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Economic, Social, and Environmental Determinants of Automotive Industry Competitiveness

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Abstract

The study investigates how economic, social, and environmental factors influence the competitiveness of the automotive industry. Competitiveness in this context is measured using the Revealed Comparative Advantage Index, a commonly used indicator to evaluate a country's export performance relative to the global average. The study employs a fixed-effect model to analyze a dataset covering 14 Asian countries over a period of nearly three decades, from 1991 to 2020. This extensive timeframe allows for a comprehensive understanding of long-term trends and the impact of various factors on the automotive industry's competitiveness. The results of the study reveal several key findings. Firstly, the competitiveness of the automotive industry is positively correlated with economic performance. This means that countries with stronger economies tend to have a more competitive automotive industry. Economic performance, in this case, is likely driven by factors such as GDP growth, industrial output, and overall economic stability. These elements create a conducive environment for the automotive industry to thrive, as they provide the necessary infrastructure, investment, and market conditions. Secondly, human capital development is found to be a significant positive factor. This suggests that countries investing in education and training for their workforce see better performance in their automotive industries. Skilled labor is crucial for innovation, efficiency, and the production of high-quality automotive products, which are essential for maintaining a competitive edge in the global market. Urbanization is another positive factor identified in the study. As urban areas expand, the demand for vehicles increases, boosting the automotive industry. Urbanization often leads to improved infrastructure, better supply chains, and greater access to markets, all of which are beneficial for the automotive sector. Additionally, higher urban population densities can lead to more significant economies of scale and increased production efficiency. Tariff rates also positively impact the competitiveness of the automotive industry. Moderate tariffs can protect domestic industries from foreign competition, allowing them to grow and develop. However, it's crucial to balance tariff levels to avoid negative repercussions such as trade wars or reduced foreign investment. On the other hand, the study finds that lending rates and carbon emissions negatively affect the automotive industry's competitiveness. High lending rates increase the cost of borrowing, making it more expensive for companies to invest in new technologies, expand production, or improve efficiency. This financial burden can hinder the growth and competitiveness of the automotive sector. Carbon emissions, reflecting environmental impact, also pose a challenge. The automotive industry is under increasing pressure to reduce its environmental footprint. High levels of carbon emissions can lead to stricter regulations, increased costs for compliance, and potential reputational damage, all of which can negatively affect competitiveness. The findings of the study highlight the importance of considering external factors in strategies aimed at improving the competitiveness of the automotive industry. Policymakers should focus on managing lending rates to make borrowing more affordable, investing in human capital development to ensure a skilled workforce, and setting balanced tariff rates to protect and nurture the domestic automotive industry. Additionally, addressing environmental concerns and reducing carbon emissions are essential for sustainable long-term competitiveness.

Keywords: Automotive Industry Competitiveness, Revealed Comparative Advantage, Economic Performance

JEL Codes: L62, F14, Q56

1. INTRODUCTION

The automotive sector is considered one of the major industries in any country and plays a significant role in economic growth. Often referred to as the "industry of industries," it is notable for its extensive backward and forward linkages. In the current globalized era, the competitiveness of the automotive industry has gained exceptional importance and is influenced by both internal and external factors. The changing competitive environment has compelled manufacturing industries, including the automotive sector, to redesign their strategies. Intense competition in the automotive industry is evident as firms continuously strive to gain a competitive advantage in all aspects of their operations and strategies (Czuchry et al., 2009). To remain competitive, automotive companies are focusing on several key areas. Innovation and technology advancements are critical for maintaining a competitive edge. This includes the development of new vehicle models, incorporating advanced features, and improving manufacturing processes. Additionally, efficient management

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of the supply chain is vital. This involves optimizing logistics, reducing costs, and ensuring timely delivery of components and finished products.

Sustainability is another crucial area of focus. With increasing environmental concerns, the automotive industry is under pressure to develop sustainable practices, including producing fuel-efficient vehicles, reducing emissions, and utilizing eco-friendly materials. The ability to quickly adapt to changing market demands and consumer preferences is also essential. This may involve diversifying product lines, entering new markets, or adjusting pricing strategies. Forming alliances and partnerships with other companies can provide access to new technologies, markets, and resources. Collaborative efforts can enhance competitiveness and drive growth. Additionally, adhering to local and international regulations is crucial to avoid legal issues and maintain a positive reputation. This includes meeting safety standards, environmental regulations, and other industry-specific requirements.

The increasing importance of competitiveness in the automotive industry for managers and policymakers has driven researchers to investigate its dynamics and driving forces. Previous studies on the automotive industry have explored various aspects, but only a few have specifically examined the effect of external factors on sales growth and competitiveness. Notable among these are studies by Winston (1987), Smith and Florida (1994), Porter and Van der Linde (1995), Jaffe and Palmer (1997), Hunya (2000), Gallagher (2003), and Triebswetter and Wackerbauer (2008). However, these studies often overlooked crucial factors that could significantly impact the competitiveness of the automotive industry. Economic performance is one such factor, as the overall economic health of a country can influence consumer purchasing power and demand for automobiles. Lending rates are another critical factor; they affect the cost of borrowing for both consumers and manufacturers, thus influencing investment and spending in the automotive sector. Human capital development is essential for maintaining a competitive edge, as a skilled and knowledgeable workforce can drive innovation and improve productivity. Urbanization plays a role in shaping the demand for different types of vehicles and transportation solutions, affecting sales growth and market strategies. Additionally, tariffs and trade policies can impact the competitiveness of the automotive industry by influencing the cost and availability of imported components and vehicles.

Given the complexity and multifaceted nature of competitiveness in the automotive industry, a comprehensive analysis that includes these overlooked factors is necessary. Future research should incorporate economic performance, lending rates, human capital development, urbanization, and tariffs to provide a more holistic understanding of the dynamics and driving forces behind competitiveness in the automotive sector. This approach will help managers and policymakers develop more effective strategies to enhance the industry's growth and sustainability. Competitiveness in the automotive industry is significantly influenced by several key factors that contribute to a nation's ability to raise living standards (Martin, 2003). Human capital development plays a pivotal role across all industries within a country, including the automotive sector, as it enhances overall competitiveness (Kumar & Chadee, 2002).

Innovation and the adoption of advanced technologies are also crucial drivers for the growth and competitiveness of the automotive industry (Fagerberg & Verspagen, 2002). The ability of automotive firms to innovate and integrate sophisticated technologies not only enhances product quality and performance but also drives efficiency and cost-effectiveness in manufacturing processes. These factors underscore the importance of continuous investment in education and skill development to foster a highly capable workforce capable of driving innovation and technological advancement in the automotive sector. Moreover, fostering an environment conducive to innovation and the adoption of new technologies is essential for maintaining competitiveness in a rapidly evolving global market.

This study addresses a notable gap in the literature by employing panel data techniques to examine the competitiveness of the automotive sector across several Asian economies. Unlike previous studies, which often overlook individual effects, panel data analysis allows for a more comprehensive understanding by capturing these unique country-level impacts. By doing so, this research aims to provide a diverse dataset that enriches our understanding of automotive sector competitiveness in Asia. Automotive policies in various Asian countries have increasingly focused on enhancing competitiveness through strategies such as developing human capital, adopting advanced technologies, and implementing auto cluster programs. These efforts are aimed at bolstering local industries and positioning them competitively in global markets. Therefore, this study seeks to investigate how economic factors (including economic performance, lending rates, and tariff rates), social factors (such as education and urbanization), and environmental considerations (like carbon emissions) collectively influence the competitiveness of the automotive industry across Asian economies.

By analyzing these factors comprehensively, the study aims to offer insights into the complex dynamics shaping the competitiveness of the automotive sector in Asia. Understanding these dynamics is crucial for policymakers and industry stakeholders alike, as they navigate strategies to foster sustainable growth and competitive advantage in the increasingly globalized automotive market.

2. LITERATURE REVIEW

Winston (1987) delved into the competitiveness of the automobile industry within the United States, highlighting key strategies to achieve and sustain competitiveness. His study emphasized the importance of market access for foreign producers and advocated against imposing import restrictions, asserting that these measures could hinder sales growth and industry competitiveness. Winston further argued for governmental involvement to bolster competitiveness, suggesting that maintaining an appropriate exchange rate and implementing supportive employment regulations could positively impact industry dynamics. This research underscored the role of policy interventions in shaping the competitive landscape of the automotive sector. By advocating for open market policies and strategic governmental

support, Winston's findings provided insights into how nations could enhance their automotive industry's competitiveness amidst global economic pressures and market dynamics. His work remains influential in discussions surrounding trade policy, industrial competitiveness, and government intervention strategies in the automotive sector.

Smith and Florida (1994) undertook an econometric analysis focused on Japanese-affiliated manufacturing industries within automotive-related sectors. Their study aimed to uncover the factors influencing demand and competition in the automobile industry. The findings highlighted several key determinants. They noted that urbanization trends, alongside a growing population and improved transportation infrastructure, played significant roles in driving demand and fostering competition within the automotive sector. Moreover, the presence of educated human resources was identified as a crucial factor contributing to industry growth and competitiveness. By employing econometric techniques, Smith and Florida's study provided empirical insights into how demographic shifts, educational advancements, and infrastructure development influenced the dynamics of automotive manufacturing under Japanese influence. Their research remains relevant in understanding the complex interplay between socio-economic factors and industrial competitiveness in automotive-related sectors. Some studies have incorporated environmental effects while analyzing the competitiveness of the auto sector. Porter and Van der Linde (1995) found that adopting emission control technology generates long-term benefits. They argued that resisting innovation in the automotive sector results in a loss of competitiveness. Their research suggested that environmentally conscious innovations could lead to cost savings and new market opportunities, enhancing the overall competitiveness of firms that embrace these changes. Similarly, Jaffe and Palmer (1997) examined the positive impact of environmental regulations on local firms. They discovered that such regulations stimulate competition and innovation among domestic players compared to foreign competitors. Their findings indicated that environmental regulations could act as a catalyst for technological advancements, pushing local firms to innovate and improve their processes to comply with stricter standards. This, in turn, enhances their competitiveness in both local and international markets. By incorporating the environmental dimension, these studies highlight the importance of sustainable practices in maintaining and enhancing the competitiveness of the automotive sector. They demonstrate that proactive environmental strategies can lead to significant competitive advantages and drive long-term growth and innovation in the industry.

Winston (1987) examined the relationships among competition, innovation, and changes in regulation within the international business environment. His research highlighted how these factors strongly impact the automobile industry and can guide future policies in this sector. Winston's findings emphasized that competition drives innovation, which is crucial for maintaining and enhancing competitiveness in the automotive industry. Additionally, he noted that changes in regulation, such as those related to trade and environmental standards, significantly influence industry dynamics. Triebswetter and Wackerbauer (2008) further explored the impact of regulatory pressure on the adoption of integrated environmental product innovation technology. Their study showed that such regulatory pressure enhances competitiveness among firms. This is because companies voluntarily undertake innovation, spurred by environmental legislation. This legislative framework encourages firms to innovate, leading to increased production efficiency and reduced pollution. By integrating environmental considerations into their product innovation processes, firms can achieve competitive advantages, such as cost savings, improved market positioning, and compliance with regulatory standards.

Gallagher (2003) examined the role of foreign players such as OEMs Ford, General Motors, and Daimler Chrysler in the development of the automotive industry in China. His findings highlighted that joint ventures between these foreign direct investments (FDIs) and local manufacturers significantly enhanced the competitiveness of the Chinese automotive industry compared to those in Japan, the U.S., and Europe. The adoption of advanced technologies, such as emission controls and fuel efficiency improvements, played a crucial role in boosting this competitiveness. Similarly, Hunya (2000) investigated the impact of access to foreign markets on international competitiveness and the ability to attract FDI. He found that such access significantly increases a country's competitiveness on the global stage. By opening up to foreign markets, local industries can benefit from new technologies, management practices, and capital inflows, all of which contribute to enhanced productivity and competitive positioning. This underscores the importance of integrating local industries into the global market to foster economic growth and industrial development.

Buckley et al. (2007) investigated the impact of foreign direct investment (FDI) on the productivity levels of the automotive industry in China. Their findings revealed a direct relationship between FDI and productivity, indicating that increased FDI significantly boosts productivity within the industry. Based on these results, the study suggests that the government should foster a conducive environment for FDI, which would in turn enhance the productivity and overall competitiveness of China's automotive sector. Muhammad et al. (2010) analyzed the causal relationship between macroeconomic variables and car sales in five countries over a period of fourteen years. Their study found that gross domestic product (GDP) has a positive and significant effect on the growth of car sales. This indicates that as GDP increases, consumer purchasing power and overall economic activity rise, leading to higher demand for automobiles. The study highlights the importance of a robust economy in driving automotive industry growth. Conversely, the study revealed that higher unemployment rates negatively impact car sales. This is because increased unemployment leads to reduced disposable income, causing consumers to cut back on large purchases, including vehicles. Additionally, higher inflation rates were found to have a detrimental effect on car sales. Inflation erodes purchasing power and increases the cost of living, leaving less discretionary income for consumers to spend on new cars. The study also identified a negative relationship between loan rates and car sales growth. Higher loan rates make borrowing more expensive, which can deter consumers from financing new car purchases. This underscores the importance of accessible and affordable credit in supporting the automotive market.

Attanasio et al. (2008) studied the Thailand automotive industry and identified key factors contributing to its success. One of the primary drivers behind Thailand's thriving automotive sector is the expansion of its production network on both regional and global scales. By integrating with global markets, the Thai automotive industry has been able to leverage economies of scale, reduce production costs, and enhance efficiency. The study also highlights the importance of aligning the domestic industry with global market demands. This alignment has allowed Thai automotive manufacturers to stay competitive and meet international standards, thereby attracting foreign investment and increasing export opportunities. The ability to adapt to global market trends and consumer preferences has been crucial in sustaining the industry's growth. Additionally, Attanasio et al. (2008) point out that protectionist policies, such as tariffs, have played a significant role in supporting the local automotive industry. By imposing tariffs on imported vehicles, the Thai government has provided a competitive edge to domestic manufacturers, enabling them to strengthen their market position and invest in technological advancements. This protective measure has also encouraged the development of local suppliers and created a robust automotive ecosystem within the country. The literature review revealed that each study has typically focused on one or two external factors affecting the competitiveness of the automotive industry. There has been no comprehensive study that collectively investigates the impact of economic, social, and environmental variables on the industry's competitiveness. Therefore, this study aims to fill this gap by examining the combined effect of economic factors (such as economic performance, lending rate, and tariff rate), social factors (including education and urbanization), and environmental factors (specifically carbon emissions) on the competitiveness of the automotive industry, particularly in the context of Asian countries. By incorporating a holistic approach, this study intends to provide a more nuanced understanding of the various influences on the automotive sector's competitiveness. The inclusion of multiple dimensions offers a comprehensive perspective that accounts for the complexity and interconnectedness of the factors at play. Analyzing these factors collectively will provide valuable insights for policymakers and industry stakeholders, helping them devise more effective strategies to enhance the competitiveness of the automotive industry in Asia.

3. METHODOLOGY

In order to investigate the impact of economic, social and environmental variables on competitiveness of automotive industry of Asian countries, following functional form is presented.

Competitiveness of Automotive = f (GDP per capita, Lending rates, Human capital, Urbanization, Tariff, Carbon emission)

The study examines the competitiveness of the automotive industry in fourteen Asian countries over the period from 1991 to 2020. The countries included in the sample are Bangladesh, India, China, Indonesia, Iran, Japan, Korea, Malaysia, Pakistan, the Philippines, Singapore, Thailand, Sri Lanka, and Vietnam. This broad sample allows for a comprehensive analysis of the diverse factors influencing the automotive industry across different Asian economies. Following the approach of Bekmez and Komut (2006), who utilized a modified version of the revealed comparative advantage (RCA) index to assess the competitiveness of the Turkish automotive industry, this study adapts similar methodologies to compare the automotive sectors across these Asian countries. The RCA index, originally developed by Balassa (1965), serves as a valuable tool in evaluating a country's comparative advantage in specific industries by comparing its export performance relative to other countries. By employing this index, the study aims to gain insights into the economic dynamics and trade performance of the automotive industry in the selected Asian countries.

Bekmez and Komut's approach involved adapting the RCA index to evaluate Turkey's automotive industry relative to European Union countries, providing critical insights into its competitive position. Similarly, this study's methodology allows for a comparative analysis of the automotive sectors in the selected Asian countries, highlighting each country's competitive strengths and weaknesses. The RCA index helps in understanding the relative performance of the automotive industry in each country, considering both economic and trade-related factors. Balassa's foundational work on trade liberalization and comparative advantage offers the theoretical grounding for this analysis, emphasizing the importance of comparative advantage in international trade and economic performance. By applying these concepts, the study seeks to provide a detailed and nuanced understanding of the factors influencing the competitiveness of the automotive industry in the context of the rapidly evolving Asian economies. This study aims to fill the gap in existing literature by providing a comprehensive analysis of the collective impact of economic, social, and environmental variables on the competitiveness of the automotive industry in Asia. The findings are expected to offer valuable insights for policymakers and industry stakeholders, helping them develop strategies to enhance the sector's competitiveness in the global market.

4. RESULTS AND DISCUSSIONS

Table 1 presents the descriptive statistics for various dependent and independent variables. The variable RCA has a mean of -1.17, a standard deviation of 2.22, with minimum and maximum values of -7.02 and 4.86, respectively. GDP per Capita shows a mean of 7,073.48, a standard deviation of 11,575.50, with a minimum value of 142.97 and a maximum value of 51,709. The Lending Rate has a mean of 10.66, a standard deviation of 5.32, ranging from a minimum of 1.41 to a maximum of 32.18. The Education variable has a mean of 68.89, with a standard deviation of 20.83, a minimum value of 23.92, and a maximum value of 104.47. Urbanization shows a mean of 1,814,030, with a standard deviation of 907,015, a minimum value of 699,808, and a maximum value of 2,928,252. CO2 Emission has a mean of 606,474.90, a standard deviation of 1,186,167, ranging from 101,000 to 1,650,000. Finally, the Tariff variable

shows a mean of 76.07, a standard deviation of 47.02, with minimum and maximum values of 10.00 and 156.00, respectively.

Table 1: Descriptive Statistics

Variable Dependent/ Independent	Mean	Std. Dev.	Min	Max
RCA	-1.17	2.22	-7.02	4.86
GDP per Capita	7,073.48	11,575.50	142.97	51,709
Lending Rate	10.66	5.32	1.41	32.18
Education	68.89	20.83	23.92	104.47
Urbanization	1,814,030	907,015	2,928,252	699,808
CO2 Emission	606,474.90	1,186,167	101,000	1,650,000
Tariff	76.07	47.02	10.00	156.00

Table 2 provides the correlation matrix for the variables. RCA is positively correlated with GDP per Capita (0.6684), Education (0.6773), Urbanization (0.6931), and Tariff (0.4696), but negatively correlated with Lending Rate (-0.7145) and CO2 Emission (-0.5200). GDP per Capita is positively correlated with RCA (0.6684), Education (0.4314), and Urbanization (0.5383), but negatively correlated with Lending Rate (-0.4958) and shows a very weak negative correlation with Tariff (-0.0032) and CO2 Emission (0.0455). Lending Rate is negatively correlated with RCA (-0.7145), GDP per Capita (-0.4958), Education (-0.5685), Urbanization (-0.4673), and CO2 Emission (-0.3708), but positively correlated with Tariff (-0.2678). Education is positively correlated with RCA (0.6773), GDP per Capita (0.4314), and Urbanization (0.4258), but negatively correlated with Lending Rate (-0.5685) and Tariff (-0.1071), and shows a very weak positive correlation with CO2 Emission (0.0656). Urbanization is positively correlated with RCA (0.6931), GDP per Capita (0.5383), and Education (0.4258), but negatively correlated with Lending Rate (-0.4673), and shows weak correlations with CO2 Emission (-0.0122) and Tariff (0.1208). CO2 Emission is negatively correlated with RCA (-0.5200), Lending Rate (-0.3708), Urbanization (-0.0122), and shows weak positive correlations with GDP per Capita (0.0455), Education (0.0656), and Tariff (0.2411). Finally, Tariff is positively correlated with RCA (0.4696), Urbanization (0.1208), CO2 Emission (0.2411), but shows weak negative correlations with GDP per Capita (-0.0032), Lending Rate (-0.2678), and Education (-0.1071).

Table 2: Correlation Matrix

Variable Dependent/ Independent	RCA	GDP per Capita	Lending Rate	Education	Urbanization	CO2 Emission	Tariff
RCA	1.0000						
GDP per Capita	0.6684	1.0000					
Lending Rate	-0.7145	-0.4958	1.0000				
Education	0.6773	0.4314	-0.5685	1.0000			
Urbanization	0.6931	0.5383	-0.4673	0.4258	1.0000		
CO2 Emission	-0.5200	0.0455	-0.3708	0.0656	-0.0122	1.0000	
Tariff	0.4696	-0.0032	-0.2678	-0.1071	0.1208	0.2411	1.0000

Table 3 presents the results of the Fixed Effect Model for the complete sample, focusing on the dependent variable RCA across six different model specifications. In the first specification, GDP Per Capita shows a positive and statistically significant coefficient of 0.0001 at the 1% significance level, indicating that higher GDP per capita is associated with an increase in RCA. In the second specification, the Lending Rate is introduced, displaying a negative and highly significant coefficient of -0.1195, also significant at the 1% level, suggesting that higher lending rates are associated with a decrease in RCA. The third specification adds the Education variable, which has a positive and statistically significant coefficient of 0.0333 at the 1% level, indicating that better education levels are linked to higher RCA. The fourth specification includes the Urban Population variable, which has a positive and significant coefficient of 0.0001 at the 1% level, highlighting the positive relationship between urban population and RCA. In the fifth specification, CO2 Emission is introduced and shows a negative and highly significant coefficient of -0.0001, significant at the 1% level, indicating that higher CO2 emissions are associated with a decrease in RCA. The sixth specification incorporates the Tariff variable, which has a positive and highly significant coefficient of 0.0137, significant at the 1% level, suggesting that higher tariffs are associated with an increase in RCA. Overall, the results from all specifications show consistent significance and direction of the coefficients, indicating robust relationships between the variables and RCA.

Table 4 presents the results of the Fixed Effect Model for the reduced sample, focusing on the dependent variable RCA across six different model specifications. In the first specification, GDP Per Capita shows a positive and statistically significant coefficient of 0.0001 at the 1% significance level, indicating a positive relationship between GDP per capita and RCA. Moving to the second specification, Lending Rate is introduced, showing a negative and statistically significant coefficient of -0.0905 at the 5% significance level. This suggests that higher lending rates are associated with

a decrease in RCA. In the third specification, Education is included, displaying a positive and statistically significant coefficient of 0.0282 at the 1% significance level. This indicates that higher levels of education are linked to higher RCA. The fourth specification introduces the Tariff variable, which has a positive and statistically significant coefficient of 0.0398 at the 1% significance level. This suggests that higher tariffs are associated with an increase in RCA. In the fifth specification, CO2 Emission is added, showing a negative and statistically significant coefficient of -0.0002 at the 10% significance level. This indicates that higher CO2 emissions are associated with a decrease in RCA. The sixth specification includes the Urban Population variable, which shows a coefficient that is not statistically significant, suggesting that urban population does not have a significant impact on RCA in this model. Overall, these results provide insights into how different factors such as GDP per capita, lending rates, education, tariffs, and CO2 emissions influence RCA in the reduced sample context.

Table 3: Fixed Effect Model - Complete Sample

	(1)	(2)	(3)	(4)	(5)	(6)
	RCA	RCA	RCA	RCA	RCA	RCA
GDP Per Capita	0.0001*** (0.0000)	0.0001*** (0.0000)	0.0001** (0.0000)	0.0001*** (0.0000)	0.0001** (0.0000)	0.0001* (0.0000)
Lending Rate		-0.1195*** (0.0257)	-0.1390*** (0.0306)	-0.0972** (0.0313)	-0.1285*** (0.0285)	-0.1180*** (0.0384)
Education			0.0333*** (0.0078)	0.0379*** (0.0076)	0.0589*** (0.0074)	0.0652*** (0.0097)
Urban Population				0.0001*** (0.0003)	0.0001*** (0.0004)	0.0001*** (0.0003)
CO 2 Emission					-0.0001*** (0.0007)	-0.0001*** (0.0005)
Tariff						0.0137*** (0.0030)

Table 4: Fixed Effect Model - Reduced Sample results

	(1)	(2)	(3)	(4)	(5)	(6)
	RCA	RCA	RCA	RCA	RCA	RCA
GDP Per Capita	0.0001*** (0.0000)	0.0001*** (0.0000)	0.0001** (0.0000)	0.0001* (0.0000)	0.0001* (0.0000)	0.0001 (0.0000)
Lending Rate		-0.0905** (0.0316)	-0.1034** (0.0353)	-0.1730*** (0.0358)	-0.1916*** (0.0436)	-0.1870*** (0.0436)
Education			0.0282*** (0.0077)	0.0408*** (0.0097)	0.0399*** (0.0101)	0.0445*** (0.0108)
Tariff				0.0398*** (0.0103)	0.0385*** (0.0104)	0.0343** (0.0110)
CO2 Emission					-0.0002* (0.0004)	-0.0001* (0.0003)
Urban Population						0.0001

5. CONCLUSIONS

The main objective of the study was to examine the impact of economic, social, demographic, tariff, and carbon emission variables on the competitiveness of the automotive industry. To accomplish this objective, the study applied panel estimation techniques to data from fourteen Asian countries over the time frame ranging from 1999 to 2020. The chosen panel estimation technique enables the analysis of both cross-sectional and time-series data, capturing the individual effects of each country as well as the temporal dynamics of the variables in question. This approach provides a robust framework for assessing the impact of multiple factors on the automotive industry's competitiveness across a diverse set of Asian economies. The economic variables considered in the study include indicators such as GDP growth, lending rates, and tariff rates, which are critical in determining the overall economic environment and trade policies that influence the automotive sector. Social variables, such as education levels and urbanization rates, were included to assess the role of human capital and demographic shifts in driving industry competitiveness. Demographic variables provide insights into population dynamics and consumer markets, which are essential for understanding demand patterns in the automotive industry. In addition to these economic and social factors, the study also incorporated environmental variables, specifically carbon emissions, to evaluate the impact of environmental policies and sustainability considerations on the automotive sector.

The inclusion of carbon emissions as a variable recognizes the growing importance of environmental standards and regulations in shaping industry competitiveness, particularly in an era of increasing emphasis on sustainable development and green technologies. The study's comprehensive approach allows for a nuanced analysis of how these diverse factors interact to influence the competitiveness of the automotive industry in Asia. By using panel data from a wide range of countries, the study aims to provide a detailed understanding of the regional variations and commonalities

in the determinants of automotive sector competitiveness. Overall, the findings from this study are expected to offer valuable insights for policymakers, industry stakeholders, and researchers, highlighting the multifaceted nature of competitiveness in the automotive industry and informing strategies to enhance the sector's performance in the rapidly evolving global market. The empirical findings of the study reveal significant insights into the factors influencing the competitiveness of the automotive industry across Asian countries. Firstly, higher economic performance, reflected in income levels and overall GDP growth, is positively associated with increased competitiveness in this sector. This relationship underscores the pivotal role of economic prosperity in driving consumer demand and expanding market opportunities for automotive products. Secondly, the presence of a well-educated workforce emerges as a crucial factor contributing to industry competitiveness. Skilled workers not only enhance the efficiency of production processes but also foster innovation within the automotive sector. Their capability to adapt to technological advancements and drive improvements in manufacturing practices reinforces the sector's competitive edge. Urbanization also plays a pivotal role in bolstering automotive industry competitiveness. Higher urbanization rates correlate with larger consumer markets, improved infrastructure, and greater accessibility to skilled labor pools. These urban dynamics create favorable conditions for automotive manufacturers to scale operations, meet market demand effectively, and innovate in response to urban mobility challenges. Moreover, the study highlights the significance of tariff rates in shaping industry competitiveness. Lower tariffs facilitate easier access to global markets, reduce production costs through cheaper inputs, and attract foreign direct investment. These factors collectively contribute to enhancing the competitive position of Asian countries in the global automotive landscape.

Overall, the findings underscore the interplay of economic, social, and policy factors in fostering a competitive automotive industry in Asia. By addressing these factors through strategic policies focused on economic growth, education and skills development, urban infrastructure enhancement, and trade liberalization, countries can further strengthen their position in the global automotive market and sustain long-term industry growth. The study highlights two critical factors that negatively impact the competitiveness of the automotive sector across Asian countries: lending rates and carbon emissions. Firstly, the findings indicate that lower lending rates are associated with increased competitiveness in the automotive industry, particularly in developing countries. Low lending rates encourage entrepreneurship and investment in auto parts sectors, fostering the growth of a robust ecosystem of suppliers and manufacturers within the automotive value chain. This expansion not only enhances domestic capabilities but also strengthens the sector's ability to compete effectively in the global market by diversifying and scaling production capacities. Secondly, environmental emission standards emerge as another significant determinant of industry competitiveness. The study reveals that countries with lower emission standards tend to perform better in the global automotive market. Lower emission standards reduce compliance costs for manufacturers, thereby enhancing cost competitiveness. Moreover, these standards may incentivize technological innovation towards cleaner and more efficient production processes, further bolstering competitiveness through sustainable practices. Together, these findings underscore the nuanced interplay between financial policies and environmental regulations in shaping the competitive landscape of the automotive industry. Policymakers and industry stakeholders in Asian countries can leverage these insights to formulate strategies that promote conducive lending environments for automotive sector growth while balancing environmental sustainability goals. By fostering a supportive policy environment that encourages investment, innovation, and adherence to competitive environmental standards, countries can enhance their global competitiveness in the automotive industry while ensuring sustainable development practices.

REFERENCES

- Attanasio, O. P. Koujianou Goldberg, P. and Kyriazidou, E. (2008). Credit Constraints in the Market for Consumer Durables: Evidence from Micro Data on Car Loans. *International Economic Review*, 49(2), 401-436.
- Buckley, P. J. Clegg, J. Zheng, P. Siler, P. A. and Giorgioni, G. (2007). The Impact of Foreign Direct Investment on the Productivity of China's Automotive Industry. *Management International Review*, 47(5), 707-724.
- Czuchry, A. Yasin, M. and Khuzhakhmetov, D. L. (2009). Enhancing Organizational Effectiveness through the Implementation of Supplier Parks: The Case of the Automotive Industry. *Journal of International Business Research*, 8(1), 45-61.
- Fagerberg, J. and Verspagen, B. (2002). Technology-gaps, Innovation-diffusion and Transformation: An Evolutionary Interpretation. *Research Policy*, 31(8), 1291-1304.
- Gallagher, K. S. (2003). Foreign Technology in China's Automobile Industry: Implications for Energy, Economic Development, and Environment. *China Environment Series*, 1(6), 1-18.
- Hunya, G. (2000). International Competitiveness Impacts of FDI in CEECs (No. 268). The Vienna Institute for International Economic Studies.
- Jaffe, A. B. and Palmer, K. (1997). Environmental Regulation and Innovation: A Panel Data Study. *Review of Economics and Statistics*, 79(4), 610-619.
- Kumar, R., and Chadee, D. (2002). Competitiveness of Asian Firms: An Analytical Framework (No. 4). ERD Working Paper Series, (37).
- Martin, R. L. (2003). A Study on the Factors of Regional Competitiveness. Report for the European Commission Directorate-General Regional Policy. Cambridge University.
- Muhammad, F. Hussin, M. Y. M. and AbRazak, A. (2010). Automobile Sales and Macroeconomic Variables: A Pooled Mean Group Analysis for Asean Countries *Journal of Business and Management*, 2(1), 15-21.

- Porter, M. E. and Van der Linde, C. (1995). Green and Competitive: Ending the Stalemate. *Harvard business review*, 73(5), 120-134.
- Smith Jr, D. F. and Florida, R. (1994). Agglomeration and Industrial Location: An Econometric Analysis of Japanese-Affiliated Manufacturing Establishments in Automotive-Related Industries. *Journal of Urban Economics*, 36(1), 23-41.
- Triebswetter, U. and Wackerbauer, J. (2008). Integrated Environmental Product Innovation and Impacts on Company Competitiveness: A Case Study of the Automotive Industry In the Region of Munich. *European Environment*, 18(1), 30-44.
- Winston, C. (1987). Blind intersection: Policy and the Automobile Industry.