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THE IMPACT OF CLUSTERING ON COMPETITIVENESS AND BUSINESS PERFORMANCE OF SMEs: EVIDENCE FROM THE SERBIAN AUTOMOTIVE INDUSTRY

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Abstract: Clusters are widely regarded by scientific researchers and policymakers as effective tools for addressing the size constraints faced by SMEs. The increased involvement of local SME suppliers in supply chain restructuring has led to the extensive adoption of clusters in the automotive industry. Despite a wealth of literature supporting the economic advantages of clustering, the absence of quantitative evidence has constrained policy support for cluster development in numerous developing countries. This research aims to empirically compare the performance of clustered and non-clustered SMEs within the same industry. The primary objective is to quantify the impact of the Serbian Automotive Cluster on the competitiveness and business performance of Serbian automotive SMEs. Utilizing Stochastic Frontier Analysis and statistic tests, the methodology examines a balanced panel of 29 SMEs in Serbia's automotive industry spanning from 2016 to 2018. The impact of clustering is analysed in terms of efficiency and effectiveness, crucial dimensions of business success. Total revenue is used to measure efficiency, reflecting an integral competitive indicator. Effectiveness is assessed using profitability indicators such as profit margin, asset turnover ratio, and return on assets. The research reveals that clustered SMEs in the automotive industry exhibit higher efficiency (competitiveness) and effectiveness (profitability) compared to non-clustered SMEs. The proposed methodology holds significance for evidence-based policymaking, providing empirical support for cluster policy. The paper introduces a novel quantitative assessment methodology for gauging the impact of clusters on SME members' competitiveness and business performance. The unique approach adds value to the paper, as similar methodologies have not been previously applied in assessing the impact of clustering on efficiency and effectiveness, fundamental dimensions of business success. The suggested methodology holds importance due to its potential applicability in evaluating how clusters influence the performance and competitiveness of SMEs across diverse industry sectors in developing nations. Acknowledging the limitations of our research, notably the small sample size that focused solely on SMEs with publicly available financial statements, excluding numerous enterprises from the analysis, we underscore the significance of clustering in enhancing the business performance of SMEs in the automotive industry. This emphasizes the need for additional research in quantitatively measuring the impact of clusters, paving the way for further exploration in this direction.

Keywords: SME Clusters, Competitiveness, Business Performance, Automotive Industry, Stochastic Frontier Analysis
Field: Business Economics

1.INTRODUCTION

The concept that clusters contribute to economic advantages by improving the performance of firms within the same industry has been acknowledged for quite some time. Clusters are widely accepted as effective solutions for overcoming the size constraints experienced by small and medium-sized enterprises (SMEs), significantly influencing their productivity, innovation, and competitiveness. The scholarly literature emphasizes the cluster's role as a catalyst for open innovation and a generator of global competitive advantage (McPhillips, 2020). Clusters provide firms with streamlined access to information and technology, enhancing coordination with related companies without the administrative complexities associated with formal partnerships or other integration forms (Meyer et al., 2021). Clusters contribute to the sustainable development of SMEs by fostering research and development activities and facilitating technology transfer. This is particularly relevant because the concept of sustainable development places a key emphasis on innovation as a critical factor for enterprise development (Đuričin et al., 2022).

The increased involvement of local SME suppliers in supply chain restructuring has led to the extensive adoption of clusters in the automotive industry. Industries specializing in a robust cluster environment exhibit superior performance measures, forming a reliable foundation for the formulation of cluster-oriented

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policies (Resbeut et al., 2019). Clusters within the automotive industry are key drivers of regional economic growth, fostering collaboration, innovation, and increased competitiveness among participating firms. Notably, regions with a strong historical presence in the automotive sector take the lead in Europe.

While qualitative research extensively highlights the positive impact of clustering on regional economic development and individual enterprises (e.g., Villa & Taurino, 2017), quantitative studies are less prevalent. Current quantitative research primarily focuses on the correlation between clustering and innovation (e.g., Kuczewska & Tomaszewski, 2022; Ștefan et al., 2018; Žižka et al., 2018). Despite Wise et al.'s (2017) call for more quantitative data to assess the impact of clusters on company performance, specifically in revenue growth, productivity enhancement, increased employment, and expanded exports, limited research has delved into these aspects. The exploration of SME characteristics and their collaborative business contexts, particularly in networks, clusters, and supply chains, is still underexplored, indicating a notable gap that warrants further investigation (Rojas-Lema et al., 2020).

This paper quantitatively investigates the positive impact of clustering on the competitiveness and business performance of SMEs in the Serbian automotive industry. It compares cluster participants to non-cluster participants within the sector, focusing on the prevalent use of the cluster concept driven by supply chain restructuring and the increased role of local SME suppliers. The methodology, incorporating Stochastic Frontier Analysis (SFA) and statistical tests, is applied to a balanced panel of 29 SMEs operating in the Serbian automotive industry from 2016 to 2018. The study addresses research questions surrounding the impact of clusters on SME competitiveness and potential performance differences between clustered and non-clustered SMEs in the automotive industry. It aims to test specific hypotheses in this context.

The competitiveness analysis rigorously examines the following hypotheses:
H0: There is no difference in efficiency (competitiveness) between clustered and non-clustered SMEs.
H1: Clustered SMEs exhibit higher efficiency (competitiveness) than non-clustered SMEs.

Similarly, the profitability analysis scrutinizes the following hypotheses:
H0: There is no difference in performance (profitability) between clustered and non-clustered SMEs.
H1: Clustered SMEs demonstrate higher performance (profitability) than non-clustered SMEs.

This paper makes significant contributions to cluster literature in multiple ways. Firstly, it conducts an empirical analysis of the impact of clustering on the business performance and competitiveness of SMEs in the automotive industry, filling a notable gap in research. The government's role in the automotive industry underscores the importance of providing empirical evidence for the benefits of clusters for SME suppliers, shaping potential policy measures to promote automotive clusters. Secondly, the proposed quantitative methodology has broader applicability for assessing clustering benefits across different industry sectors. Additionally, it enhances the existing knowledge on the advantages of clustering for SMEs, contributing to a deeper understanding of how industrial clusters facilitate the integration of local SMEs into supply chains.

2. MATERIALS AND METHODS

SMEs are categorized into two groups based on cluster membership criteria. The first group consists of 10 SMEs affiliated with the larger Serbian Automotive Cluster, while the second group comprises 19 non-clustered SMEs in the Serbian automotive industry. The sample includes all SMEs serving as suppliers to the Serbian automotive industry with publicly available financial reports, retrieved from the Serbian Business Registers Agency website. SMEs without publicly available financial statements are excluded from the analysis.

SFA quantifies operational efficiency as a comprehensive measure of business performance, while operational effectiveness is evaluated through SMEs' profitability indicators, including profit margin, asset turnover ratio, and return on business assets. Statistical tests are used to compare the overall efficiency and individual profitability performance of clustered and non-clustered SMEs. In contrast to standard linear regression models, which reveal only the magnitude and significance of a factor's impact on economic activity outcomes, SFA goes further by providing insights into how effectively the entire set of factors contributes to achieving the outcome. The evaluated efficiency in SFA serves as a comprehensive measure of a business's performance. This analytical advantage is particularly valuable in comparative analyses, allowing for the assessment of business performance or competitiveness based on a singular integral performance measure, as opposed to comparing individual aspects like profitability, cost efficiency, or liquidity.

In the SF modelling, the choice of total revenue as the dependent variable for assessing inefficiency stems from its nature as a value-expressed outcome of business activities. Total revenue is favoured over profits, offering an alternative to evaluate business results. This preference arises notably because numerous SMEs in the sample operated at a loss, and the negative sign associated with losses impedes logarithmic conversion.

The empirical specification of the stochastic revenue frontier is given in the form of a log-linear Cobb-Douglas function:

$$log\, rev_{i,t} = log\beta_0 + \sum_j log\, x'_{i,t}\, \beta_j + \sum_k D'_{i,t}\, \gamma_k + \vartheta_i + v_{i,t} - u_{i,t} \quad (2)$$

$$\{x\} = \{oa, fa, mc, wc, ne\}$$

in the following notation:

$rev_{i,t}$ – revenue of enterprise *i* in year *t*,

$oa_{i,t}$ – operating assets,

$fa_{i,t}$ – fixed assets,

$mc_{i,t}$ – material costs,

$wc_{i,t}$ – wage costs,

$ne_{i,t}$ – number of employees,

$D'_{i,t}$ - set of vectors of control dummy variables,

ϑ_i – individual enterprise fixed effect *i*;

$v_{i,t}$ – random error, $v_i \sim N(0, \sigma_v^2)$

$u_{i,t}$- technical (managerial) inefficiency, $u_i \sim F(\Theta)$.

Selected inputs aim to analyse revenue efficiency concerning fixed assets, number of employees (representing classic production factors of capital and labour), wage and material costs (reflecting cost efficiency), and business assets generating revenue. The empirical model introduces a novel aspect by encompassing individual enterprise effects and control variables. Individual fixed effects account for factors like ownership structure with a time-invariant systematic impact on business efficiency, while dummy time variables control for sector-specific business conditions each year.

The SF methodology proposed by Greene (2005) evaluates the model using the Maximum Likelihood Dummy Variable (MLDV) estimator, ensuring a robust analysis. The empirical model undergoes three variants, considering stochastic inefficiency following exponential, half-normal, and truncated normal probability distributions to ensure comprehensive assessment.

In the final phase of the SF analysis, technical or managerial efficiency is computed, serving as an integral measure of business competitiveness. While the primary outcome of the SF analysis is technical inefficiency, it readily transforms into a compatible efficiency indicator with a clearer economic interpretation. Theoretically, revenue generation efficiency ($ef\_r_{i,t}$) is obtained by dividing the revenue line (excluding technical inefficiency) by the generated revenue.

$$ef_{r_{i,t}}(x, \beta, v, u) = \frac{f(x,\beta)e^{v_{i,t}}}{f(x,\beta)e^{v_{i,t}-u_{i,t}}} = e^{u_{i,t}} \quad (3)$$

The calculated efficiency represents the percentage of revenue generation efficiency aligned with the revenue frontier, showcasing the practice of revenue generation for the most successful enterprises. The econometrically estimated efficiency values from the SF analysis serve as inputs for evaluating the impact of clustering on SME performance. To address the research questions, statistical tests are employed. The analysis begins with the estimated efficiency of SMEs in the cluster, assumed to reflect a comprehensive measure of competitiveness in resource utilization for revenue generation. Subsequent measurement of business performance concentrates on profitability indicators as a gauge of SME effectiveness in the market.

3. RESULTS

Table 1 highlights the robust impact of business assets on the estimated model, while the influence of other inputs varies based on the distribution of inefficiencies. Preferential interpretation leans toward the model estimated with the truncated normal distribution due to its theoretical superiority and representing a

general positive asymmetric distribution.

Inputs	Probability distribution		
	exponential	half-normal	truncated normal
Operating assets	0.692***	0.160	0.444***
	(0.000)	(0.296)	(0.045)
Fixed assets	0.085***	0.162	-0.026
	(0.000)	(0.121)	(0.079)
Material costs	1.361***	0.171	0.527**
	(0.000)	(0.484)	(0.213)
Wage costs	-1.250***	0.248	0.308***
	(0.000)	(0.826)	(0.050)
Number of employees	0.541***	0.323	-0.038
	(0.000)	(0.302)	(0.178)
Dummy for 2016	-0.156***	0.009	0.097
	(0.000)	(0.136)	(0.705)
Dummy for 2017	-0.075***	-0.047	0.066
	(0.000)	(0.090)	(0.596)

Note: standard rating errors are given in parentheses
Significance levels: * p<0.1, ** p<0.05, *** p<0.01
Source: Authors' research results

Competitiveness analysis results (Table 2) consistently indicate that clustered SMEs in the Serbian automotive industry effectively utilized wage costs, material costs, and operating assets for revenue generation. However, challenges arose in the efficient use of fixed assets and the number of employees. Efficiency values ranged from 88.7% to 94% for clustered SMEs and 80% to 87% for non-clustered SMEs, with statistical significance at various levels across distributions. This suggested higher competitiveness for clustered SMEs.

Table 2. Competitiveness analysis of clustered and non-clustered SMEs

Distribution	exponential		half-normal		truncated normal	
Statistics	Clustered SMEs	Non-clustered SMEs	Clustered SMEs	Non-clustered SMEs	Clustered SMEs	Non-clustered SMEs
Average	0.887	0.798	0.909	0.843	0.940	0.870
Standard deviation	0.124	0.209	0.088	0.216	0.062	0.194
T test	2.42***		1.97**		2.50***	

Significance levels: * p<0.1, ** p<0.05, *** p<0.01
Source: Source: Authors' research results

In the profitability analysis (Table 3), both clustered and non-clustered SMEs showed negative average profit margins, but non-clustered SMEs experienced significantly larger losses. Clustered SMEs demonstrated better asset turnover and return rates, with statistical significance in profit margin and asset turnover. Despite the negative average profit margin, better overall profitability performance for clustered SMEs was indicated.

Table 3. Profitability analysis of clustered and non-clustered SMEs

Indicator	Profit margin		Asset turnover		Return on assets	
Statistics	Clustered SMEs	Non-clustered SMEs	Clustered SMEs	Non-clustered SMEs	Clustered SMEs	Non-clustered SMEs
Average	-0.012	-1.312	0.923	0.762	0.002	-0.036
Standard deviation	0.149	3.872	0.494	0.484	0.180	0.254
T-test	2.53***		1.47*		0.82	

Significance levels: * p<0.1, ** p<0.05, *** p<0.01
Source: Authors' research results

4. DISCUSSIONS

The novelty of this research lies in its innovative approach, utilizing quantitative analysis to investigate how clustering affects the business performance and competitiveness of SMEs. The proposed methodology holds the potential to guide evidence-based policymaking in various developing countries, where the concept of clusters is not adequately integrated into the industrial policy agenda.

Cluster prevalence is notable in EU economies, with the European Union actively funding projects geared towards establishing and fostering cluster development. The European Commission (2021) reports the existence of 30 national cluster programs in 20 countries within the EU, encompassing approximately 3,000 clusters with varying sizes, formats, and levels of maturity across countries and regions. It is anticipated that cluster members demonstrate higher turnover, a more adept adoption of advanced technologies, and a greater potential for implementing sustainable and digital innovations compared to non-cluster companies. While the benefits of joining industrial clusters and other EU-level SME support organizations are apparent, their prevalence varies among economies. In countries like Sweden, more than half of SMEs (51%) are cluster members, while in Belgium and Spain, the figures are approximately 38% and 36%, respectively. In stark contrast, only 1% of SMEs in Romania, Hungary, and Lithuania are associated with specific industrial clusters or other SME support entities (European Commission, 2020).

Clusters continue to be underdeveloped in developing countries, underscoring the necessity for empirical evidence to substantiate the positive impacts and advocate for enhanced policy support for cluster development in crucial sectors. This significance is further emphasized by the economic importance of the automotive industry and the growing prospects for local SMEs to engage in its supply chain.

The research results confirm that clustered SMEs are more competitive and perform better in terms of profitability than non-clustered SMEs in the automotive industry. Accordingly, clusters have a positive impact on efficiency and effectiveness, two fundamental dimensions of business success. Empirical evidence demonstrates a connection between profitability and the growth and development of SMEs (Ashtalkoska et al., 2023). Competitive and profitable SMEs possess characteristics that enhance their dynamism and resilience, facilitating integration into global value chains. Their adaptability, financial stability, operational efficiency, and access to resources contribute to their competitiveness and ability to weather economic challenges. Integration into global value chains provides SMEs with opportunities to access larger markets, collaborate internationally, and enhance technological capabilities. The relationships formed in these networks foster growth and development, while specialization and niche expertise contribute to their attractiveness as partners. In the context of the global automotive industry, SMEs play a vital role as local suppliers, and their competitiveness and profitability are crucial for successful integration into the industry's global value chain, facilitating knowledge transfer, technology adoption, and sustained contributions to industry advancement.

5. CONCLUSIONS

Our empirical findings advocate for an enhanced government role in fostering automotive cluster development in developing countries, emphasizing the need to link clusters to the automotive supply chain for greater engagement of local SME suppliers. The proposed methodology's relevance extends beyond the automotive sector, offering a valuable tool for assessing cluster impact on SME performance in diverse industries across developing countries.

Despite research limitations, notably the small sample size focused on SMEs with publicly available

financial statements, excluding certain enterprises, our study underscores the pivotal role of clustering in enhancing SME business performance within the automotive industry. This calls for further research endeavors aimed at quantitatively measuring the broader impact of clusters.

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