Legal Issues of the Ecosystem Model on the Efficiency of Financial and Monetary Banks

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Abstract

The developments in today's world, followed by the large volume of economic transactions and the formulation of various monetary and banking laws and regulations, have resulted in various legal issues. The initial transactions between humans were goods for goods, and in the later stage, money was invented, and diversity in this financial relationship became more colorful. Today, in just a few seconds, a large amount of money and credit documents are transferred or converted from one point to another point in the world and from one bank to another through information technology systems, which indicates the value of money. Banks today offer a wide range of services and have moved away from their original role of simply keeping money. Therefore, the legal issues of banks should be investigated. The banking ecosystem provides complex integrated products of banking and non-banking services and relies on the digital platform as a uniform operational and interaction environment. This study proposes a nonparametric data envelopment analysis for examining the efficiency of banking ecosystems. The data from a total of 93 Russian banks are used in this study. We used Tobit regression to estimate the effect of the bank-level variables on the derived banking efficiency. The results exhibit that throughout the study banking ecosystems demonstrate higher efficiency compared to banks with traditional business models. The advantage of ecosystem banking comes from leveraging digital technology to communication, data processing, and decision-making. This finding is confirmed for models with a constant and a variable return to scale. The study summarizes the objective drivers of the widespread adoption of banking ecosystems in the digital economy, as well as the threats and regulatory challenges that arise in this regard.

Keywords: banking laws, legal system, banking ecosystem, banking efficiency, data envelopment analysis, digitalization, digital platform

Introduction

The literature suggests that commercial banks have faced big challenges in the digital economy: changes in consumer behavior and preferences, tighter banking regulation, the entry of fintech companies [1,2]. The defragmentation of the value chain permits commercial banks to outsource specific operations or to act as white-label providers. Competition forces commercial banks to actively adopt digital technologies, benefiting from the data utilization to maintain market positions and reduce competitive pressures [3]. Digitalization could be interpreted as "creative destruction" that facilitates the emergence of banking models.

The banking ecosystem is a business model that relies on the digital platform as a universal environment for banking operations and communications and provides complex products of banking and non-banking services [4]. Cooperation with non-banking companies provides an opportunity to retain customers and avoid price competition by increasing customer loyalty and responding to a broad range of their needs. Digital technology enables not only to expand the functionality of distance service but also to reduce costs and accelerate the

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launch of new products on the market. In this regard, the study of new business models' effectiveness becomes an important issue for commercial banks when selecting optimal digital transformation strategy, and for the government when setting regulation agendas and promoting sustainable socio-economic development.

The complexity of measuring the banking efficiency arises from the multiplicity of outputs (borrowed deposits, issued loans, other banking services) and relative importance of inputs (personnel, physical capital, information and communication technologies, shareholders equity) [5]. The convenience of location is no longer a factor in competitiveness in the digital economy. The importance of frontline customer service is also reduced because the data input, transfer, and primary processing are carried out automatically. At the same time, the banking ecosystem requires permanent investment in technological infrastructure and software development, equity investments in partner companies. The current studies of banking effectiveness rely on a limited set of parameters that cannot reflect the digital economy's features [6]. There are no banking efficiency studies that incorporate core ecosystem inputs such as IT investments or participation in subsidiaries.

The purpose of the study is to provide a comparative analysis of the effectiveness of the ecosystem banking model. The study hypothesizes that the use of the ecosystem model increases the efficiency of commercial compared to the exploitation of traditional models. The object of the study refers to the Russian banking system, where several credit institutions successfully implemented the ecosystem approach. As noted by Boston Consulting Group, Russia remains one of the world leaders in the adoption of digital innovations in the financial sector[4].

The rest of the paper is structured as described next. Section 2 gives a theoretical background on data envelopment analysis and its application related to banking efficiency. Section 3 is focused on the descriptive statistics for the studied sample of Russian banks and the results of data analysis. Section 4 is dedicated to the discussion of results and the generalization of factors determining the efficiency of banking ecosystems in the long run. Conclusions follow in Section 5.

Methods

A considerable number of studies have been published on commercial bank efficiency since the early 1990-es [7,8]. The prevailing methodology remains the concept of boundary efficiency, which consists of the nonparametric data envelopment analysis and parametric stochastic frontier analysis. Although both methods use the same data on inputs and outputs, nonparametric methods require no additional information regarding the characteristics of the production function and the shape of the efficiency frontier. Data envelopment analysis provides efficiency scores that are less sensitive to specification error than parametric methods [9].

In the context of data envelopment analysis, the effective frontier is defined by the set of observations with the maximum efficiency of transformation of inputs into the output with constant or variable returns to scale assumed. Figure 1 provides a graphical representation of the effective frontier structure. Of the four banks *A* to *D*, only bank *B* achieves maximum efficiency in the transformation of input into output, so the linear efficiency frontier under constant returns to scale would pass through the origin and point *B*. Hence, the bank *D* inefficiency would be determined by the output difference between the actual *Y1* and the potential *Y2*, which could have been provided by the best production function. For variable returns to scale, the efficiency frontier draws on the banks with the best transformation performance under different inputs. The efficiency frontier would represent the envelope of banks *A* to *C*, and the bank *D* inefficiency would be determined by the output difference between the actual *Y1* and the potential *Y3*.

[4] "Russian miracle" in cashless payments // https://www.bcg.com/russian-miracle-in-cashless-payments

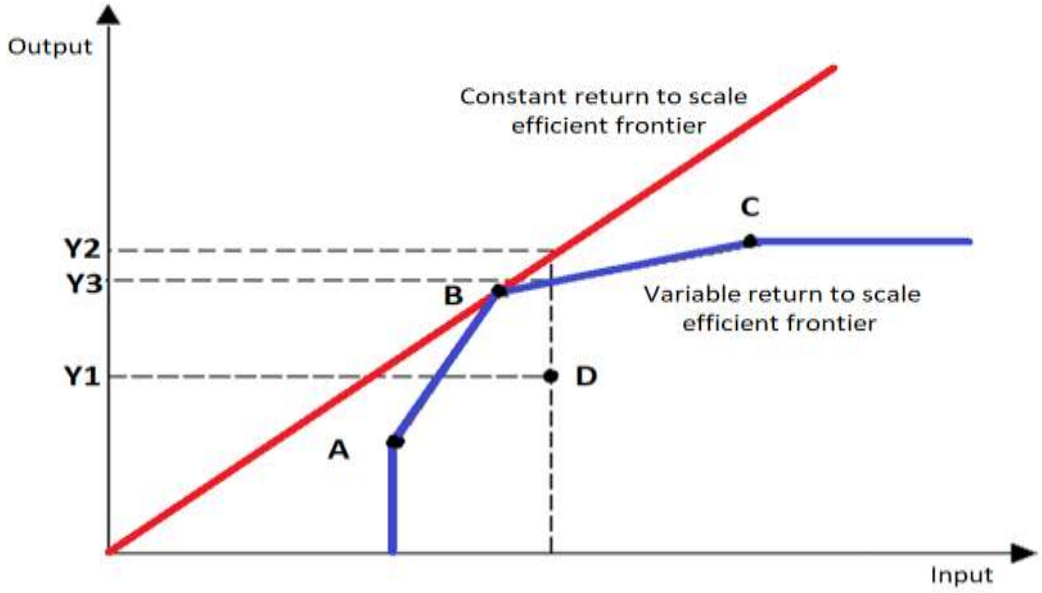

Figure 1. The efficient frontier concept in data envelopment analysis

Note: adapted from Leonov [10].

Efficiency scores are obtained by solving the linear optimization problem of the objective function (1) of each commercial bank (k=1, …, K) represented by the ratio of weighted outputs to weighted inputs for given constraints:

$$\max_{\alpha,\beta} Efficiency_k = \frac{\sum_{i=1}^{I} \alpha_i * y_{i,k}}{\sum_{j=1}^{J} \beta_j * x_{j,k}} \quad \textbf{(1)}$$

$$\text{subject to } \frac{\sum_{i=1}^{n} \alpha_i * y_{i,k}}{\sum_{j=1}^{m} \beta_j * x_{j,k}} \leq 1 \text{ for k=1,…,K} \quad \textbf{(2)}$$

$$\alpha_i \geq 0 \text{ for (i=1,…,n)} \quad \textbf{(3)}$$

$$\beta_j \geq 0 \text{ (j=1,…,n).} \quad \textbf{(4)}$$

where y_i and x_j are commercial bank outputs (i=1,…,I) and inputs (j=1,…,J),

α_i and β_j are outputs (i=1,…,J) and inputs (j=1,…,J) weights accordingly.

The constraint (2) means that for each bank (k=1,..., K) the efficiency score should not exceed the maximum allowed value of 1, indicating absolute efficiency. Constraints (3) and (4) specify non-negative values of the output and input weights.

Since efficiency score ranges are limited, we apply the Tobit regression model. The model examines the impact of the used business model, administrative and operational variables on bank efficiency score:

$$Efficiency_k = \gamma_0 + \gamma_1 * Ecosystem_k + \sum_{l=2}^{L} \gamma_l * X_{l,k} + \varepsilon_k \quad \textbf{(5)}$$

where *Efficiency* is computed variable from described above data envelopment analysis model for each bank (k=1, …, K),

Ecosystem is a dummy variable for used business model by bank,

X_l are other bank level variables (l=2, …, L).

The Tobit regression model is estimated with the parametric maximum likelihood method. If the implementation of the ecosystem model results in an increased bank efficiency, the corresponding ecosystem variable would have a statistically significant positive coefficient.

Results and Discussion

The scope and dynamics of banking digitalization depend on national, historical, and regulatory contexts. The banking system in Russia has demonstrated a high digital adoption rate and has undergone a series of changes over the last two decades [10]. Despite the high frequency of license revocations, there is strong public confidence in the banking system. To promote the growth and competitiveness of the financial system, the Bank of Russia is continuously enhancing the regulation: payment infrastructure and instant payment system, new types of licensed intermediaries, contact and advisory supervision, and regulatory sandboxes. Banks are forced

to adjust their business models by adopting digital technologies in operating activities and risk management, optimizing costs, and expanding cooperation with other service providers. In the last decade, the emergence of banking ecosystems is one of the most pronounced trends. In 2021 the Bank of Russia published a report for public consultation on ecosystem regulation[5].

Under the ecosystem model, the banking service becomes only a part of a complex product with other financial and non-financial services. It assumes uniform access to complex products and services via mobile application (super-app) or website. All operations, including document flow, customer, and partner communications, are executed on the information technology platform and supported by a unified personal identification and personal data management. The bank fully controls access and distribution of information within the ecosystem and exploits its clients' aggregated digital footprint. All settlements between clients and partners within the ecosystem are handled exclusively by the bank. Table 1 presents several examples of the most developed banking ecosystems in Russia.

Table 1. Examples of banking ecosystems in Russia

Bank	Ecosystem focus	Complex products
Sberbank	Universal: retail, small and middle enterprises	E-commerce and delivery services, financial supermarket, insurance,
VTB	Residential real estate; Savings and investments	Real estate and legal services, insurance, maintenance and repair
Gazprombank	Lifestyle; personal assistance	Online movie theater, mobile communications, gas stations
Rosselkhozbank	Farmers	E-marketplace, it-service, professional consulting
Tinkoff	Lifestyle; small and middle enterprises	Virtual mobile network, travel agency, accounting, cyber security, e-document flow, call center
RGS Bank	Automobile Drivers	Legal services, payment settlements, insurance

Our data set comes from the Bank of Russia statistics portal that covered all credit organizations with valid licenses[6]. We assembled reported data for the first 100 out of 398 active credit institutions, which account for 97,5% of total assets at the end of 2020. Engaged exclusively in the investment business, national development, custodian services, and payment and settlement operations credit institutions were removed from the data set. As a result, the final sample consists of 93 commercial banks included 13 banking ecosystems. Descriptive statistics are presented in table 2. All data were collected only for the financial year 2020.

Table 2. Descriptive statistics of the variables used in DEA and Tobit regression

Variable	Mean	Standard deviation	Maximum	Minimum
Personnel	11241.3	43720.1	401692.0	98.4
Physical capital	14736.4	65057.3	597151.9	9.8
IT capital	4580.4	19960.8	172367.2	17.5
Partner investments	28124.6	127220.7	920887.1	0.0
Net interest income	35878.0	161150.9	1488006.4	378.1
Commission revenues	16776.6	74986.2	690181.6	7.1
Loan loss provisions	38754.0	116116.4	793445.4	0.0
Ecosystem model dummy	0.13	0.34	1.00	0.00
Assets	902948.4	3396955.7	28894527.6	19452.6
Retail deposits	310641.6	1449744.6	13312649.0	0
Corporate loans	385631.9	1516353.2	12227910.6	0
State-controlled dummy	0.16	0.37	1.00	0.00
Foreign controlled dummy	0.25	0.43	1.00	0.00

Note: All the input and output variables are in Russian rubles mln except dummy variables.

We used the data envelopment analysis package of statistical software Stata.15.0 that provided a linear programming method for assessing efficiency [11]. It requires selecting the input and output variables with the return to scale options specified. We considered Net interest income, Commission revenues, and Loan loss provisions as output variables for all models. As input variables, we used Personnel and physical capital for

[5] Consultation paper 'Ecosystems: Regulatory Approaches' // https://www.cbr.ru/Content/Document/File/119962/Consultation_Paper_eng_02042021.pdf

[6] The banking sector statistics // https://www.cbr.ru/banking_sector/otchetnost-kreditnykh-organizaciy/

traditional models as well as Personnel, IT capital, Partner investments for digital models. Table 3 presents a comparative study between the results obtained through the models. Both variable returns to scale models and digital models generally lead to higher estimations of banks efficiency for the sample. For all models, the average efficiency score of ecosystem-based banks is statistically significantly higher compared to estimations for traditional banks.

Table 3. Bank efficiency DEA estimation

Model	Overall banks efficiency (93 banks)	Ecosystem banks efficiency (13 banks)	Traditional banks efficiency (80 banks)	Two-sample t-tests for means
Traditional model, CRS	0.52	0.62	0.50	t=2.002 (p-val=0.024)
Traditional model, VRS	0.57	0.70	0.55	t=1.949 (p-val=0.027)
Digital model, CRS	0.37	0.45	0.36	t=2.648 (p-val=0.005)
Digital model, VRS	0.40	0.44	0.39	t=2.345 (p-val=0.011)

Note: CRS – constant return to scale, VRS – variable return to scale

H0 two-sample t-tests for means: Mean (Ecosystem banks) > Mean (Traditional banks)

To identify the drivers of bank efficiency, we performed a regression analysis. The inability of using linear models is explained by the censoring of the values of efficiency scores constrained from below (no output of any kind) and from above (the most efficient bank). Therefore, it is reasonable to use Tobit regression to estimate the significance of the impact of explained variables on derived bank efficiency estimations. Table 4 presents the main results.

Table 4. Tobit regression on banking efficiency

Variable	Traditional model, CRS	Traditional model, VRS	Digital model, CRS	Digital model, VRS
Ecosystem model dummy	0.029 (0.008)**	0.041 (0.017)**	0.058 (0.013)***	0.044 (0.021)**
Ln(Assets)	0.041 (0.008)***	0.035 (0.014)**	0.027 (0.008)***	0.039 (0.013)***
Retail deposits to Assets	-0.119 (0.072)	-0.095* (0.058)	-0.075* (0.042)	-0.079 (0.056)
Corporate loans to Assets	0.057 (0.016)***	0.032 (0.013)**	0.074 (0.036)**	0.069 (0.014)***
State-controlled dummy	-0.097 (0.082)	-0.123 (0.078)	-0.054* (0.029)	-0.036 (0.044)
Foreign controlled dummy	0.023 (0.009)**	0.029 (0.012)**	0.012 (0.006)**	0.016 (0.009)*
No. of observations	93	93	93	93
LR chi2	19.66	18.73	22.16	25.72

Note: *, **, *** represents significance level of 10%, 5% and 1% level, respectively.

The ecosystem dummy variable is found to have a positive impact on efficiency at the 5 percent level of significance only for digital models. Bank efficiency is positively associated with bank size reflected by increasing return to scope assumptions. Banks controlled by foreign owners and members of international financial groups exhibit greater efficiency. By contrast, although the coefficient of state control is negative, it is not significant, indicating that state-controlled ownership of a bank has no influence on the bank's efficiency and guaranteed support from the government under the threat of insolvency has not gained a non-competitive advantage.

Summary

In the digital economy, traditional business models do not solve the long-term problem of achieving sustainable growth of a bank and retaining the customer base. Operating and organizational innovations are quickly copied by other banks, and positioning value to customers in terms of lower costs dilutes both net interest margins and commission revenues. The problem to avoid direct price competition under the commoditization of banking products also remains important. In this regard, we identify several reasons that justify the relatively higher efficiency of the banking ecosystem model in the digital economy.

First, a digital platform enables an ecosystem bank to take advantage of positive economies of scale since more operations do not require additional resources. The bank could revise its operational processes and utilized

inputs: personnel reduction through automation of data processing and decision-making, capital expenditures cutting by use of cloud technology, changes in the office format due to changes in communication processes.

Second, in contrast to the product-centered approach to banking in the traditional model, the banking ecosystem is characterized by a customer-centered approach. Ecosystem products are composed primarily in response to customer needs, rather than the technological capabilities of the bank. Therefore, the banking ecosystem blurs the boundaries between banking and non-banking services by implementing digital technology. The customer gets added value through easy access, saving time and money.

Third, a bank is empowered to flexibly fit its services into customer experience by participating in the satisfaction of their needs. It can predict customer needs more accurately based on the available information. With personalized communication channels bank gets the opportunity to promptly deliver any offers as well as track its receipt. As the structure of an ecosystem product becomes more complex, it becomes more difficult for the customer to compare its price with the case of receiving services separately from different providers.

Forth, the bank can provide revealed customer preferences to ecosystem partners for a fee. Consequently, they get a competitive advantage over other industry players and can increase revenues and margins

It is important to note that the ecosystem model raises new challenges for the sustainable development of banks. Poor quality products and services of ecosystem partners or unqualified after-sales services reflect negatively on the entire banking ecosystem. A discredited reputation can provoke customers to look for alternative providers of banking services. The exit of certain providers from the partnership can cause its loyal users outflow and reduce ecosystem competitiveness at all. Since the ecosystem model leads to increased returns to scale, we expect increased market concentration in the banking industry. The regulation authority could initiate the setting of uniform principles of banking ecosystem design, guaranteed access to alternative services suppliers, or limitation of price differentiation.

Conclusions

The progressive development of science and technology has a definite impact on the banking industry. This study proposes a data envelopment analysis for examining the efficiency of banking ecosystems. The data from a total of 93 Russian banks are used in this study. We have disclosed the contents of the ecosystem model on the example of different Russian banks. There is an increased number of Russian banks that declare an implementation of digital technology as well as announce banking ecosystem transformations[7].

The contributions of this study are threefold. Firstly, to the best of the authors' knowledge, the ecosystem inputs are being used for the first time to examine banking efficiency in the data envelopment context. Secondly, using different models with a constant and variable return to scale, we have demonstrated that ecosystem banks are more efficient than traditional ones. Thirdly, in the digital economy, the advantage of ecosystem banking comes from leveraging digital technology to communication, data processing, and decision-making. Despite the reduction of information asymmetry, customer engagement in the banking ecosystem decreases the demand elasticity and results in higher loyalty. As a direct consequence, the results presented here shed light on how regulation may impact the stability of the banking system under digital transformation. Several policy implications can be recommended in connection with the results obtained from the above. The development of the banking business model requires a comprehensive strategic decision to ensure the unique positioning of the ecosystem and the design of its products should fully fit the customer's needs. Discussions presented in the paper shed light on how regulation may impact the stability of the banking system under digital transformation.

Finally, future studies may consider the comparative study of banking ecosystems efficiency in different countries and incorporate other ecosystem output and input variables. In this context, it is appropriate to consider the dynamic network data envelopment analysis that considers the time factor in the construction of the effective boundary for banking ecosystems.

Acknowledgements

This paper has been supported by the Kazan Federal University Strategic Academic Leadership Program.

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