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EFFICIENCY ANALYSIS OF THE FINANCIAL LEASING SECTOR IN SERBIA: A DATA ENVELOPMENT APPROACH

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Abstract:

The aim of the paper is to analyze the efficiency of the financial leasing sector in the Republic of Serbia using the Data Envelopment Analysis (DEA) methodology. The BCC model with variable returns to scale was applied to a sample of 13 companies in 2024. The results indicate that seven companies demonstrated high efficiency across all models, while some showed significant inefficiency. Sensitivity analysis revealed that the number of employees and equity are critical inputs. A super-efficiency DEA model confirmed the dominance of Intesa Leasing, while ERB Leasing was identified as an outlier due to its unique business model. The study indicates the importance of careful variable selection and grouping firms by size for reliable results.

Keywords:

financial leasing, efficiency, DEA, market concentration, Serbia.

1. INTRODUCTION

Leasing has evolved from a simple financing alternative into a sophisticated instrument integral to corporate finance and investment, particularly in capital-intensive industries. The financial leasing sector represents a vital component of the modern financial system, providing an alternative to traditional debt financing for acquiring assets. It acts as a catalyst for investment, especially for small and medium-sized enterprises (SMEs) that may face constraints in accessing conventional bank loans. The performance and health of this sector are therefore directly linked to broader economic growth and capital formation. Scholarly inquiry into leasing has focused on three interconnected themes: understanding its current status and development drivers, forecasting its future perspectives in a changing financial landscape, and rigorously measuring its efficiency to ensure optimal resource allocation.

Even though the financial sectors of the transition countries are largely dominated (about 90%) by banks (Kaličanin *et al.*, 2021), the importance of financial leasing is also on the rise. In Serbia, the leasing market has matured, with thirteen active companies in 2024, most of which are bank affiliated. However, this growth occurs within a complex environment characterized by economic volatility, high competition, and a client base dominated by SMEs that present higher perceived risk. While traditional financial ratio analysis (e.g., ROA, ROE) offers snapshot assessments, it fails to provide a holistic, multi-faceted measure of efficiency that accounts for the simultaneous use of multiple inputs to produce multiple outputs.

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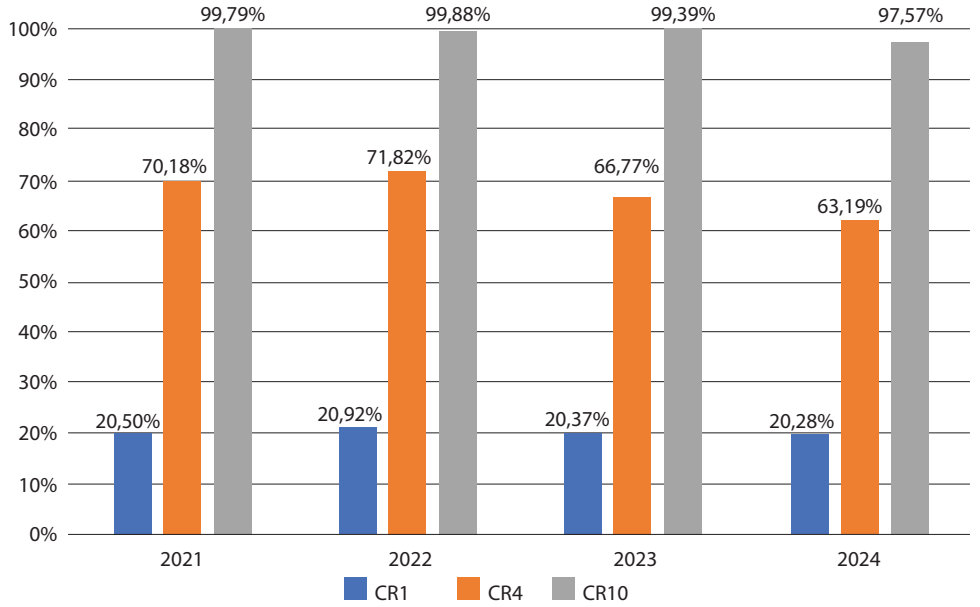
This gap in analytical depth is particularly critical for regulators and managers who need to understand not just if a company is profitable, but how efficiently it utilizes its resources to achieve those results.

Figure 1. CR1, CR4 and CR10 of the financial leasing sector, 2021-2024, Serbia

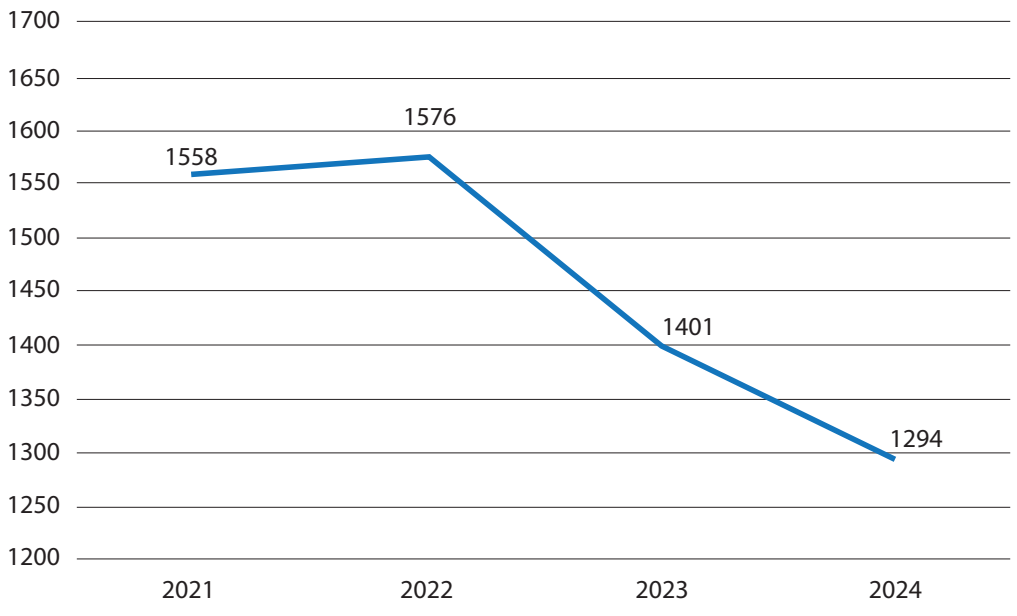


Source: Authors based on www.nbs.rs

The Figure 1 shows the values of the concentration ratio of the leading leasing company, sum of first four companies with the highest market share and sum of the first ten companies. As it can be seen from the figure, the leading company has not changed its market share in the last four years – it is about 20% and it is Intesa leasing. Intesa is also leader in the banking sector Republic of Serbia. Little change can be found speaking of CR4, decrease from around 70% to 63%. The values of CR10 are not significant so much as long as there are only 13 companies that operate in this market.

The decline in the CR4 also agree with the trend of HHI index which is shown in the next figure. Considering HHI as the index of concentration there has been decline from the 1576 in 2022 to 1294 in 2024. We can conclude that the concentration level decreased and that this sector went from moderately concentrated market to unconcentrated – competitive market.

Figure 2. Herfindahl-Hirschman index of the financial leasing sector, 2021-2024, Serbia



Source: Authors based on www.nbs.rs

Despite its economic significance, there is a notable scarcity of comprehensive efficiency analyses of the financial leasing sector in Serbia, especially those employing advanced non-parametric techniques like Data Envelopment Analysis (DEA). Existing studies on the region are either outdated, focus on a single aspect of performance, or apply methodologies that cannot fully capture the multi-input, multi-output nature of leasing operations. Furthermore, the high heterogeneity in the size and business models of leasing companies in Serbia, from large, bank-owned entities to small, specialized firms, poses a significant challenge for comparative analysis, which existing literature has not sufficiently addressed. This lack of a nuanced, data driven efficiency benchmark hinders strategic decision-making within companies and effective oversight by regulators.

The primary aim of this paper is to bridge this research gap by conducting a rigorous efficiency analysis of the financial leasing sector in the Republic of Serbia. The specific objectives are:

1. To evaluate the relative technical efficiency of all 13 leasing companies operating in Serbia in 2024 using the non-parametric DEA methodology.
2. To apply the BCC model with Variable Returns to Scale (VRS) to account for the significant heterogeneity in the size and scale of operations among the companies.
3. To identify the key inputs and outputs that most significantly influence efficiency scores through sensitivity analysis.
4. To rank the technically efficient companies using a super-efficiency DEA model to identify absolute performance leaders and outliers.
5. To discuss the implications of the findings for company managers, policymakers, and regulators, such as the National Bank of Serbia (NBS).

This paper contributes to the existing body of literature in several ways. Firstly, it provides one of the most contemporary and comprehensive efficiency analyses of the entire Serbian leasing sector. Secondly, it methodologically advances the discussion by demonstrating the critical importance of model specification and variable selection in DEA, particularly in a sector with high firm heterogeneity. The identification of multicollinearity between key variables (e.g., employee costs and equity) serves as a crucial caveat for future research. Thirdly, the paper offers practical, data driven insights for leasing companies to benchmark their performance and identify areas for improvement. Finally, it provides valuable information for regulators to assess the sector's health beyond traditional solvency metrics, promoting a more stable and efficient financial market.

The remainder of this paper is organized as follows. Section 2 provides a review of the relevant literature on leasing and efficiency analysis. Section 3 outlines the DEA methodology, the selected models, and the variables used. Section 4 presents and discusses the empirical results, including the efficiency scores, sensitivity analysis, and super efficiency rankings. Finally, Section 5 concludes with a summary of the key findings, acknowledges the study's limitations, and suggests avenues for future research.

2. LITERATURE REVIEW

This review explores the literature across efficiency analysis of the financial leasing sector, with a particular emphasis on the methodology of Data Envelopment Analysis (DEA) as a powerful tool for efficiency evaluation within the leasing industry.

The global leasing market has experienced substantial growth over the past few decades. According to the World Leasing Yearbook (2023), despite global economic shocks, the volume of new leasing business remains significant, exceeding $1.5 trillion annually. The market is characterized by a stark contrast between mature economies (e.g., North America and Western Europe) and emerging ones (e.g., China, Eastern Europe, and Southeast Asia).

Early literature, such as the work of Miller and Upton (1976), established the theoretical foundations of leasing, framing it within the Modigliani-Miller theorem and discussing its tax and balance-sheet advantages. Later, Smith and Wakeman (1985) expanded on the contractual and incentive structures that make leasing preferable to owning in certain scenarios.

Research on developed markets often focuses on market saturation, innovation in lease products, and regulatory changes (e.g., IFRS 16 Leasing standard) (Beatty, Liao, & Weber, 2010). Conversely, literature on emerging markets, such as those in the Balkans or Asia, emphasizes the sector's growth potential, its role in financial deepening, and the existing institutional and regulatory hurdles that need to be overcome (Berger, 2003; Drljača, 2015). These studies consistently find that a well-developed legal framework, stable macroeconomic conditions, and tax alignment between leasing and lending are critical for the sector's development.

The perspectives of the leasing sector are shaped by several megatrends. The literature identifies digitalization as a primary force. FinTech and digital platforms are streamlining the leasing process, from application to asset management, enhancing customer experience and reducing operational costs (Frame & White, 2014).

Sustainability is another key perspective. The transition to a green economy is creating new product lines like "green leasing" for energy-efficient equipment and electric vehicles. This aligns leasing companies with Environmental, Social, and Governance (ESG) criteria, which are increasingly important to investors and regulators (Weber, 2014).

Furthermore, the post-2008 financial regulatory environment (e.g., Basel III/IV) continues to impact the sector. While stricter capital requirements for banks can make leasing a more attractive option, they also affect leasing companies that rely on bank funding, potentially squeezing margins and necessitating more diversified funding strategies.

Efficiency is a central concept in evaluating the performance of financial institutions, including leasing companies. It is typically broken down into:

- Cost Efficiency: The ability to minimize costs for a given level of output.
- Profit Efficiency: The ability to achieve maximum profit given input prices and output prices.
- Operational Efficiency: The effectiveness of internal processes and management.

Traditional financial ratio analysis (ROA, ROE, cost-to-income ratio) has been widely used. However, ratios provide a one-dimensional view and cannot easily handle multiple inputs and outputs simultaneously. This limitation has led researchers to adopt frontier efficiency techniques, most notably Data Envelopment Analysis (DEA).

The application of DEA in leasing is a growing subfield. Researchers have tailored the choice of inputs and outputs to reflect the unique business model of leasing firms

In a more advanced application, Zhu (2014) applied a network DEA model to leasing companies in China, separating their operations into a "fund-raising" stage and a "profit-making" stage. This provided deeper insights into which specific process (acquiring funds vs. deploying them profitably) was the source of inefficiency for each firm. These studies demonstrate that DEA is not merely a diagnostic tool but can be used to analyze the impact of macroeconomic events, regulatory shifts, and ownership structures on leasing company performance.

Comparative DEA studies of leasing sectors across regions of Western Balkans are still relatively rare and would be highly valuable. There is a notable scarcity of literature applying DEA to the leasing sector in the Western Balkans countries. Pervan and Kuvek (2013) evaluated and compared the relative efficiency of leasing companies to other non-bank financial institutions (e.g., banks) within the Croatian financial system using a non-parametric DEA methodology. They found that leasing companies, on average, demonstrated a higher level of technical efficiency compared to banks in Croatia over the examined period, highlighting their competitive operational performance. Subotić *et al.* (2020) examined the evolution of the financial leasing sector in Bosnia and Herzegovina during 2009–2018. They used descriptive and econometric methods, including correlation and regression, to analyze relationships between leasing volumes, GDP, FDI, exports/imports, and SME investment decisions. They found that leasing contributes significantly to SME investments especially in relation to traditional bank financing.

Klenak and Lukić (2022) analyzed the efficiency of leasing companies using the DEA method for the period 2013-2020 including number of companies, number of employees, total assets, total equity, total business revenue and income/loss. According to the BCC-O model, financial leasing companies in Serbia were efficient in 2014, 2015, 2016 and 2018, and in the other years of the observed time period they were ineffective (2013, 2017, 2019 and 2020).

Utilizing the DEA Super-radial model, Lukić (2023) evaluated the financial efficiency of Serbian companies, including those in the leasing sector. He found that none of the analyzed companies were efficient in 2021, suggesting areas for improvement in asset and capital management.

The Serbian leasing sector, while mature relative to its Western Balkan neighbors, operates in a complex environment characterized by economic volatility, high competition, and a client base dominated by SMEs that present higher perceived risk. Traditional financial ratio analysis, though useful for snapshot assessments, fails to provide a multi-faceted measure of efficiency that accounts for the simultaneous use of multiple inputs to produce multiple outputs. This is where DEA becomes an indispensable tool.

This paper will try to fill this research gap, focusing on leasing sector in Serbia and employing DEA. Applying DEA to the Serbian leasing sector is necessary to:

- Benchmark Performance: Provide an objective, relative efficiency score for each leasing company against a best-practice frontier composed of its peers.
- Identify Best Practices: Pinpoint the most efficient companies and analyze their operational strategies (e.g., target market, funding structure, cost control) for emulation.
- Inform Policy and Regulation: Offer the National Bank of Serbia (NBS) and other regulators data-driven insights into the overall health and operational efficiency of the sector, beyond mere solvency ratios.
- Guide Strategic Decision-Making: Help managers of inefficient firms identify specific input excesses or output shortfalls and develop targeted strategies for improvement.

3. METHODOLOGY

The aim of this research is to analyze the relative efficiency of leasing companies so the Data Envelopment Analysis (DEA) methodology was used, as a non-parametric technique for measuring the efficiency of the decision-making units (DMU). DEA allows for the simultaneous consideration of multiple input and output variables without a predefined efficiency function, which is particularly suitable for the analysis of financial institutions whose outputs are interconnected. The methodology involves the construction of a piecewise linear efficiency frontier that allows for the identification of the most efficient companies and the quantification of the inefficiency of other units relative to this frontier. For the purpose of this research data was analyzed using the R programming language.

Table 1. The list of inputs and outputs

	Inputs		Outputs
1.	total assets	1.	net-result
2.	employee costs	2.	interest income from leasing
3.	number of employees	3.	inflows from financial leasing investments
4.	equity	4.	long-term receivables from financial leasing

Source: Authors

In this study authors use BCC model (Banker, Charnes, Cooper) with the assumption of Variable Returns to Scale (VRS). There are several reasons for using the specific model: 1) the nature of leasing companies' business involves variable returns to scale - smaller companies may have increasing returns to scale as they grow, while larger companies could face decreasing returns due to excessive operational complexity and diseconomies of scale. The BCC model accommodates these variations, in contrast to the CCR model, which implies constant returns to scale; 2) Secondly, the analysed sample includes highly heterogeneous companies in terms of size (ranging from 1 to 73 employees) and operational scale (with assets from 24 million to 41 billion dinars). The BCC model facilitates a more suitable comparison of companies within similar operational scales, which is particularly crucial in the financial services sector, where size significantly influences business models and efficiency benchmarks; 3) empirical studies that analysed financial sector emphasize that the BCC model yields more realistic and robust efficiency estimates, especially when analysing firms with diverse business models and those operating in specific market niches and 4) the goal of the research is to identify best practice companies within their specific business conditions, which the BCC model enables through a more flexible efficiency frontier.

Based on the list of the inputs and outputs authors created the six models that were applied in order to analyze the relative efficiency of leasing companies that operate in the Republic of Serbia:

Table 2. Models for DEA

Total assets + Employee costs + Number of employees	**M1)** Net result + Interest income from leasing + Inflows from financial leasing investments
	M2) Net result + Interest income from leasing + Long-term receivables from financial leasing
	M3) Interest income from leasing + Inflows from financial leasing investments + Long-term receivables from financial leasing
Total assets + Employee costs + Equity	**M4)** Net result + Interest income from leasing + Inflows from financial leasing investments
	M5) Net result + Interest income from leasing + Long-term receivables from financial leasing
	M6) Interest income from leasing + Inflows from financial leasing investments + Long-term receivables from financial leasing

Source: Authors

4. RESULTS AND DISCUSSION

The results of the six models used to analyze the relative efficiency of 13 leasing companies that operate in the Republic of Serbia in 2024 are shown in the table 3. Using the DEA method and taking into the consideration results we can conclude that seven out of thirteen leasing companies have shown high efficiency score in all the observed models - ERB Leasing, Intesa Leasing, Lipaks Leasing, OTP Leasing, Porsche Leasing, Raiffeisen Leasing and UniCredit Leasing. On contrary, some leasing companies show the really significant low level of efficiency such as Alta leasing in M1 and M4 - 0,212 and 0,221, respectively, and NLB leasing 0,55 in M1 and M4.

The M3 and M6 have the most efficient DMU – 12 of total 13 and these models also have the highest average score – 0.994. These models have the same outputs - interest income from leasing, inflows from financial leasing investments and long-term receivables from financial leasing so it can be concluded that these variables contribute significantly to the level of efficiency of leasing companies. Taking into consideration the minimal average score, it can be found in M1 and M4 – 0.863 and 0.885, respectively.

Table 3. The results of DEA BCC model, the leasing companies in 2024

DMU	M1	M2	M3	M4	M5	M6
Aik Leas.	1	0,895	1	1	0,895	1
Alta Leas.	0,212	0,92	0,92	0,221	0,92	0,92
BKS Leas.	0,454	1	1	0,883	1	1
ERB Leas.	1	1	1	1	1	1
Erste Leas.	1	0,997	1	1	1	1
Intesa Leas.	1	1	1	1	1	1
Lipaks Leas.	1	1	1	1	1	1
NLB Leas.	0,55	1	1	0,55	1	1
OTP Leas.	1	1	1	1	1	1
Porsche Leas.	1	1	1	1	1	1
Raiffeisen Leas.	1	1	1	1	1	1
Scania Leas.	1	1	1	0,856	1	1
UniCredit Leas.	1	1	1	1	1	1
Average Score	0,863	0,986	0,994	0,885	0,986	0,994

Source: Authors

The sensitivity analysis revealed that the variables number of employees and equity are the most critical inputs across all models. Their removal consistently resulted in the most substantial decline in the average efficiency scores, with reductions from – 0.133 of up to -0.256. This indicates that these two factors can be the primary drivers of measured inefficiency. However, the profound impact of removing the number of employees also suggests that this variable may act as a poor proxy for actual labor input or productivity. Its significant influence likely stems from its high correlation with other inputs rather than its direct contribution to output generation, meaning it may not accurately reflect the true picture of operational efficiency. These results are shown in the Table 1a in the Appendix.

To further differentiate between the efficient DMUs and establish a complete ranking, a super-efficiency DEA model was employed (Andersen & Petersen, 1993). This methodology evaluates each decision-making unit by excluding it from the reference set, thus allowing efficient units to achieve scores greater than 1. The results of the super-efficiency analysis, presented in Table 2a in the appendix, provide a more insightful performance ranking. Intesa Leasing emerged as an absolute benchmark with a score that could not be quantified (#NUM!), indicating extreme dominance and robustness. ERB Leasing followed with an exceptionally high score of 93.955, demonstrating remarkable efficiency despite its smaller scale. Other top performers included Lipaks Leasing (2.109) and UniCredit Leasing (1.791). Conversely, Aik Leasing (0.895) and Alta leasing (0.92) confirmed their relative inefficiency, ranking at the bottom. The exceptionally high super-efficiency score of ERB Leasing (93.955) is methodologically valid but must be interpreted with caution. It does not indicate that ERB is so much more productive than other companies. Instead, it highlights its status as an extreme outlier—a 1 employee company that achieves measurable outputs with negligible inputs compared to its peers. When excluded from the reference set, the remaining, far larger companies form a relatively inefficient frontier for that specific output level, thereby allowing ERB to achieve an extreme score. This confirms that DEA super-efficiency models can be sensitive to chosen outliers or, that meaningful comparison may require grouping companies by size or other criteria.

To identify potential multicollinearity issues that could undermine the stability of the DEA models, a correlation analysis between the used input and output variables was conducted. The resulting correlation matrix (Picture 1a) revealed the very strong positive linear relationships between certain pairs of variables. Most notably, a near-perfect positive correlation ($r > 0.999$) was observed between the variable employee costs (V2) and equity (V5), as well as between the number of Employees (V3) and long-term receivables (V6). These extremely high correlations indicate that these variables are essentially measuring the same underlying dimension of business size or resource intensity, representing a serious multicollinearity problem (Dyson *et al.*, 2001; Jenkins & Anderson, 2003). In the context of DEA methodology, this suggests that models which simultaneously include these highly correlated variables may be statistically redundant and their results potentially less robust, as the DEA technique is sensitive to the inclusion of overlapping measures that do not provide unique information (Jenkins & Anderson, 2003). These findings are aligned to the results of the sensitivity analysis, which showed that removing one variable from a highly correlated pair drastically reduces efficiency, and they underscore the necessity for a careful variable selection process in future research to avoid construct overlap and ensure discriminant validity.

5. CONCLUSION

This DEA study of leasing companies reveals that efficiency scores are highly sensitive to variable selection, a finding compounded by the significant multicollinearity identified among input variables (e.g., between Employee Costs and Equity Capital). The high super-efficiency score of ERB Leasing underscores a critical methodological limitation: DEA models can produce extreme results when the dataset contains outliers operating at a vastly different scale, highlighting that the technique measures relative efficiency within the defined peer group, not absolute productivity. Future research must therefore prioritize rigorous pre-screening for variable independence and consider employing a meta-frontier approach to compare homogeneous groups, as applying standard DEA to a highly heterogeneous dataset can yield scores that are statistically valid but contextually misleading for policy or managerial decisions.

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APPENDIX

Table 1a. Sensitivity analysis

Model	Variable	Change	Model	Variable	Change
M1	1	-0,032	M4	1	-0,043
	2	-0,037		2	-0,035
	3	**-0,133**		3	**-0,156**
M2	1	-0,118	M5	1	-0,139
	2	-0,010		2	-0,009
	3	**-0,256**		3	**-0,256**
M3	1	-0,131	M6	1	-0,149
	2	-0,012		2	-0,017
	3	**-0,170**		3	**-0,170**

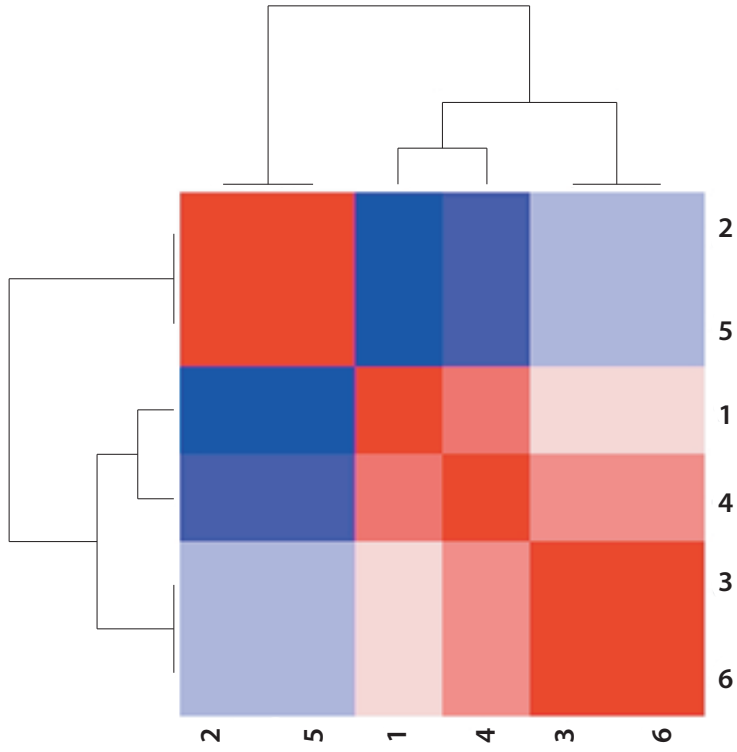
Source: Authors

Table 2a. Super Efficiency

DMU	Super_Efficiency	Rank
Aik Leasing	0,895	13
Alta leasing	0,92	12
BKS Leasing	1,115	8
ERB Leasing	93,955	2
Erste Leasing	0,997	11
Intesa Leasing	#NUM!	1
Lipaks Leasing	2,109	3
NLB Leasing	1,091	9
OTP Leasing	1,153	7
Porsche Leasing	1,408	5
Raiffeisen Leasing	1,063	10
Scania Leasing	1,206	6
UniCredit Leasing	1,791	4

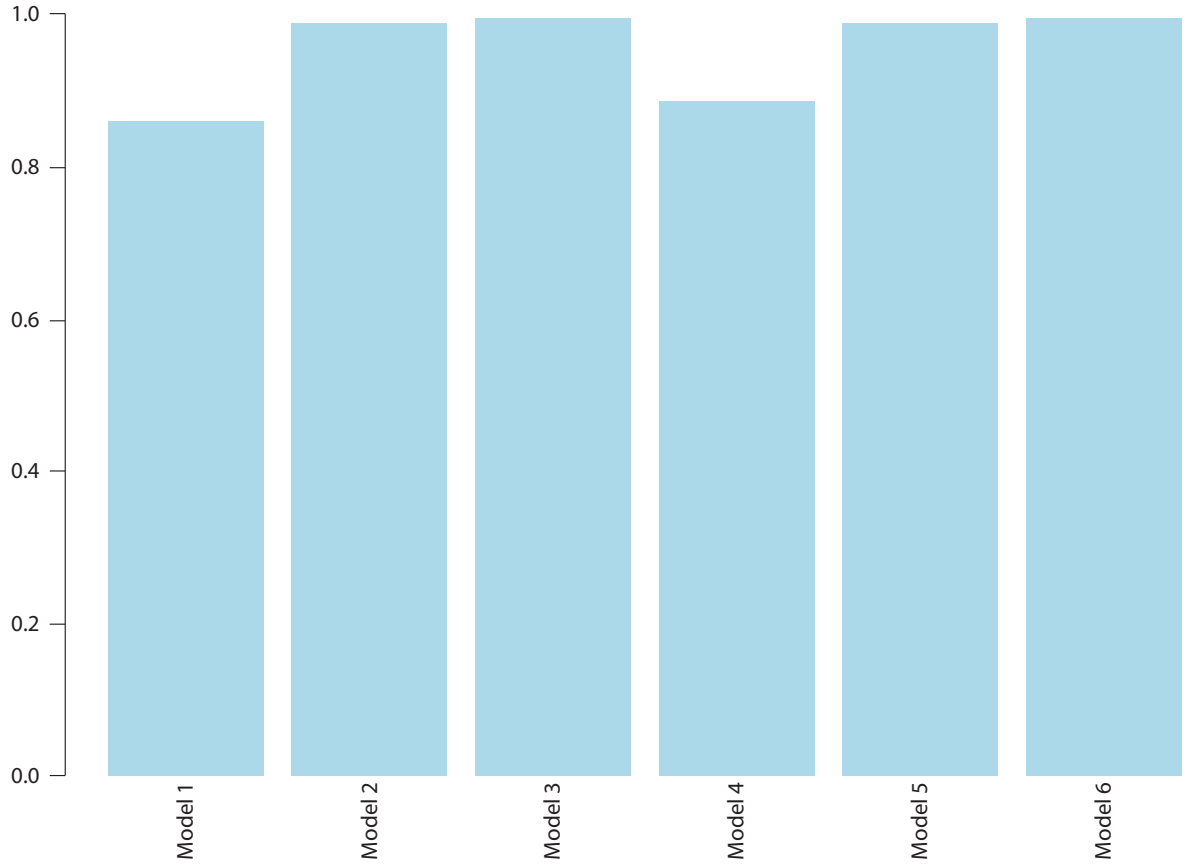
Source: Authors

Figure 1a. The correlation matrix



Source: Authors

Figure 2a. The average efficiency of the models



Source: Authors