hu, 2002; Guill_en et al., 2014; Pasiouras and Kosmidou, 2007; Short, 1979; Smirlock, 2006). A good bank is one that can maintain a high level of CAR because it can reduce its bankruptcy rate (Liu and Wilson, 2010; Pasiouras and Kosmidou, 2007). In general, a private-owned bank will be more powerful than the state-owned bank (Nouaili et al.,

2015). This is due to state-owned banks often bearing more risky loans, namely customers with a high risk of default and not having good asset quality (Cornett et al., 2009). A bank with a weak market share usually tends to have poor performance (Liu and Wilson, 2010). In addition, a high NPL usually has a negative effect on a bank's performance (Georgievska et al., 2011). The determinant of ef? ciency scores in this study is also seen from the possibility of internal and external factors. The location also greatly determines the success of MFI ef? ciency (Ferdousi, 2013).

Furthermore, the age of MFIs and the number of of? ces is considered to have a positive effect on their ef ? - ciency (Akram et al., 2016). In summary, the variables used in the panel Tobit are provided in Table 3 . 4. Findings and discussions In Indonesia, BPR emerged in 1977 since PT. Bank Rakyat Indonesia (BRI) began to develop village barns, market, village, employee and other similar banks. By De Yure, BPR was ?rst recognized in the De facto on October 27, 1988, as part of the Financial, Monetary and Banking Policy Package.

Furthermore, the institution is basically a new name for several ? nancial institutions built by BRI namely Bank Desa, Lumbung Desa, Bank Pasar, Bank Pegawai Lumbung Pilih Nagari (LPN), Lembaga Perk- reditan Desa (LPD), Badan Kredit Desa (BKD), Badan Kredit Kecamatan (BKK), Kredit Usaha Rakyat Kecil (KURK), Lembaga perkreditan Keca- matan (LPK), Bank Karya Desa (BKPD) and other similar institutions. Furthermore, since the issuance of Law No. 7 of 1992 concerning Prin- cipal Banking, the ?nancial institution has clearer legal status through the Minister of Finance.

In a further development, BPRs were not only managed convention- ally using the interest system but also began to be managed using Islamic ? nancial principles, hereinafter referred to as BPRS. In Indonesia, the BPRS that ?rst operated were PT. BPR Dana Mardhatillah, PT. BPR Berkah Amal Sejahtera, and PT. BPR Amanah Rabbaniyah in 1991, located in Bandung, West Java. Thus, BPR existed long before BPRS. The inef ? ciency in carrying out the intermediation role shows that the two micro? nance institutions still cannot optimally channel their funds to the community. This means that many of the collected funds are not ? nancially channeled to customers.

Considering that the market shares of the two institutions are micro, small and medium enterprises tend to have high business risks. In addition, BPR and BPRS managers have calculated that with their current conditions of intermediation, they have succeeded ef ?ciently from the production aspect, meaning they succeeded in achieving optimal revenue at an ef ?cient cost. From these calculations, the ef? ciency level of BPR and BPRS in the observation period is higher than the intermediation ef ?ciency. In 2013 to 2017, with a trend that was often stagnant, the average ef ?ciency of BPR intermediation was 0.51 while that of BPRS was 0.53. Meanwhile, as the trend increases yearly, the average production ef ? ciency of BPR is 0.86 and 0.89 for BPRS. When the ef ?ciency score is between 0.40 to 0.60, the company is still said to be inef? cient, while if it is between 0.80 to 1.00, then the company is said to be ef? cient. Based on the grouping, it can be concluded that by using the intermediation approach, both BPR and BPRS are still inef? cient.

Meanwhile, they achieved ef ?cient con- ditions in terms of the production approach. More speci?cally, there are several BPRs and BPRS that have the potential to be ef ? cient in carrying out their intermediary roles (see Table 4). However, these two cannot be compared because in this study, BPR and BPRS are separated in ef? ciency analysis. Thus, the number of Decision Making Units (DMUs) analyzed is not the same and the ef ? - ciency score of BPR applies to it alone, which is valid for BPRS as well. Even though an ef ?ciency comparison shows 78.39 and 83.54 percent for BPR and BPRS respectively, from this study it can be seen that there is around 22.01 percent of BPRs capable of being very ef ?cient in carrying out the intermediation process. Whereas for BPRS, around 25.49 percent are able to achieve similar results. Comparison of the two institutions using DEA has been conducted in several studies, but the variables and amounts used are not as complex as this research.

Interestingly, the ef ?ciency of BPRS is higher than BPR (Muhari and Hosen, 2014 ; Putri, 2016; Zuhroh et al., 2015). According to Hartono et al. (2008) BPRs have been inef?cient since 2005 (Hartono et al., 2008). In some regions, the same results are also shown, specif- ically, ef ? cient BPRs are less than those that are inef? cient, such as in Semarang (Septianto and Widiharih, 2010) and Jakarta-Bogor-Depok-Tangerang-Bekasi (JABODETABEK) (Hartono et al., 2008). The average technical ef ? ciency of BPR that is lower than BPRS may be due to the number of cases of fraud in BPR that are very serious (Rustiarini et al., 2016). As a result of this fraud, the community is Table 3. Variables of Tobit model.

Variables Description of Variables TE-Prod Technical Ef? ciency of the produ ction approach TE-In ter Technical Ef? ciency of the intermediatio n approach Car The capitalization rate is measured by the ratio of capital to total assets (capital adequacy ratio/CAR) NPL/ NPF * Non-performing loan/ ?nancing in percentage Owner Ownership structure (1 represents government property , and 0 is others) Loc Location of of? ce (1 indicates city, and 0 is others) Scale Total asset in natural logarithm * Note: NPL is non performing loan di BPR, and NPF is non perfroming ?nancing in BPRS. Wasiaturrahma et al. Heliyon 6 (2020) e04390 5 Table 4. The classi? cation of BP R and BPRS according to the technical ef? ciency results.

Institution Classi ?cation Period 2013 2014 2015 2016 2017 Unit Percent Unit Percent Unit Percent Unit Percent Unit Percent BPRS Intermedia tion Approach Very Ef ?cient 13 11. 50 8 7.08 7 6.19 9 7.96 9 7.96 Ef ?cient 19 16. 81 19 16.81 19 16.81 20 17.70 21 18.58 Quite Ef ?cient 18 15. 93 20 17.70 22 19.47 19 16.81 23 20.35 Inef ? cient 22 19. 47 23 20.35 23 20.35 22 19.47 18 15.93 Very Inef ?cient 41 36. 28 43 38.05 42 37.17 43 38.05 42 37.17 Prod uction Approach Very Ef ?cient 41 36. 28 40 35.40 41 36.28 41 36.28 43 38.05 Ef ?cient 29 25. 66 46 40.71 57 50.44 64 56.64 70 61.95 Quite Ef ?cient 23 20. 35 22

19.47 15 13.27 8 7.08 0 0.00 Inef ? cient 14 12. 39 5 4.42 0 0.00 0 0.00 0 0.00 Very Inef ?cient 6 5.3 1 0 0.00 0 0.00 0 0.00 0 0.00 Total Samples 113 Picture 1: The Average of Technical Ef ?ciency of BPR and BPRS. Table 5. Descriptive statistics of variables used in the Tobit model. Variables Mean Std. Dev Min Max BPR TE-In termediation 0.51 0.29 0.00 1.00 TE-Production 0.86 0.15 0.20 1.00 CAR 0.20 0.34 0.01 8.06 NPL 0.08 0.38 0.01 18.00 Owner 0.07 0.26 0.00 1.00 Loc 0.25 0.43 0.00 1.00 Size 17.01 1.23 12.55 22.21 Turnover 15.44 1.15 9.71 20.67 BPRS TE-In termediation 0.53 0.31 0.01 1.00 TE-Production 0.89 0.15 0.20 1.00 CAR 0.21 0.29 0.01 4.35 NPL 10.81 11.62 0.01 85.07 Owner 0.19 0.39 0.00 1.00 Loc 0.33 0.47 0.00 1.00 Size 17.05 1.17 13.31 20.78 Turnover 15.32 1.11 11.70 19.06 Wasiaturrahma et al.

Heliyon 6 (2020) e04390 6 increasingly distrustful of BPRs, which has resulted in a decline in their performance. There are conventional and Islamic banks in other countries that actually show different results from Indonesia, for instance, in Malaysia, each bank has a different type of ef ?ciency. Islamic banks are considered more capable of allocating and utilizing their resources, while conven- tional banks are more ef? cient because they utilize information and electronic technology (Ismail et al., 2013).

In the Middle East, Islamic banks are less ef? cient than conventional (Rosman et al., 2014). A f te r ca l c u lat i ng t h e ef ? c i e n c y l e v e l o f ea c h B P R a n d BP R S, i t i s imp o rt a n t t o d e t e r m i n e t h e fa c t o r s t h a t i n ? u e n c e th e i r i n t e r m e d i a t i o n and production ef ? c i e nc i e s . Ge n e r a l l y, T a b l e 5 s h o w s t h e c o n d i t i o n o f t h e v a r i a b l es u s ed i n t h e To b i t m o d el .

F r o m 20 1 3 to 20 1 7, th e av e r ag e C A R , b u s i n es s s c a le an d v ol u m e o f B P R an d B P R S wer e n ot s i g ni ? - c an t ly d i f f er e nt . H ow ever, a s tr i k i ng d i f f er e nce ex i s t s in t h e c o n di ti o n o f n on - p er f o r m i n g l o an s wh er e th e le v el o f BPR S N P L i s much hi g h e r t h a n B P R. Al t h ou g h no t si g ni ? c a n tl y dif f e r en t, t h e a v er a g e BP R S o w ne rs h i p by lo c a l g o v e r n m e n ts t e n ds t o b e h i g h e r .

Th i s in di c a t e s t h e i r t en d en c y to swit c h t o t h e l s lam i c ? nan c i a l sy s t e m in ma na g i n g their ? n an c e s . In ad d i tio n , t h e av e r ag e BP R S l o c a te d i n c i t i es i s a l s o h ig her. The data summarized in Table 5 are then processed using the Tobit model to determine which factors affects the level of technical ef ? ciency using both intermediation and production approaches. Overall, the re- sults of the Tobit estimation in this study can be shown in Table 6 .

From Table 6 , it can be seen that the capital adequacy ratio (CAR) consistently has a signi? cant effect on the intermediation ef? ciency of both BPR and BPRS, and the

production ef ? ciency of BPRS. It cannot be denied that the capital adequacy of the two institutions greatly de- termines their ? nancial performance. The greater the capital owned, the higher the level of production and intermediation ef ?ciency. CAR shows the ability of BPR and BPRS in providing funds to anticipate the possi- bility of default.

When CAR increases mainly due to the higher capital and or low-risk assets, the potential to achieve ef ? ciency in both pro- duction and intermediation will also be higher. High capital is basically a source of cheap funds for banks, therefore, the selling price of their credit will be more competitive. Of course, this makes bank intermediation capabilities higher because these funds are deposited funds that have a small possibility of being withdrawn by investors except in a state of dispute or bankruptcy.

This ? nding is consistent with the research conducted by Anwar (2016) which states that CAR is one of the impor- tant components in improving banking ef ? ciency (Anwar, 2016). Non-performing loans only affect the intermediation and production ef? ciencies of BPRS, despite a 10 percent signi? cance level. Similar to Devi and Firmansyah (2018), we also found on the high NPF has a negative impact on the ef ? ciency of the collection and distribution of funds (Devi and Firmansyah, 2018).

BPRS seems to be increasingly careful in channeling funds because it is feared that this will lead to higher risks in the future. However, NPLs actually have a positive effect on the institution's production ef ? ciency. The average NPL of BPRS continues to increase gradually from 9.06 percent in 2013 to 12.01 percent in 2017, while the level of production ef ? ciency also rises from 0.80 to 0.95. Increasing the prudence of BPRS in the distribution of ? nance may improve its quality. Thus, making it possible to obtain relatively high income from good quality customers.

The loan to deposit ratio has a signi? cant negative effect on the level of ef? ciency of BPR production. The higher the LDR level, the lower the score. This is likely to happen when the credit characteristics of the BPR are quite risky. Thus, to maintain production performance, it should regulate its LDR in a safe position. The locations in which BPRs and BPRS operate have a signi? cant role in in?uencing the level of production ef ? ciency and intermediation. In this study, the aspect of location was attempted to be included as a determinant of ef ? ciency scores.

This variable was chosen to determine whether the location of the BPR or BPRS in the Municipality and District was different considering that the Municipality was identical to the area that had more complete facilities and infrastructure as well as a higher level of community income. Although on average, there are many in the Regency region, it follows that BPRs and BPRS located in the Munici- pality have a higher chance of being

more ef ?cient. Location factors turned out to be more positively in?uential on intermediation ef ?ciency. This means that there are more opportunities for BPR and BPRS to collect and channel funds to the city community than other regions.

However, although signi?cant, the effect of location on production ef? ciency is not as large as intermediation. Thus, obtaining pro? ts in the Regency region also has equally small opportunities compared to BPRs and BPRS oper- ating in the Municipality area. The business scale has a signi? cant positive effect on the production ef? ciency score of BPRS. As a relatively new player in the Indonesian banking industry, high assets greatly contribute to increasing production Table 6. Tobit estimation results. Variables Intermediation Production BPR BPRS BPR BPRS car 0.015663 0.043206 0.008595 0.0672581 0.0016808*** 0.0170889** 0.0054259 0.0251003*** NPL/ NPF 0.0002775 -0.0006286 0.0018252 0.0010656 0.0012219 0.000372* 0.0048 0.0005653* ldr 2.80e-06 -3.71e-06 -0.0002546 0.000046 0.0000201 0.0001278 0.0000831*** 0.0001813 owner 0.0078902 -0.0844014 0.0057572 -0.0269201 0.019017 0.0712616 0.0070569 0.0191252 loc 0.4299951 0.1047641 0.1237972 0.0349064 0.0146986*** 0.0473664** 0.0042312*** 0.0153156** size 0.0008238 -0.0077431 0.0010532 0.0294696 0.0005161 0.0089912 0.001502 0.0071274*** consta nt 0.3831199 0.6449112 0.824713 0.351693 0.0117142*** 0.1590406*** 0.0264482*** 0.1240744*** Wald chi2 949.79*** 20.80*** 892.75*** 27.87*** Note: *** signi ?cant at 1%, ** signi ?cant at 5%, * signi ?cant at 10%. Wasiaturrahma et al. Heliyon 6 (2020) e04390 7 ef? ciency.

In this case, it is possible that the operational costs incurred are also relatively low. Supposing this study also shows that CAR and assets have a signi?cant positive effect on BPRS production ef ?ciency scores, then it should increase asset components other than capital, for example, third-party funds or those from Sharia commercial banks. Previous research stated that there are several causes of ef ? cient and inef ?cient BPR and BPRS. For a number of cases, BPRs that carry out mergers are fully ef ? cient (Hartono et al., 2008).

The causes of in- ef? ciencies are capital, third-party funds, and excessive interest expenses when lending and bank interest income are less than optimal (Putri, 2016). In BPRS, the causes of inef? ciency are the absence of ? nancing that contains pro? t sharing and business competition between Islamic micro? nance institutions (Fauzi, 2014), and low ROA, ROE, and liquidity (Hamidi, 2017). In order to avoid these, some efforts are needed such as controlling other income variables, current assets, total ? xed assets, third-party funds, and workforce expenses (Muhari and Hosen, 2014 ; Sembiring, 2019).

BPRS that operate with sharia principles can optimize transactions or contracts that use

pro ?t-sharing contracts and control their assets and liquidity, reduce production costs (Miah and Uddin, 2017), and increase bank size (S. Ahmad et al., 2012). 5. Conclusion From the technical ef ?cacy calculation using the DEA method, this study concludes that BPRs and BPRS are still inef?cient in carrying out their intermediary roles. However, both institutions have been proven ef? cient in the production aspect. To improve the ef ?ciency of inter- mediation and production, both institutions should increase their capital.

This is because, from the results of Tobit's estimation, the capital ade- quacy ratio has a signi?cant positive effect on technical ef ? ciency in both approaches. Additionally, the location factor also has an in ?uence as it can be seen that the more there is in the city, the greater the potential for ef? ciency. Evidently, the city has a more complete infrastructure that allows for quicker business development. The overall ef ? ciency associated with the production and interme- diation of BPRS is relatively slightly higher compared to BPR (Anwar, 2016), which shows that its ?nancial performance is better.

This is certainly in line with the number of BPRs liquidated by LPSwhich does not make it feel safe due to the 1.2 liquidated of the younger age dif- ferences leaving4 units or 2.2 percent currently in the liquidation process. Although Tobit regression estimation has been conducted to look for factors capable of affecting the ef? ciency of BPR and BPRS, The model in this study does not cover several other important causes such as the ex- istence of banking crimes which turned out to be the main cause of the default of many BPRs in Indonesia (Rustiarini et al., 2016).

The various forms of competition between banks, product innovations and other ? nancial institutions which also targets micro? nance, and innovation technology in ? nancial worlds such as ? ntech. This became a limitation of this study which is important to highlight due to the ef ? ciency of BPR and BPRS which is not solely determined by the variables analyzed in the Tobit model. Furthermore, from this study, it appears that there was a trade-off between the functions of production and intermediation in both BPRs and BPRS as micro?nance institutions.

The inef?ciency of their inter- mediation aspects turned out to be accompanied by the success of pro- duction. This certainly raises a new question; Does this really have to be the case in micro? nance institutions in Indonesia? To maintain ?nancial sustainability, the companies limited the distribution of funds and chose healthy partners, therefore, they succeeded in making ef ? cient pro? ts.

Then, the next questions arise; What is the pro? le of recipients of BPR and BPRS funds? Are micro? nance institutions intended to develop micro, small and medium enterprises?

If not, which institutions will serve the businesses not covered by BPRs or BPRS? This is certainly a recom- mendation for further research to answer these questions. The Financial Services Authority or Otoritas Jasa Keuangan (OJK) should provide more supervision of inef? cient BPRs and BPRS in order not to disrupt the stability of the banking industry in Indonesia.

Declarations Author contribution statement Wasiaturrahma and S.R. Ajija: Conceived and designed the experi- ments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper. R. Sukmana: Performed the experiments; Contributed reagents, ma- terials, analysis tools or data; Wrote the paper. S.C.U. Salama: Performed the experiments; Wrote the paper. A. Hudaifah: Contributed reagents, materials, analysis tools or data; Wrote the paper. Funding statement This research is funded by the Indonesia Ministry of Research, Technology, & Higher Education.

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