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Technical and Scale Efficiency of Russian Far East Banks: A Non-Parametric Approach

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This article looks into the technical and scale efficiency of Russian Far East banks. In the analysis we employ a non-parametric approach. The characteristics of this approach enable us to investigate the efficiency without specifying assumptions on the form of the production function and to easily implement the analysis using multiple outputs. We find Far East banks to have little difference in technical and scale efficiency by administrative districts. We also find that larger banks' overall inefficiency scores tended to be due to scale inefficiency, and many that smaller banks operate efficiently from both technical and scale aspects. Furthermore, we mention that there is a tendency for larger Far East banks to operate at decreasing returns to scale, whereas many smaller banks work at constant returns to scale.

Keywords: Banking, Russia, Russian Far East District, Non-parametric Approach, Efficiency Measurement.
JEL Classification: C14, G21, P29.

1. Introduction

The purpose of this paper is to provide a measure of banks' technical and scale efficiency in the Russian Far East District. After the collapse of the Soviet Union, the Russian Far East District attracted more attention from Japan from an economic aspect. Former studies on the Russian banking sector have mainly focused on Moscow banks, and there is no research focusing on banks in the Russian Far East District. For example, Dmitriev et al. (1996) picked up 627 banks and analyzed characteristics of their activities. He investigated only banks whose headquarters are located in Moscow, however. Though the OECD (1997) analyzed the Russian banking sector without limiting the objects of its analysis to Moscow banks, it took up only aggregated data by 13 economic districts.

Therefore, given the increasing interest in the Russian Far East District it is worth estimating the efficiency of Russian Far East banks. To estimate the efficiency of a decision making unit (DMU) we have to derive the locus of efficient production plans, or the frontier, and then measure the distance between the frontier and the point calculated by some observed inputs and outputs for each DMU. Given a sample of DMU with observed inputs and outputs, the derivation of the locus of the efficient production plans can be achieved through the implementation of two alternative methodologies: one parametric and one that is non-parametric[1]. This paper employs the non-parametric approach to estimate the efficiency of each bank. This means that the approach utilizes the observed inputs and outputs to construct the best practice reference units as a convex hull in input/output space, without estimating parameters. In the analysis we computed the efficiency of input usage to produce a given level of outputs; therefore it can be referred to as input-based method. There are several favorable characteristics in this approach. First, it does not have to specify the estimated production function, which the parametric approach requires. Second, not only can it easily implement multiple outputs and variable returns to scale, it also provides technical and scale efficiency scores for each individual bank without having data on input prices, in contrast to the parametric cost function estimation. Third, it can easily estimate the amounts of scale inefficiency and can determine the source of scale inefficiency.

The outline of this paper is as follows. Section 2 illustrates the methodology of non-parametric linear programming, which will be used to calculate degrees of technical efficiency and scale efficiency. Section 3 gives a description of the data for 44 banks, and specifies outputs and inputs for the banking sector. The empirical results of the efficiency analysis are presented in Section 4. The last section is the summary and conclusion.

2. The Non-Parametric Approach

This section presents the non-parametric approach used to estimate efficiency of each DMU. This approach is aimed at determining an envelopment surface, and the frontier is derived by joining those points in the input-output space so there is no case that produces the same outputs with less inputs. In the case of constant returns to scale (CRS), the frontier will be linear. Relative to this reference technology, the following linear programming problem can be solved:

$$C = \min \Theta_{CRS} \tag{1}$$

subject to

$$\Theta_{CRS} x_0 - X\lambda \geq 0 \tag{2}$$

$$Y\lambda \geq y_0 \tag{3}$$

$$\lambda \geq 0 \tag{4}$$

where $y_o = (y_1, y_2, \cdots, y_m)$ is a vector of outputs produced by DMU_o $(0 = 1,2 \cdots j)$ and $x_o = (x_1, x_2, \cdots, x_n)$ is a vector of inputs utilized by DMU_o. Y denotes the $(j \times m)$ matrix (j represents the number of firms) and X denotes the $(j \times n)$ matrix. λ denotes a non-negative vector $(\lambda_1, \lambda_2, \cdots, \lambda_j)^T$ of variables. We have , $0 < \Theta_{CRS} \leq 1$, and refer to Θ_{CRS} as overall technical efficiency.

In the case of variable returns to scale (VRS), the frontier will be convex. In order to estimate the efficiency of a DMU under this condition, the following linear programming problem needs to be solved :

$$V = \min \Theta_{VRS} \tag{5}$$

subject to

$$\Theta_{VRS}\, x_O - X\lambda \geq 0 \tag{6}$$

$$Y\lambda \geq y_0 \tag{7}$$

$$e\lambda = 1 \tag{8}$$

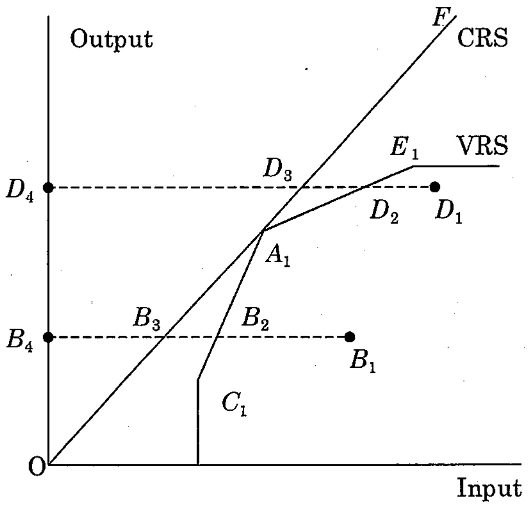
$$\lambda \geq 0 \tag{9}$$

where $e\lambda = \sum_{k=1}^{j} \lambda_k = 1$. We refer to Θ_{VRS} as pure technical efficiency.

Figure 1 illustrates these efficiency measures, utilizing the one-input and one-output model. In the case of constant returns to scale, only A_1 is regarded as efficient. For example, the overall technical efficiency of B_1 is calculated as $B_3 B_4 / B_1 B_4$, and that of D_1 is calculated as $D_3 D_4 / D_1 D_4$. Under the assumption of variable returns to scale A_1, C_1 and E_1 are observations forming the efficient frontier, whereas B_1 and D_1 are inefficient observations. For example, the pure technical efficiency score of B_1 is calculated as $B_2 B_4 / B_1 B_4$, and that of D_1 is calculated as $D_2 D_4 / D_1 D_4$.

In order to measure the scale efficiency we use another indicator, which is calculated as the ratio of overall technical efficiency to pure technical efficiency. The formula can be given as:

Figure 1 . Measuring technical and scale efficiency



$$S = \frac{\Theta_{CRS}}{\Theta_{VRS}} \tag{10}$$

The unit value of S implies that DMU is scale efficient. When scale inefficiency exists, it is the consequence of operating at non-constant returns to scale. Färe, Grosskopf and Lowell (1985) indicated that the reason for scale inefficiency can be found for each DMU by the comparison of measures of CRS, VRS and NIRS (non-increasing returns to scale). To measure the score of NIRS, the following linear programming problem should be solved :

$$N = \min \Theta_{NIRS} \tag{11}$$

subject to

$$\Theta_{NIRS} x_0 - X\lambda \geq 0 \tag{12}$$

$$Y\lambda \geq y_0 \tag{13}$$

$$e\lambda \geq 1 \tag{14}$$

$$\lambda \geq 0 \tag{15}$$

N is greater than or equal to C but is less than or equal to V. If S is less than one and N is greater than C, then we can say that scale inefficiency is due to increasing returns to scale. Alternatively, if S is less than one and N

and C are equal, then decreasing returns to scale are indicated. In terms of observation B_1 in figure 1, $S = B_3 B_4 / B_2 B_4 < 1$. Since $N = B_3 B_4 / B_1 B_4$ and $V = B_2 B_4 / B_1 B_4$, the result $S \neq N$ indicates increasing returns to scale.

3. Specification of Outputs and Inputs

A definition of banking activity is necessary in order to analyze the efficiency of the banking sector. Former studies on banking activity employed various data as inputs and outputs. We can broadly classify methods of analysis into four categories. One of them is the production approach. According to this approach, banks are considered as producers of deposit accounts and loan services.[2] Therefore, outputs are measured by the number of accounts, loans, and so on. A second method is the intermediation approach. According to this method, banks are regarded intermediators which transfer financial resources from units in surplus to units in deficit.[3] A third alternative is the asset approach, which is a variant of the intermediation approach. This method utilizes assets, mainly the production of loans, as outputs.[4]

The production approach has been applied to the evaluation of the relative efficiency of branches within a particular bank. However, in the case of analysis of a great number of banks, it is not easy to acquire the data. Furthermore, this approach does not take the profitability of banks into account. The intermediate approach and the asset approach have been widely used in cross-section studies. For example, English et al. (1993) utilized deposits, labor and purchased funds as inputs, and loans and investments as outputs. Berger and Humphrey (1991) employed labor, purchased funds and capital as inputs, and deposits and loans as outputs. As we can easily understand from above-mentioned examples, the intermediate approach and the asset approach also do not reflect the profitability of banks. In order to satisfy this condition, let us introduce a fourth method, the income-expense approach.[5] This approach is of great significance in the analysis of the Russian banking sector. As Gerashchenko (1993) indicated, "the practice in works of commercial banks [in Russia] shows that stockholders of banks in general enjoy privileged terms for loans. The share of those debtors reached to 80-90% in some cases." (Words in brackets added by this author). Furthermore, particular banks raise local government funds at a low interest rate. Therefore, the simple application of the production approach, the intermediate approach and the asset approach to the Russian banking system will not give us an explanation of its realities.

In the analysis we chose total interest expense, total non-interest expense and total operating expense as inputs, and total interest income and total non-interest income as outputs. Let us survey the indicators on the basis of Russian banks' accounting standards.[6] Total interest expense mainly includes interest expense on deposits and issued bonds. The major components of total non-interest expense are expense for foreign exchange operations, securities operations and various commissions. Total operating expense mainly consists of salaries, depreciation and communication expense. Total interest income chiefly includes interest income from bonds and loans to customers including banks. Total non-interest income consists of income for foreign exchange operations, securities operations and various commissions, and so on.

The original cross-sectional data for this study are taken from the web site of the Central Bank of Russia for the year 2000. In this paper we aim to analyze the current situation of Russian Far East banks after the Russian economic crisis in 1998. The descriptive statistics are provided in Table 1.

Table 1. Descriptive statstics of the output and input variables (thousand Rubles)

	Mean	Standard deviation	Minimum value	Maximum value
Interest expense	15,531	29,785	11	120,477
Operating expense	19,669	24,213	1,472	139,059
Non-interest expense	35,856	58,845	327	213,255
Interest income	34,899	59,809	443	332,647
Non-interest income	45,735	73,651	556	268,669

4. The Empirical Results

Table 2 includes means, standard deviations, minimum and maximum values for each efficiency measure. The average overall technical efficiency for all Far East banks was 0.79721. Since a value of unity means efficient usage of inputs, banks could have produced the same level of outputs with approximately 20% fewer resources than they actually utilized. Similarly, the average pure technical efficiency and the average scale efficiency are 0.87106 and 0.91616, respectively, which means that inefficiency amounts to about 13% and 9%, respectively. Since C is V multiplied by S, the effect of reducing the overall technical efficiency score by V is stronger than that of S. This fact means that the overall technical efficiency score was primarily due to waste of inputs, rather than scale inefficiency.

Table 2. Descriptive statistics of the efficiency measures

	Mean	Standard deviation	Minimum value	Maximum value
C	0.79721	0.22140	0.14967	1.00000
V	0.87106	0.20721	0.19340	1.00000
S	0.91616	0.12832	0.32625	1.00000

Table 3. Descriptive statistics of the efficiency measures by administrative districts

	Number of banks	Mean	Standard deviation	Minimum value	Maximum value
Pirmorskii Territory					
C	8	0.81859	0.17387	0.44045	1.00000
V		0.87487	0.18680	0.44058	1.00000
S		0.94016	0.06746	0.82995	1.00000
Amur Region					
C	5	0.70059	0.32104	0.23058	1.00000
V		0.77573	0.33718	0.24244	1.00000
S		0.91247	0.13362	0.67958	1.00000
Kamchatka Region					
C	8	0.84852	0.18608	0.45955	1.00000
V		0.87480	0.19369	0.46038	1.00000
S		0.97217	0.04095	0.90230	1.00000
Sakhalin Region					
C	6	0.87425	0.16189	0.64858	1.00000
V		0.88710	0.14917	0.68022	1.00000
S		0.98292	0.01996	0.95350	1.00000
Magadan Region					
C	3	0.83249	0.23798	0.56008	1.00000
V		0.87051	0.19914	0.64120	1.00000
S		0.94652	0.06548	0.87350	1.00000
Republic of Sakha					
C	8	0.68979	0.32010	0.14967	1.00000
V		0.85859	0.28629	0.19340	1.00000
S		0.80334	0.23020	0.32625	1.00000
Khabarovsk Territory					
C	6	0.82935	0.11891	0.64620	1.00000
V		0.94132	0.09197	0.76960	1.00000
S		0.88105	0.09277	0.77575	1.00000

Table 4. Returns to scale of banks by administrative districts

	Constant	Decreasing	Increasing	Total
Pirmorskii Territory	1	6	1	8
Amur Region	2	0	3	5
Kamchatka Region	3	5	0	8
Sakhalin Region	3	3	0	6
Magadan Region	1	2	0	3
Republic of Sakha	3	3	2	8
Khabarovsk Territory	1	5	0	6
Total	14	24	6	44

Let us analyze each efficiency measure by banks' locations. There are 7 administrative districts in the Russian Far East District. Table 3 indicates descriptive statistics of the efficiency measures by administrative district. Ac-

Table 5. The efficiency measures for each bank by administration districts

		C	V	S	Returns to scale
Dalrybbank	Pirmorskii Territory	0.44045	0.44058	0.99970	Increasing
Dalnevostochnyi		0.82995	1.00000	0.82995	Decreasing
Merkurii		0.94737	0.95137	0.99580	Decreasing
Primore		1.00000	1.00000	1.00000	Constant
Primsotsbank		0.77475	0.91365	0.84798	Decreasing
Primorskii Territorialnyi		0.78499	0.81367	0.96475	Decreasing
Volshoi Kamen		0.94466	0.98871	0.95545	Decreasing
Vostokbiznesbank		0.82657	0.89101	0.92767	Decreasing
Amurbank	Amur Region	1.00000	1.00000	1.00000	Constant
Amurpromstroibank		0.23058	0.24244	0.95109	Increasing
Belogorskagrokombank		0.67958	1.00000	0.67958	Increasing
Dalvneshtorgbank		0.59277	0.63623	0.93169	Increasing
Superbank		1.00000	1.00000	1.00000	Constant
Kamchatka	Kamchatka Region	0.85500	0.88579	0.96524	Decreasing
Kamchatkomagroprombank		0.91536	1.00000	0.91536	Decreasing
Kamchatbiznesbank		0.45955	0.46038	0.99820	Decreasing
Kamchatprombank		1.00000	1.00000	1.00000	Constant
Kamchatrybbank		0.71545	0.71816	0.99623	Decreasing
Krainii Sever		0.84281	0.93408	0.90230	Decreasing
Munitsipalnyi		1.00000	1.00000	1.00000	Constant
Kamchatprofitbank					
PIKO-bank		1.00000	1.00000	1.00000	Constant
Dolinsk	Sakhalin Region	0.69553	0.71743	0.96947	Decreasing
Iturup		1.00000	1.00000	1.00000	Constant
Kholmsk		0.64858	0.68022	0.95350	Decreasing
Okhabank		1.00000	1.00000	1.00000	Constant
Sakhalin-Vest		0.90142	0.92497	0.97454	Decreasing
Tikhaokeanskii Vneshtorgbank		1.00000	1.00000	1.00000	Constant
Kolyma-bank	Magadan Region	0.93738	0.97032	0.96605	Decreasing
Magadanskii		0.56008	0.64120	0.87350	Decreasing
Nadezhnyi Bank		1.00000	1.00000	1.00000	Constant
Aldanzolotobank	Republic of Sakha	1.00000	1.00000	1.00000	Constant
Almazergienbank		0.66584	0.96091	0.69293	Decreasing
Maiinskii		1.00000	1.00000	1.00000	Constant
Neriungribank		0.73352	1.00000	0.73352	Decreasing
Sakhabiliibank		0.32625	1.00000	0.32625	Increasing
Sakhakreditbank		0.14967	0.19340	0.77390	Increasing
Sir		0.64305	0.71440	0.90012	Decreasing
Taatta		1.00000	1.00000	1.00000	Constant
Dalkombank	Khabarovsk Territory	0.84414	1.00000	0.84414	Decreasing
Dzemgi		0.77575	1.00000	0.77575	Decreasing
Grad-bank		1.00000	1.00000	1.00000	Constant
Dalnevostochnoe OVK		0.64620	0.76960	0.83966	Decreasing
Regiobank		0.81242	0.97425	0.83389	Decreasing
Ussuri		0.89757	0.90405	0.99284	Decreasing

cording to this table, the measure of overall technical efficiency in the Amur Region and Republic of Sakha is 0.70059 and 0.68979, respectively, which is relatively lower level than that of the other districts. It does not mean that all banks in those districts operate inefficiently however, which we can understand from the fact that standard deviation in the Amur Region and Republic of Sakha is larger than that of other districts. In fact, there are banks with a value of unity, and at the same time there exist quite inefficient banks in these two districts (see Table 5).

The scale efficiency scores in the Republic of Sakha and Khabarovsk Territory are, on average, lower than in other districts. If scale inefficiency exists, the source of the inefficiency is the result of operating at either increasing or decreasing returns to scale. To investigate this further, let us analyze the source of inefficiency by district. According to Table 4, in each district there exist various numbers of banks operating at non-constant returns to scale. The Republic of Sakha and Khabarovsk Territory do not any have remarkable difference with other districts relative to the number of banks. Table 5 shows, however, that there are banks with a quite low scale efficiency score both in the Republic of Sakha and in Khabarovsk Territory, while there are few such banks in other districts. Since the measure of scale efficiency is calculated as the ratio of the overall technical efficiency score to the pure technical efficiency score, the quite low score of scale efficiency means that the score of overall technical efficiency is much smaller than that of pure technical efficiency.

Let us turn our attention to the relationship between the banks' scale and efficiency measures. We first employ regression analysis to look into this relationship. We utilized total assets for each Far East bank as the independent variable, and each efficiency score (overall technical efficiency, pure technical efficiency and scale efficiency) as the dependent variable.

$$C=0.78647+0.00000ASSET \qquad R^2=0.005$$

$$V=0.85126+0.00000ASSET \qquad R^2=0.201$$

$$S=0.92406-0.00000ASSET \qquad R^2=0.009$$

According to the result, we can conclude that there is almost no correlation between each efficiency score and the banks' scale. There is a possibility, however, that several efficiency measures with a unity hide the relationship in the regression analysis. Therefore, let us survey the efficiency measures for each bank by its scale. Table 6 includes the efficiency measures by each bank's

Table 6. The efficiency measures by each bank's scale

	Asset (thousand Rubles)	C	V	S
Dalkombank	2,352,060	0.84414	1.00000	0.84414
Dalnevostochnyi	1,285,257	0.82995	1.00000	0.82995
Primore	1,141,539	1.00000	1.00000	1.00000
Regiobank	882,933	0.81242	0.97425	0.83389
Kamchatkomagroprombank	876,643	0.91536	1.00000	0.91536
Iturup	536,878	1.00000	1.00000	1.00000
Dalrybbank	528,688	0.44045	0.44058	0.99970
Primsotsbank	506,946	0.77475	0.91365	0.84798
Munitsipalnyi	432,501	1.00000	1.00000	1.00000
Kamchatprofitbank				
Kamchatprombank	370,092	1.00000	1.00000	1.00000
Sakhalin-Vest	315,859	0.90142	0.92497	0.97454
Dalnevostochnoe OVK	265,425	0.64620	0.76960	0.83966
Amurpromstroibank	231,096	0.23058	0.24244	0.95109
Sakhakreditbank	230,446	0.14967	0.19340	0.77390
Kolyma-bank	228,140	0.93738	0.97032	0.96605
Neriungribank	219,686	0.73352	1.00000	0.73352
Nadezhnyi Bank	199,321	1.00000	1.00000	1.00000
Ussuri	194,647	0.89757	0.90405	0.99284
Dzemgi	187,982	0.77575	1.00000	0.77575
Almazergienbank	180,943	0.66584	0.96091	0.69293
Vostokbiznesbank	168,960	0.82657	0.89101	0.92767
Dolinsk	143,693	0.69552	0.71743	0.96947
Sir	118,684	0.64305	0.71440	0.90012
Sakhabiliibank	90,186	0.32625	1.00000	0.32625
Krainii Sever	82,435	0.84281	0.93408	0.90230
Kamchatbiznesbank	82,395	0.45955	0.46038	0.99820
Kamchatka	79,929	0.85500	0.88579	0.96524
Magadanskii	67,108	0.56008	0.64120	0.87350
Tikhaokeanskii	65,564	1.00000	1.00000	1.00000
Vneshtorgbank				
PIKO-bank	60,387	1.00000	1.00000	1.00000
Volshoi Kamen	60,055	0.94466	0.98871	0.95545
Kholmsk	59,303	0.64858	0.68022	0.95350
Kamchatrybbank	58,623	0.71545	0.71816	0.99623
Superbank	55,984	1.00000	1.00000	1.00000
Okhabank	53,260	1.00000	1.00000	1.00000
Primorskii Territorialnyi	50,550	0.78499	0.81367	0.96475
Taatta	50,362	1.00000	1.00000	1.00000
Dalvneshtorgbank	47,321	0.59277	0.63623	0.93169
Aldanzolotobank	39,675	1.00000	1.00000	1.00000
Grad-bank	37,164	1.00000	1.00000	1.00000
Merkurii	24,478	0.94737	0.95137	0.99580
Belogorskagrokombank	22,444	0.67958	1.00000	0.67958
Amurbank	18,300	1.00000	1.00000	1.00000
Maiinskii	14,011	1.00000	1.00000	1.00000

Table 7. Returns to scale for each bank

	Location	Total asset (thousand Rubles)	Returns to scale
Dalkombank	Khabarovsk Territory	2, 352, 060	Decreasing
Dalnevostochnyi	Pirmorskii Territory	1, 285, 257	Decreasing
Primore	Pirmorskii Territory	1, 141, 539	Constant
Regiobank	Khabarovsk Territory	882, 933	Decreasing
Kamchatkomagroprombank	Kamchatka Region	876, 643	Decreasing
Iturup	Sakhalin Region	536, 878	Constant
Dalrybbank	Pirmorskii Territory	528, 688	Increasing
Primsotsbank	Pirmorskii Territory	506, 946	Decreasing
Munitsipalnyi Kamchatprofitbank	Kamchatka Region	432, 501	Constant
Kamchatprombank	Kamchatka Region	370, 092	Constant
Sakhalin-Vest	Sakhalin Region	315, 859	Decreasing
Dalnevostochnoe OVK	Khabarovsk Territory	265, 425	Decreasing
Amurpromstroibank	Amur Region	231, 096	Increasing
Sakhakreditbank	Republic of Sakha	230, 446	Increasing
Kolyma-bank	Magadan Region	228, 140	Decreasing
Neriungribank	Republic of Sakha	219, 686	Decreasing
Nadezhnyi Bank	Magadan Region	199, 321	Constant
Ussuri	Khabarovsk Territory	194, 647	Decreasing
Dzemgi	Khabarovsk Territory	187, 982	Decreasing
Almazergienbank	Republic of Sakha	180, 943	Decreasing
Vostokbiznesbank	Pirmorskii Territory	168, 960	Decreasing
Dolinsk	Sakhalin Region	143, 693	Decreasing
Sir	Republic of Sakha	118, 684	Decreasing
Sakhabiliibank	Republic of Sakha	90, 186	Increasing
Krainii Sever	Kamchatka Region	82, 435	Decreasing
Kamchatbiznesbank	Kamchatka Region	82, 395	Decreasing
Kamchatka	Kamchatka Region	79, 929	Decreasing
Magadanskii	Magadan Region	67, 108	Decreasing
Tikhaokeanskii Vneshtorgbank	Sakhalin Region	65, 564	Constant
PIKO-bank	Kamchatka Region	60, 387	Constant
Volshoi Kamen	Pirmorskii Territory	60, 055	Decreasing
Kholmsk	Sakhalin Region	59, 303	Decreasing
Kamchatrybbank	Kamchatka Region	58, 623	Decreasing
Superbank	Amur Region	55, 984	Constant
Okhabank	Sakhalin Region	53, 260	Constant
Primorskii Territorialnyi	Pirmorskii Territory	50, 550	Decreasing
Taatta	Republic of Sakha	50, 362	Constant
Dalvneshtorgbank	Amur Region	47, 321	Increasing
Aldanzolotobank	Republic of Sakha	39, 675	Constant
Grad-bank	Khabarovsk Territory	37, 164	Constant
Merkurii	Pirmorskii Territory	24, 478	Decreasing
Belogorskagrokombank	Amur Region	22, 444	Increasing
Amurbank	Amur Region	18, 300	Constant
Maiinskii	Republic of Sakha	14, 011	Constant

scale. Under the assumption of constant returns to scale the larger banks tend to operate inefficiently, whereas the smaller banks tend to operate efficiently. On the other hand, under the assumption of variable returns to scale there is almost no difference between larger banks and smaller banks. Relative to the scale efficiency measure, there are many smaller banks with a unity score while larger banks are mainly scale-inefficient. Furthermore, larger banks' scores of scale efficiency tend to be smaller than that of pure technical efficiency, whereas many smaller banks have a unity scale efficiency score. As we mentioned above, the scale efficiency score is, on average, larger than the pure efficiency score. When we look into efficiency measures for each bank, however, it becomes clear that the overall inefficiency score for larger banks tends to be due to scale inefficiency, and that many smaller banks operate efficiently from both technical and scale aspects.

We also analyzed the reason for scale inefficiency. Table 7 shows the returns to scale for each bank. There is an obvious tendency for larger banks to operate at decreasing returns to scale, whereas smaller banks work at constant returns to scale. This may imply that banks do not have promising companies to which they can provide loans, and as a result larger banks are forced to operate at decreasing returns to scale.

5. Summary and Conclusion

By solving linear programs, our study clarified that the major cause of overall technical inefficiency was, on average, pure technical inefficiency rather than scale inefficiency. This conclusion indicates that the overall technical efficiency score was reduced more by waste of inputs than by scale inefficiency.

We also investigated technical efficiency and scale efficiency by administrative districts in the Russian Far East District. The overall technical efficiency scores of banks in the Amur Region and Republic of Sakha were relatively low. This does not mean that all banks in those districts operate inefficiently. In fact, there are banks with a value of unity, and at the same time there exist quite inefficient banks in these two districts. The scale efficiency scores in the Republic of Sakha and Khabarovsk Territory are, on average, lower than in other districts. Similarly, the existence of quite inefficient banks reduced the average scale efficiency score there. Though the above-mentioned characteristics were observed, we can conclude that there was little difference between efficiency measures and districts.

Furthermore, we analyzed the relationship between the efficiency measures and banks' scale. According to the result of regression analysis, we concluded that there was almost no correlation between each efficiency score and the banks' scale. We also surveyed the efficiency measures for each bank by its scale. Under the assumption of constant returns to scale the larger banks tend to operate inefficiently, whereas smaller banks tend to operate efficiently. On the other hand, under the assumption of variable returns to scale there is almost no difference between larger banks and smaller banks. Relative to the scale efficiency measure, there were many smaller banks with a unity score on the scale efficiency measure while larger banks were mainly scale-inefficient. Furthermore, larger banks' scores of scale efficiency tended to be smaller than that of pure technical efficiency, whereas many smaller banks had a unity scale efficiency score. When we looked into efficiency measures for each bank, it became clear that larger banks' overall inefficiency score tended to be due to scale inefficiency, and that many smaller banks operate efficiently from both technical and scale aspects. We also analyzed the reason for scale inefficiency. There is an obvious tendency for larger banks to mainly operate at decreasing returns to scale, whereas many smaller banks worked at constant returns to scale. This may imply that banks do not have promising companies to which they can provide loans, and as a result larger banks are forced to operate at decreasing returns to scale.

We plan to expand on this work by applying this methodology to banks in all districts of Russia and considering the issue of the evolution of efficiency over time.

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Notes

1. Lewin and Knox Lovell (1990) give general surveys on the two methodologies.
2. Sherman and Gold (1985) and Ferrier and Lovell (1990) utilize this approach.
3. Aly et al. (1990), Rangan et al. (1998) and Berger and Humphrey (1991) utilize this approach.
4. English et al. (1993) employ this approach.
5. Charnes et al. (1990) also utilize this approach.
6. The accounting standards for Russian banks were enacted by the Regulation of the Central Bank of Russian Federation No. 61 as of June 18, 1997. The Regulation has since been revised several times.

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