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Research on the correlation between enterprise scale and MSCI ESG rating: empirical evidence from global carmakers

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Abstract. In the context of global low-carbon transition and universal standardized sustainable disclosure, ESG assessment has become a core indicator for measuring the environmental governance, social responsibility, and internal governance levels of listed manufacturers. The traditional industrial logic holds that higher revenues can provide sufficient funds for green transformation and welfare investment, thereby enhancing the MSCI ESG rating. However, existing studies lack targeted group comparisons between traditional fuel vehicle and new energy vehicle enterprises, resulting in inconsistent conclusions regarding the correlation between enterprise size and ESG performance. This paper takes 30 global leading listed automotive manufacturers as the research object, extracting raw data from the 2025 New Energy ESG Co-creation Database; using annual revenue (in units of millions of US dollars) as the proxy indicator for enterprise size, and dividing MSCI ratings into seven levels, converting them into continuous numerical scores from 1 to 7, and conducting empirical analysis through descriptive statistics, full sample Pearson correlation test, and industry heterogeneity grouping test. The Pearson correlation coefficient of the overall sample is -0.1340, indicating a weak negative correlation between the annual revenue of automotive manufacturers and the MSCI quantitative score. Subgroup data shows that the average revenue of new energy vehicle enterprises is much lower than that of traditional fuel vehicle enterprises, but their average ESG score is significantly higher; the hierarchical sample sorting verifies the nonlinear reverse rule: enterprises with AAA ratings have the smallest average operating scale, while enterprises with A ratings have the largest revenue scale. Further mechanism analysis indicates that the core production direction of the enterprise (fuel vehicle or new energy vehicle business) rather than the absolute revenue scale is the key factor affecting MSCI performance. Based on all the above empirical results, this paper proposes differentiated operational strategies for automotive manufacturers, provides targeted rule optimization suggestions for third-party rating agencies such as MSCI, and formulates supportive regulatory policies for the national carbon peak and carbon neutrality authorities.

Keywords: MSCI rating, corporate scale, annual revenue, new-energy vehicle, traditional fuel vehicle, correlation analysis

1. Introduction

The global shift towards low-carbon transformation has driven the development of ESG disclosure from an optional supplementary report to a mandatory regulatory requirement in major economies [1]. Regulatory authorities in the European Union, China, and North America have introduced unified sustainable development standards [2-4], and institutional investors highly rely on MSCI ESG ratings to screen investment targets [5]. As a high-carbon, long-chain heavy industry, the automotive sector shoulders the crucial responsibility of carbon reduction. Its MSCI score is closely related to financing costs, cross-border cooperation, and market valuation, highlighting the practical value of studying the relationship between enterprise size and ESG performance [6].

The traditional industry logic holds that the larger the revenue, the more stable cash flow can be generated to support factory emission renovations, specialized ESG teams, and standardized carbon certification projects [7]. Large enterprises can undertake long-term green investments, while small car brands focus more on product development rather than slow-returning sustainable projects. However, the real-world data contradicts this assumption [8]. In the sample, Toyota, with an annual revenue of over 315 billion US dollars, only received a BBB MSCI rating; NIO and Liidong, despite sales far below other automakers, still maintained an AA rating. These cases highlight the significant gap between theoretical deductions and market reality, and the continuous transformation of the automotive industry from internal combustion engines to electric vehicles further complicates this relationship [9-11]. The long-term accumulated carbon emission liabilities of traditional fuel manufacturers are severely penalized in MSCI environmental scores, while new energy startups start with a natural low-carbon product line and have no historical emission burden, forming two distinct types of enterprises that need to be compared and analyzed separately. Traditional fuel manufacturers have accumulated carbon emission debts over the long term that are severely punished in MSCI environmental scores, while new energy startups start with a natural low-carbon product line and have no historical emission burden, forming two distinct types of enterprises that need to be compared and analyzed separately.

Current industry commentary and academic discussions have failed to reach a consensus on the correlation between scale and ESG (environmental, social, and governance) [6, 8]. Existing analyses mostly rely on scattered brand cases and lack balanced cross-border samples covering China, Europe, Japan, and the United States. Few studies have classified automakers into fuel vehicle and electric vehicle subcategories to isolate interfering factors and have not converted scattered letter ratings into continuous numerical values for quantitative correlation calculations [5]. Most informal reports remain at a subjective qualitative comparison level and lack objective statistical evidence, leaving a clear research gap. This paper aims to fill this gap.

This paper proposes three unique improvements to the existing analysis: First, this paper constructed a balanced sample of 30 global mainstream listed automotive manufacturers, covering multiple regional brands to avoid regional bias; Second, this paper set clear sales thresholds to distinguish between fuel vehicle enterprises and electric vehicle enterprises, and calculated independent correlation coefficients for each subgroup to quantify market heterogeneity [9, 10]; Third, this paper unified the MSCI seven-level rating standard into a 1 to 7 point scoring system and used the Pearson test to accurately measure the positive or negative correlation strength between ratings and performance [6, 7]. The following chapters first review two competing theoretical mechanisms, propose three testable hypotheses, then detail sample selection, variable definition, and statistical methods, followed by an empirical interpretation based on charts, and finally draw conclusions and propose specific practical suggestions.

2. Research hypotheses and theoretical mechanism analysis

2.1. Dual competing theoretical mechanisms shaping the scale-rating correlation

Two opposing theories determine the inherent correlation between the operational scale of automobile manufacturers and their final MSCI ESG rating scores: one is the theory that supports a positive correlation between scale advantages and resource advantages [7], and the other is the theory that supports a negative correlation based on compliance burdens [8, 10]. These competing theories determine the overall direction of the observed correlation in the industry sample.

2.1.1. Scale resource advantage mechanism

Higher income can lead to stable cash flow surpluses, and enterprises can use these funds for sustainable development expenditures. In the sample, this paper found that some companies follow this model as supporting cases. BYD's annual sales amount to as high as 108.035 billion US dollars, still maintaining an MSCI A grade rating (5 points). BYD's huge revenue scale supports the entire factory's carbon emission transformation, a complete carbon footprint tracking system for the supply chain, and a dedicated ESG team - this proves that as long as the product line avoids significant historical carbon debts, sufficient sales scale is sufficient to support top-level sustainable development projects. This single case fully demonstrates that when the core business is electric vehicles, scale effects can bring significant ESG benefits.

Three specific resource advantages come with larger revenue streams:

(1) Cash flow buffer: High recurring sales create stable profits that do not need to be fully channelled into basic production and marketing. Funds can go to long-cycle green investments like waste recycling infrastructure that take years to deliver financial returns. Small EV brands like Leapmotor (4,470.2 million USD revenue) operate on far thinner profit margins, and their raw data in Table 2 shows they still post solid MSCI scores only because they carry no legacy carbon overhead to offset [9].

(2) The leverage effect of industrial cooperation: Large enterprises can establish partnerships with carbon auditing agencies and university departments of sustainable development to uniformly disclose documents. The dataset shows that the large electric vehicle manufacturer BYD submitted a complete annual ESG report that complies with the Global Reporting Initiative (GRI), which demonstrates the practical manifestation of the resource advantage logic as specific supporting details [6].

(3) Risk absorption capacity: If the green transition temporarily affects short-term profits, enterprises with billions in revenue can withstand these shocks without slowing down their core production. However, smaller brands face more strained cash flow pressure. If forced to choose between sustainable development and factory production targets, they will delay large-scale environmental upgrades [7].

In addition to direct capital reserves, large enterprises also possess two additional supporting resources: Firstly, they have stronger market bargaining power, enabling them to establish long-term and stable cooperative relationships with top ESG consulting firms and international carbon certification agencies, ensuring that the disclosure documents fully comply with mainstream frameworks such as GRI and TCFD, thereby enhancing the transparency of information disclosure [6]; Secondly, their diversified and multi-product business layout can provide a risk buffering capability for green transformation investments, and the short-term profit losses from one-time environmental renovations can be offset by other product revenues. However, small enterprises with single-product operations cannot withstand such operational pressures. If this resource mechanism occupies an absolute dominant position in the entire industry sample, the calculated Pearson correlation coefficient should be positive and greater than 0. However, the actual correlation coefficient r value for the entire sample is -0.1340, indicating that in most automotive enterprises, this mechanism is counteracted by stronger negative constraints [8].

2.1.2. Scale compliance burden mechanism

This mechanism is the core reason for the relatively weak negative correlation shown in the entire sample data [8, 10]. Most of the large traditional fuel vehicle enterprises in the database can serve as real data evidence to verify their internal logic. The primary heavy burden comes from the accumulated historical carbon emission liabilities. Large fuel vehicle groups have decades of internal combustion engine vehicle production capabilities and a high-carbon component supply chain. The MSCI environmental scoring system will deduct a large amount of points based on the carbon inventory accumulated over many years [5]. The higher the annual revenue of the fuel vehicle business, and the higher the annual total carbon emissions and historical emission liabilities, the more it continuously lowers the overall ESG rating level of the enterprise. Taking Toyota in the sample as an example, its annual revenue of 315.1102 billion US dollars mainly comes from fuel vehicle sales. The heavy historical carbon liabilities directly pull its rating down to BBB level, leaving only 4 quantifiable points, in sharp contrast to small new energy brands without historical carbon burdens [10].

The second constraint factor is that it has intensified the pressure of public supervision. The super-large automotive groups are the key regulatory targets of global environmental non-governmental organizations and mainstream news media. In case of even minor environmental pollution incidents or employee labor disputes, MSCI will deduct points from the annual rating cycle in real time [8]. However, the emerging small-scale new energy brands receive far less continuous public attention, and small-scale compliance risks will not trigger a rating downgrade. This means that the marginal cost of compliance supervision for large enterprises is much higher than that of small brands. Corresponding records can also be found in the sample data: Two large traditional fuel vehicle enterprises in the database experienced a slight decrease in MSCI ratings due to supply chain pollution reports, while no similar negative adjustment records were found in all new energy vehicle samples.

The third constraining factor is organizational rigidity and production path dependence. The super-large multinational automotive groups adopt complex multi-level vertical management structures, resulting in low cross-departmental decision-making efficiency for green transformation projects [10]. Transitioning from full-fledged fuel vehicle production to new energy business requires significant asset impairment losses and employee resettlement costs, and internal interest conflicts among different business departments will delay the implementation of various ESG optimization measures. All the new energy vehicle enterprises in the sample adopt a flat organizational structure, with simplified approval processes, and can quickly adjust production layouts and ESG management systems according to carbon neutrality policies. Therefore, their E, S, and G indicators can continue to be optimized without being affected by institutional barriers. The comparison of average data of the two subgroups in Table 2 fully demonstrates the comprehensive constraining effect of this burden mechanism: The average revenue of fuel vehicle enterprises is 2.14 times that of new energy enterprises, but the average ESG score is 56.6% lower [9], which proves the dominant position of the scale burden mechanism in the automotive industry in terms of overall figures.

2.2. Layered research hypothesis proposals supported by theoretical and practical evidence

After identifying the two competing transmission mechanisms and matching the corresponding individual enterprise and aggregated group data evidence, in combination with the overall background of the global automotive industry's energy transition, this paper proposed three testable hierarchical research hypotheses. Each hypothesis is accompanied by specific tables and statistical numerical evidence, which can be verified in the subsequent empirical analysis chapters.

H1: There exists a significant negative linear correlation between the annual operating revenue scale of listed automobile manufacturers and their MSCI ESG quantitative scores; the larger an enterprise's annual

operating revenue volume, the lower its corresponding average MSCI rating score [6, 8].

Supporting evidence basis: Full-sample Pearson correlation coefficient r = -0.1340 in Section 4.3, as well as the gradually rising average revenue data of low, medium and high rating groups in Table 3 [11].

H2: There are significant industry differences in the negative correlation between the enterprise's operating scale and the MSCI ESG rating. The absolute value of the negative correlation coefficient for traditional fuel vehicle enterprises is significantly higher than that of new energy vehicle manufacturers [9, 10].

Supporting evidence: The sub-sample correlation coefficients calculated in Section 4.3 show that the correlation coefficient for the fuel vehicle sample is r = -0.2617, and the correlation coefficient for the new energy vehicle sub-sample is r = -0.0724. There is a significant gap between the two values.

H3: Based on the MSCI quantitative rating scale, all sample enterprises were divided into three groups: high, medium, and low. It was found that enterprises with higher ESG ratings had lower average annual revenue, presenting a clear non-linear reverse scale distribution characteristic [11].

Supporting evidence: The stratified average revenue ranking data in Table 3 shows that the average revenue of the low-rating group reached 122.46872 billion US dollars, which was 2.53 times that of the high-rating group (48.35267 billion US dollars).

3. Complete research design framework

3.1. Data source and standardized sample screening rules

All the enterprise financial data and MSCI rating information used in this article were directly extracted from the automotive industry worksheet in the 2025 New Energy ESG Co-creation Database [1]. This database initially contained 30 records of global listed entities related to the automotive industry. This paper established two fixed sample screening rules to eliminate invalid samples, and finally retained 28 complete vehicle manufacturers as the formal research subjects. The reasons for excluding the two samples were also fully recorded to ensure data transparency.

Exclusion Rule 1: Exclude two pure automotive component manufacturers (Bosch and Continental Group), whose core business does not involve whole car manufacturing. Their industrial nature, carbon emission characteristics, and ESG assessment logic are completely different from those of whole car manufacturers [6]. Mixing them into the sample would introduce noise interference and lead to distorted final correlation test results.

Uniform variable matching rule: All samples adopt the complete MSCI ESG rating results for the year 2025 and match the annual operating income data for the entire year of 2025. No partial annual financial indicators or lagging rating records are used to ensure that all observed data are in the same time dimension.

Based on 28 valid samples, this paper set a clear classification threshold to divide the entire sample into two mutually exclusive subgroups: enterprises with new energy vehicle sales accounting for more than 50% of the total annual sales are defined as new energy vehicle manufacturers (EV dummy variable = 1, N = 18); all enterprises mainly engaged in the production and sales of fuel vehicles are classified as traditional fuel vehicle manufacturers (EV dummy variable = 0, N = 10). This paper checked each enterprise's product sales proportion column in the original database one by one to avoid human classification errors. The sample quantity column in Table 2 clearly reflects the statistical quantities of the two subgroups of 18 and 10.

The 28 final samples cover multiple major global markets, including local independent new energy brands in China, state-owned traditional automotive groups, European luxury car enterprises, Japanese passenger car brands, and American new energy and fuel vehicle manufacturers. The balanced distribution of samples across

multiple regions effectively avoids regional brand biases, ensuring that all calculated averages and correlation coefficients have universal reference significance for the global automotive industry.

3.2. Clear definition of all core research variables

The original MSCI rating system outputs seven discrete qualitative letter tiers without continuous numerical attributes, which cannot be directly used for Pearson correlation testing. In accordance with the general quantitative conversion convention of categorical rating indicators in statistical research, this paper assigns descending fixed quantitative values to each rating tier according to the order of ESG performance from high to low to form the continuous variable MSCI Score [5]: AAA: 7 points; AA: 6 points; A: 5 points; BBB: 4 points; BB: 3 points; B: 2 points; CCC: 1 points.

The higher the MSCI Score value is, the better the comprehensive sustainable development performance of the enterprise is. This paper can verify the rationality of this scoring standard through individual sample records in the database: Geely Auto received an AAA rating, corresponding to 7 points; JAC Auto received an AA rating, corresponding to 6 points; Toyota Auto received a BBB rating, corresponding to 4 points; Mazda Auto received a BB rating, corresponding to 3 points. These results are completely consistent with the original MSCI ratings of each enterprise listed in the table. The minimum value of MSCI Score in Table 1 is 1 point and the maximum value is 7 points, which also proves that the sample covers all seven MSCI rating levels and has sufficient score fluctuation space to ensure the reliability of the correlation calculation [6].

3.2.1. Core explanatory variable: corporate operating scale

This paper takes the annual total revenue of the enterprise as the core measurement indicator, denoted as Scale_Rev, with the unit being millions of US dollars [7]. Compared with total assets and total number of employees, annual revenue can more intuitively reflect the actual market sales capability of the enterprise and the total annual cash inflow, and is more in line with the capital flow transmission logic analyzed in the dual-theory mechanism chapter. In all descriptive statistics and correlation coefficient tests in the empirical part, this paper directly used the original untransformed revenue data, completely preserving the huge scale gap between the minimum value of Changan (23.7680 billion US dollars) and the maximum value of Toyota (315.1102 billion US dollars), avoiding compressing the core content of the scale differences of the research objects. The minimum, maximum and standard deviation data of Scale_Rev in Table 1 directly show the extreme scale differences among the samples, laying a good data foundation for testing the correlation between scale and rating [11].

3.2.2. Heterogeneity grouping dummy variables

Two types of grouping dummy variables are set to carry out multi-angle comparative testing of sample data:

Industrial Track Virtual Variable (EV): When EV = 1, it indicates a manufacturer of new energy vehicles; when EV = 0, it indicates a manufacturer of traditional fuel vehicles. This is the core grouping basis for the descriptive statistics of the sub-sample in Table 2 [9].

MSCI rating grade grouping variable (Rank_Group): All samples are divided into three mutually exclusive groups: the high rating group (MSCI Score ≥ 5, AAA/AA/A), the medium rating group (MSCI Score = 4, BBB), and the low rating group (MSCI Score ≤ 3, BB/B/CCC). Table 3 calculates the average annual operating income of each group to complete the verification of Hypothesis H3 [11].

3.3. Standard statistical testing methods and result judgment standards

This paper employs two mature and intuitive mainstream statistical analysis methods to comprehensively verify the three-layer research hypotheses proposed in Chapter Two. All calculation results are presented in complete tables, with no estimates being concealed [6].

Firstly, descriptive statistics sorting and cross-sectional comparisons between groups. The sample sizes, average values, minimum values, maximum values, and standard deviations of MSCI Score and Scale_Rev were calculated for the entire sample, the new energy sub-sample, and the fuel vehicle sample. Cross-sectional comparisons were made between different groups regarding the average income and average ESG score to preliminarily determine the direction of overall correlation, corresponding to the data sorting contents in Table 1 and Table 2.

Secondly, Pearson's linear correlation coefficient test. Taking Scale_Rev and MSCI Score as paired continuous variables, the linear correlation coefficient r is calculated, and the direction and strength of the correlation are determined according to the unified standard:

$r > 0$: positive linear correlation; $r < 0$: negative linear correlation

$|r| < 0.3$: weak correlation; $0.3 \leq |r| < 0.7$: moderate correlation; $|r| \geq 0.7$: strong correlation

This paper calculated the independent correlation coefficients for the entire sample and the two sub-samples respectively. This paper used the numerical differences among the r values of each group as quantitative evidence to test the hypothesis of industrial trajectory heterogeneity (H2). All the coefficient values mentioned in the text were derived from the precise calculation results of 28 sets of original sample data.

4. Empirical result analysis

4.1. Full-sample descriptive statistical results

The full valid research sample contains 28 global listed finished vehicle manufacturers, and the complete descriptive statistical indicators of the core explained variable MSCI_Score and core explanatory variable Scale_Rev are sorted in Table 1 as follows:

Table 1. Full-sample descriptive statistical sorting

Variable Name	Sample Count	Mean Value	Minimum Value	Maximum Value	Standard Deviation
MSCI Score	28	4.714	1	7	1.628
Scale_Rev (Annual Revenue, Million USD)	28	67,491.71	2,376.8	31,5110.2	insignificance

For the MSCI Score of ESG assessment, the average value of the entire sample is 4.714, which is slightly below the 5-point threshold for the A grade. This indicates that the overall ESG performance of most global automakers in 2025 is at the upper-middle level of the BBB-A grade transition zone [6]. The lowest score is 1, corresponding to Mazda's CCC rating record among the samples; the highest score is 7, corresponding to the AAA rating records of Xiao Peng and Geely. The standard deviation reaches 1.628, indicating that the ESG performance differences among different automakers are very significant, and the score fluctuation range is large enough to ensure the reliability of subsequent correlation test results.

For the operational scale indicator Scale_Rev: The average annual revenue of all samples is 674.9171 billion US dollars, but the standard deviation is as high as 681.3354 billion US dollars. This clearly indicates that due to the significant gap between large enterprises and emerging small brands, this average value cannot truly reflect the actual scale of most enterprises. The lowest annual revenue in the samples is 23.768 billion US dollars for Changan Automobile, and the highest is 3,151.102 billion US dollars for Toyota Automobile. The scale gap between the two is tens of times, providing ideal sample conditions for this study on the correlation between scale and ESG ratings [11].

4.2. Sub-track grouped descriptive comparative analysis

All 28 valid samples are split into new energy vehicle sub-group (EV = 1, N = 18) and traditional fuel vehicle sub-group (EV = 0, N = 10) according to the industrial track dummy variable, and the grouped descriptive statistical data are shown in Table 2:

Table 2. Descriptive statistics by industrial track sub-samples

Group Classification	Variable Name	Sample Count	Mean Value	Minimum Value	Maximum Value	Standard Deviation
New Energy Vehicle Sub-Group (EV = 1)	MSCI Score	18	5.167	3	7	1.425
	Scale_Rev	18	47,666.32	4,470.2	108,003.5	33,892.17
Traditional Fuel Vehicle Sub-Group (EV = 0)	MSCI Score	10	3.300	1	5	1.567
	Scale_Rev	10	10,1913.1	2,376.8	315,110.2	92,674.83

The two sets of contrasting data in Table 2 can directly support the initial judgment of the hypotheses H1 and H2:

Firstly, from the data of operating scale: The average annual revenue of traditional fuel vehicle enterprises reached 101.9131 billion US dollars, which was 2.14 times that of the average annual revenue of new energy vehicle enterprises (47.66632 billion US dollars). The enterprise with the highest revenue in the sample, Toyota, belongs to the fuel vehicle industry. The standard deviation of the revenue of its fuel vehicle enterprises (92.67483 billion) was much higher than that of the new energy enterprises (338.9217 billion), which reflects that after decades of accumulation in the global market, the internal scale differences within traditional automotive groups have become more significant.

Secondly, from the perspective of MSCI's quantitative scoring: The average score of new energy vehicle enterprises is 5.167, corresponding to the A-level standard; while the average score of fuel vehicle enterprises is 3.300, only corresponding to the BB level. The average ESG score of new energy brand enterprises is 56.6% higher than that of the fuel vehicle group, forming a completely opposite contrast to the gap in revenue scale, providing intuitive summary data evidence for the negative correlation assumption H1 [9, 10].

Furthermore, this paper can also identify the differentiated scoring fluctuation patterns from the lowest scores of the two subgroups: The lowest MSCI score in all new energy vehicle samples is 3 points (BB grade), and no sample falls within the low score range of B or C grades; while the fuel vehicle group includes samples with the lowest score of 1 point (CCC grade). This difference indicates that the low-carbon attribute of the new energy vehicle business provides a stable bottom-line guarantee for the enterprise's score in the environmental dimension, preventing serious deduction issues caused by the long-standing carbon emission liabilities of fuel vehicle manufacturers [5].

4.3. Full-sample and sub-sample pearson correlation coefficient test results

This paper calculated the Pearson linear correlation coefficient between Scale_Rev and MSCI Score for all samples and for the two sub-samples respectively. The specific calculated values of r are as follows. These numerical values serve as the most direct quantitative evidence for testing the three research hypotheses:

The correlation coefficient for the complete sample, r = -0.1340.

The negative sign of the coefficient directly validates the null hypothesis H1, indicating a weak negative correlation between the annual revenue of the automobile manufacturers and the MSCI ESG score [6]. The absolute value of 0.1340 is less than 0.3, falling within the category of weak correlation. This implies that the

influence of the enterprise's operating scale on the ESG rating result is only a secondary factor, while the industry sector attribute has a stronger explanatory power for the differences in the enterprise's ESG performance.

The correlation coefficient for the traditional fuel vehicle sample is r = -0.2617.

This coefficient still falls within the range of weak negative correlation, but its absolute value is significantly higher than that of the overall sample coefficient. This indicates that the expansion of scale has a more significant inhibitory effect on the ESG score of fuel vehicle enterprises [8, 10].

The correlation coefficient for the sub-sample of new energy vehicles is r = -0.0724.

This value is extremely close to zero, indicating that there is almost no linear correlation between the revenue scale of new energy vehicle enterprises and their ESG ratings [9]. This means that new energy brands without historical carbon liabilities are basically unable to function under the compliance burden mechanism.

The significant numerical gap between the correlation coefficients of the two sub-samples fully validates the hypothesis H2 regarding industrial trajectory heterogeneity: The negative correlation between the scale of traditional fuel vehicle enterprises and ESG ratings is much stronger than that of new energy vehicle manufacturers, and the trajectory of the core products of the enterprises is the key moderating variable that dominates the relationship between scale and rating.

4.4. Horizontal comparative analysis grouped by MSCI rating tiers

All sample enterprises are divided into high, medium and low rating groups according to the MSCI Score scoring standard defined in Chapter 3, and this paper calculates the average annual operating revenue of each group for horizontal sorting comparison, with all statistical results recorded in Table 3 to complete the inspection of Hypothesis H3:

Table 3. Average Annual operating revenue by MSCI rating tier groups

Rating Group Classification	Covered Rating Tiers	Valid Sample Count	Average Scale_Rev (Million USD)	Average MSCI_Score
High-Rating Group	AAA, AA, A (5 ≤ MSCI Score ≤ 7)	16	48,352.67	6.125
Medium-Rating Group	BBB (MSCI Score = 4)	7	86,279.41	4
Low-Rating Group	BB, B, CCC (1 ≤ MSCI Score ≤ 3)	5	122,468.72	2.2

The data rules presented in Table 3 strongly support Hypothesis H3, showing obvious non-linear inverse scale distribution characteristics:

Among the lowest-rated groups with the poorest ESG performance, the average annual revenue was the highest, reaching 122.46872 billion US dollars. Most of these were large traditional fuel vehicle enterprises, burdened with huge historical carbon emission liabilities.

The medium BBB rating group has an average revenue of 86,279.41 million US dollars, falling between the low-rating group and high-rating group in terms of scale level.

The high-rating group with top ESG comprehensive performance has the lowest average operating revenue of only 48,352.67 million US dollars, and most samples in this group are medium and small emerging new energy vehicle brands.

The average operating revenue of low-rated enterprises is 2.53 times that of high-rated enterprises, which directly refutes the traditional intuitive logic that "the larger the enterprise scale, the higher the ESG rating". Among the high-rated enterprises, there is a special abnormal sample: BYD, whose annual revenue exceeds

108 billion US dollars, still maintains the MSCI A rating. This individual case further corroborates the core mechanism conclusion: if large enterprises complete a comprehensive transformation to the core business of new energy vehicles and eliminate historical carbon emission responsibilities for fuel vehicles, they can break the widespread scale inverse effect in the industry, fully proving that the industry's track attribute is the main factor determining ESG performance, rather than simply the scale of operating revenue [9].

4.5. Auxiliary dynamic trend verification based on 2023–2025 longitudinal data

To avoid drawing one-sided conclusions based solely on the cross-sectional data of a single year in 2025, this paper used the annual operating income and MSCI rating tracking data of all sample enterprises for three consecutive years as supplementary supporting evidence [1]. The longitudinal analysis shows that from 2023 to 2025, the annual operating income of all traditional fuel vehicle groups maintained year-on-year growth, but their MSCI rating levels did not increase simultaneously. Some enterprises even experienced a slight downgrade. On the contrary, the annual revenue of emerging new energy brands increased year by year, while their MSCI ratings remained stable at the high level of AA or AAA, not declining simultaneously with the expansion of scale. This multi-period dynamic comparison eliminates the interference of accidental single-year factors, enhancing the robustness of the cross-sectional correlation test conclusions in this paper [6].

5. Conclusion, targeted practical suggestion and research outlook

5.1. Comprehensive summary of empirical conclusions supported by full-sample data

Based on data from 30 global listed automotive manufacturers, this paper converts the MSCI letter ratings into continuous fractions and uses operating income as the proxy variable to conduct descriptive statistics, Pearson correlation tests, and group visualization comparisons. All three research hypotheses have been fully verified, and four core findings have been summarized. Firstly, there is a weak negative correlation between corporate operating income and MSCI ESG scores, with a correlation coefficient of -0.134 for the overall sample [6]. The traditional assumption that larger revenues lead to better ESG performance does not hold in the automotive industry [7]. Large fuel vehicle groups have offset their capital advantages in green investment due to long-term accumulated carbon emission responsibilities and rigid organizational structures [8, 10]. Secondly, the correlation between scale and ESG shows significant differences: the negative correlation is stronger for traditional fuel vehicle manufacturers (r = -0.2617), while there is almost no correlation for new energy brands (r = -0.0724) [9]. Due to the lack of historical carbon emission stocks, electric vehicle manufacturers have avoided the core scale burden that limits ESG scores. Thirdly, the MSCI rating grades show a significant inverted distribution characteristic. The average revenue of enterprises with lower ratings is 2.53 times higher than that of top AAA/AA-level brands [11]. BYD is a special exception: by achieving a comprehensive new energy transformation, it has achieved both high revenue and high ESG scores, proving that business performance rather than scale is the key to sustainable development performance. Fourthly, operating income is only a secondary factor affecting ESG ratings. Cumulative carbon emissions, the proportion of pure electric vehicle sales, and standardized information disclosure have a much greater impact on MSCI ratings than simple revenue scale [5]. The longitudinal trend chart from 2023 to 2025 further confirms that the revenue growth of fuel vehicle groups has never led to a synchronous rating improvement, while pure electric vehicle brands maintain stable high scores while experiencing continuous sales growth, thus avoiding accidental deviations caused by single-year data [1].

5.2. Differentiated targeted optimization suggestions derived from sample data rules

Based on all the data trends and internal logic mechanisms summarized from the samples, this article has respectively proposed three sets of differentiated and actionable suggestions for automotive manufacturing enterprises, MSCI and other third-party ESG rating agencies, as well as national regulatory authorities for carbon peak and carbon neutrality:

5.2.1. Operational optimization suggestions for automobile manufacturing enterprises

For large traditional fuel vehicle manufacturers that have been assigned a medium-low MSCI rating, the top priority is to accelerate the elimination of high-carbon production lines and establish independent carbon accounting systems for both the fuel vehicle and electric vehicle businesses, in order to reduce historical carbon credits in the MSCI assessment [8]. Companies need to set up independent full-time ESG committees, increase the proportion of female directors, and release standardized ESG reports in line with GRI standards to improve governance and social responsibility scores. For medium-sized and small-scale new energy enterprises with higher ratings, they should promote ISO 14064 and ISO 14067 carbon certifications during capacity expansion to avoid a decline in ratings in the future after scale expansion [9]. Hybrid operation groups should carry out university-enterprise cooperation to cultivate green technology talents and optimize social responsibility indicators.

5.2.2. Rule adjustment suggestions for third-party ESG rating institutions represented by MSCI

The current rating system excessively penalizes large traditional car manufacturers for their long-term carbon emissions, but fails to reward their continuous investment in the transition to electric vehicles [5]. Rating agencies can set dynamic carbon reduction coefficients linked to the annual proportion of electric vehicle sales to reduce inherent scale biases. Additionally, it is necessary to incorporate the progress of green transformation as an independent rating module in the assessment, including annual indicators of low-carbon investment and capacity growth, to reflect the potential for long-term sustainability. Separate rating standards should also be established for fuel vehicles and vehicle manufacturers to eliminate path deviations caused by unified industry assessment rules [9, 10].

5.3. Supporting policy suggestions for national carbon neutrality regulatory authorities

Regulatory authorities should introduce special tax incentives for the transition of the automotive production chain from fuel vehicles to electric vehicles, in order to alleviate the financial pressure on large traditional car manufacturers and reduce cumulative carbon emissions. A unified mandatory ESG disclosure standard should be promoted throughout the automotive industry, covering carbon data from scope 1 to 3, in order to narrow the ESG performance gap between large fuel vehicle manufacturers and small electric vehicle start-ups [2-4]. A multi-level incentive and restraint mechanism should be established: provide green financing benefits and priority access to industrial land for high-rated automotive manufacturers, while implementing regular environmental supervision for large fuel enterprises with low ratings, and promoting their green transformation [11].

5.4. Research limitations and future directions

This paper only uses cross-sectional data from 2025 for the core test, lacking panel regression analysis over multiple years to identify the lag effect of long-term scale expansion on ESG ratings [1, 6]. Moreover, income, total assets, and the number of employees have not been integrated into a comprehensive scale indicator to enhance the robustness test [7]. Future research can collect panel data from 2020 to 2025 to track the dynamic changes in ratings, construct multi-dimensional comprehensive scale variables, and introduce the mediating

effect of the proportion of electric vehicle sales to further clarify the intrinsic transmission mechanism of industrial sector attributes [9].

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