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Industrial Agglomeration and Corporate ESG Performance: Empirical Evidence from Manufacturing and Producer Services

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Abstract: Global climate change has emerged as a persistent global crisis. Under the dual pressures of industrial structure upgrading and ecological environment improvement, enhancing enterprise ESG (Environmental, Social, and Governance) performance can contribute to achieving sustainable development of the global economy. Selected a sample of 285 prefecture-level cities in China from 2005 to 2020 and panel data of listed companies to empirically examine the impact of industrial agglomeration on corporate ESG performance and its heterogeneity effects. We found that industrial agglomeration generally positively affects corporate ESG performance, with the significant promotion of ESG performance in manufacturing and a "U"-shaped relationship between producer services. Influence channel analysis found that industrial agglomeration acts on corporate ESG performance through the micro-transmission mechanisms of financing constraints, investment levels, market competitiveness, and internal control. Heterogeneity research found that the impact of manufacturing agglomeration on corporate ESG performance is more significant in capital-intensive and high-end technology industries, while producer service agglomeration has a more significant effect on ESG performance for knowledge-intensive industries. This study contributes to a better understanding of the microeconomic consequences of industrial agglomeration and expands the research perspective on the internal mechanisms and external incentives of corporate ESG performance. It provides a basis for local governments to analyze the different characteristics and microeconomic consequences of industrial agglomeration and provide empirical evidence for listed companies to adjust their ESG performance structure dynamically.

Keywords: industrial agglomeration; corporate ESG performance; manufacturing; producer services; industrial agglomeration heterogeneity

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1. Introduction

Industrial agglomeration is a dominant feature of developing countries and a typical way of allocating resources and spatial organization in the industrial era. However, this non-intensive mode entails severe costs such as resource depletion, environmental degradation, and ecological damage (Wang et al., 2019) [1]. As the world economy proliferates, the regional ecological conflict between extensive growth and resource-environment constraints becomes more acute, hindering further economic development. In addition, in the context of anti-globalization and global value chain restructuring, manufacturing shifts from developed countries with rising labor costs to emerging economies. The COVID-19 pandemic and international geopolitical competition also accelerate the trend of industrial relocation and value chain localization across regions. The role of manufacturing in driving economic growth diminishes. ESG refers to the configuration of principles of environmental, social, and governance responsibility; processes of environmental, social, and governance responsiveness; and politics, programs, and observable outcomes relating to the firm's societal relationships. The UN-PRI encourages and stimulates member institutions to incorporate ESG factors into their decision-making processes, thereby achieving dual benefits of economic and social value. Since then, the ESG development concept

has gradually become the inevitable choice for transforming the global microeconomic development model (Li et al., 2023) [2]. The Environmental, Social, and Governance concept originated from ethical and responsible investment and is an enrichment and extension of corporate social responsibility. It is a development perspective that pursues the unity of economic and social values. Focusing on enterprises' non-financial returns and stakeholder value, it promotes enterprises to adapt to economic globalization and sustainable development. It has become the core sustainable enterprise development framework (Leins, 2020) [3]. Hence, exploring the economic consequences and mechanisms of industrial agglomeration influences enterprise ESG performance holds significant theoretical and practical implications. This research is crucial for establishing a global, green, low-carbon circular economic system.

Industrial agglomeration refers to a phenomenon where similar industries are highly concentrated in a specific geographic area, creating interactions and continuously gathering production elements within that spatial scope. As the theoretical research on new economic geography deepens, industrial agglomeration has gradually become a hot topic among scholars as a localized market organization form for production, trade, and coordination. The academic community generally believes that agglomeration externalities include labor pool, knowledge spillover, and input share. Marshall (1890) defined the external effects of industrial agglomeration as the economies of scale achieved by related firms through a specialized division of labor in each production process. This effect can create a positive feedback mechanism between regional economic growth and industrial agglomeration, forming a virtuous cycle (Niklas, 2002; Beaudry and Schiffauerova, 2009; Amado and Elizabeth, 2016; Chen et al., 2022) [4–7]. Porter (1998) conducted research based on the perspective of external economy and competitive advantage and believed that industrial agglomeration could effectively reduce innovation and transaction costs of micro-subjects in a region, as well as improve the efficiency of factor utilization. By constructing product differentiation, it can establish a positive feedback mechanism between regional economic growth and agglomeration self-growth and achieve spatial spillover effects and industrial correlation effects, thus realizing dual growth in both quality and quantity of regional economy (Martin and Ottaviano, 2001; Martin et al., 2014; Alberto and Philip, 2021) [8–10].

Current research mainly focuses on the economic consequences of corporate ESG performance. However, the findings are inconsistent (Silva and Pereira, 2022) [11]. On the one hand, actively improving ESG performance can release positive signals, attract market attention, reduce information asymmetry, alleviate financing constraints, and improve operating efficiency, thus creating positive value effects (Xie et al., 2019; Wong et al., 2020; Serafeim, 2021; Yang et al., 2022) [12–15]. On the other hand, the significant demand for funds and resources required for ESG performance may cause companies to invest too many resources in external activities that could divert companies from primary business, increasing their operational burden and reducing core competitiveness (Ganda, 2018; Fu et al., 2021) [16,17]. Moreover, actively practicing ESG may induce short-term behavior by executives. It could squeeze resources available for investment, leading to decreased investment efficiency (Ganda, 2018; Broadstocket et al., 2019) [18,19], and then sacrifice shareholders' interests (Chen et al., 2018) [20], adversely affecting the enterprise's value (Buchanan et al., 2018; Capelle and Petit, 2019) [21,22]. To sum up, it can be found that academic research on the empirical study of the spillover effects of industrial agglomeration is explored chiefly at the macro and meso levels. However, there is a need to examine further the dynamic mechanism and heterogeneity effects of its micro-level impact on corporate ESG performance.

Potential marginal contributions are as follows: firstly, incorporating the internal development law of enterprises into the analytical framework, introducing the perspective of corporate ESG performance, and thus expanding the research scope of endogenous macro variables in national economic transformation, specifically the association between industrial agglomeration and corporate ESG performance. This work depicts the linear or curvilinear relationship between industrial agglomeration and corporate ESG performance

while proposing the theoretical logic, which is a critical supplement to studying the microeconomic consequences of industrial agglomeration. Secondly, this paper clarifies the differentiation between manufacturing agglomeration and producer services agglomeration, the impact, and different mechanisms on corporate ESG performance. It is a necessary supplement to the micro-mechanism of existing research. Thirdly, from a macro-to-micro perspective, this study further explores and reveals the differences in the effects of industrial agglomeration on corporate ESG performance under various industry characteristics and enterprise features. It thus provides empirical evidence for enterprises adjusting ESG responsibility fulfillment with distinct industry and feature characteristics.

The remainder of this paper is structured as follows: Section 2 "Theoretical Analysis and Research Hypothesis" develops research hypotheses. Section 3 "Research Methodology" section describes samples, data, measures, and statistical techniques. Section 4 "Results" outlines our empirical results. Section 5 "Heterogeneity test" tells the heterogeneity test of industries and corporations, and Section 6 "Extensibility test" examines the manifestations of ESG performance heterogeneity and economic consequences. Finally, Section 7 "Conclusions" discusses the policy implications are summarized.

2. Theoretical Analysis and Research Hypothesis

As one of the critical drivers of macroeconomic development policies, the external effects of industrial agglomeration can influence the social responsibility and internal governance outcomes of micro-enterprises. Thus, industrial agglomeration directly determines the ESG performance of micro-enterprises within a region to a certain extent. Drawing a connection between agglomeration in manufacturing and producer services and their externalities and heterogeneity effects on corporate ESG performance, we propose potential mechanisms and research hypotheses that impact corporate ESG performance.

2.1. The Effect of Manufacturing Agglomeration on the Corporate ESG Performance

In environmental terms, manufacturing agglomeration activities allow resources to be allocated and used optimally and economically. This reduces energy consumption and waste emissions and enhances ecological management and awareness. As a result, corporate environmental performance improves. In China's rapid industrialization era, manufacturing is one of the main drivers of economic growth. Since 2013, the Chinese government has issued a series of policies and measures to promote manufacturing upgrading and sustainable development. The aim is to promote the transformation and upgrading of manufacturing, improve resource allocation efficiency, and guide enterprises to focus on ESG issues. The clear policy orientation has brought more policy tilt and credit support to manufacturing, amplifying the regulatory effects of policies. The manufacturing agglomeration exhibits geographical proximity and spatial accessibility, enabling manufacturing enterprises to realize resource sharing, scale economy, and collaborative innovation. First, concerning resource conservation, regional resource agglomeration's synergy effects aid enterprises in reducing production costs and improving efficiency through sharing infrastructure, logistics networks, human capital, and other factors (Lan and Pu, 2021) [23]. Second, regarding emission curtailment, the manufacturing congregation facilitates enterprises adopting clean production technologies, utilizing renewable or low-carbon energy, and participating in carbon market transactions to decrease greenhouse gas emissions, energy consumption, waste emissions, and carbon footprint (Luo and Tang, 2022) [24]. Finally, regarding green innovation, the manufacturing agglomeration aids enterprises in augmenting technological investment, establishing innovation platforms, and fostering knowledge sharing and collaborative innovation to cultivate and promote green products and services.

In social terms, manufacturing agglomeration helps ensure employment, improve welfare, and fulfill social responsibility, enhancing corporate responsibility and trust in employees, customers, suppliers, and communities. First, in terms of ensuring employment, manufacturing agglomeration provides diverse employment opportunities for numerous

workers. According to statistics, the average proportion of workers (including front-line employees) in the total number of employees of the 40 companies on the Fortune 2021 China ESG Impact List is 67.9%, some of which even exceed 90%. These companies not only absorb local workers but also promote cross-regional mobility. Second, in terms of improving welfare, manufacturing agglomeration significantly improves working conditions, increases pay and benefits, and perfects social security and incentive mechanisms to enhance employees' happiness and sense of belonging. Rapid industrialization and urbanization have promoted the scale expansion and technological progress of China's manufacturing, increasing the demand for employment and human capital investment. Agglomeration areas provide diverse employment and training opportunities and help employees improve their skills and income. They also improve employees' and residents' quality of life and happiness using establishing social security systems, medical and health services, and educational and cultural facilities (Wang et al., 2022) [25]. Finally, in terms of fulfilling social responsibility, the linkage effect of the industrial chain promotes collaboration, making enterprises consider their brand image and compliance risks. Therefore, companies prefer to focus on social responsibility issues to benefit from competitive advantages in the market and gain consumer trust and support (Ray and Sharma, 2022) [26].

In governance terms, China's manufacturing agglomeration improves corporate governance and reputation using establishing standardized laws and regulations, transparent information disclosure, effective supervision mechanisms, and fair, competitive environments. First, agglomeration areas facilitate the formulation of unified environmental standards, social responsibility guidelines, and financial reporting requirements. It also enables undergoing third-party institution or platform audits and certification. In daily supervision, governments and industry organizations are inclined to guide and oversee the common problems of clustered enterprises. This includes strengthening supervision and management of enterprise production and operation, promoting compliant operation and information disclosure, and safeguarding consumer and investor rights. Secondly, homogenizing manufacturing enterprises' production processes enables local governments to regulate enterprise information disclosure through relevant policies and regulations. It can be achieved by establishing information-sharing platforms, stakeholder communication channels, and complaint-handling mechanisms to enhance enterprise transparency, communication efficiency, and reliability. This, in turn, protects consumer and investor rights and improves internal governance efficiency (Liu et al., 2023) [27]. Finally, agglomeration areas provide fair access conditions, tax incentives, and market access to foster cooperation and competition among enterprises. Enterprises must continuously improve product quality and service levels to gain competitive advantages. To gain competitive advantages, enterprises need to pay more attention to content governance, including strengthening management of product quality, employee quality, intellectual property, etc., to enhance corporate competitiveness (Zeng et al., 2022) [28].

The above discussion leads to our hypothesis:

Hypothesis 1. *Manufacturing Agglomeration has positive impacts on corporate ESG performance.*

2.2. The Effect of Producer Services Agglomeration on the Corporate ESG Performance

The producer services are dominant, characterized by modern high-tech services such as finance, information technology, research and development, and technology services. It highlights the knowledge, technology, information, and labor-intensive features compared to manufacturing. Its significant industry characteristics will affect the allocation and circulation of economic factors by the externalities brought about by the agglomeration effect, thus affecting enterprise ESG performance. According to the lifecycle theory, the external characteristics of industrial agglomeration differ in different development stages. Therefore, the agglomeration externality of the producer services at different stages affects enterprise ESG performance differently.

Producer services agglomeration often occurs in regions where manufacturing agglomeration has already reached a particular scale. A complete and supporting manufacturing chain gradually forms in the early stage of producer services agglomeration. The cluster effect becomes more competitive and stable. The continuous increase in service inputs will further promote the industrial value chain of manufacturing, and superior enterprises will gradually erode market share. The "survival of the fittest" effect becomes prominent, and low-value-added and inefficient enterprises will be squeezed out. At this time, the producer services have entered a period of rapid development. China's economic growth mainly relies on resource consumption and labor-intensive manufacturing industries, which have caused severe environmental pollution and destruction. The competition within the industry has increased while cooperation has decreased. Meanwhile, due to reasons such as the market mechanism being incomplete, a legal system being imperfect, and lack of supervision, part of enterprises engage in illegal activities such as discharging pollutants illegally, false disclosure, insider trading, etc., which damage the public interest and investor confidence (Kim, 2020) [29]. Against this background, producer services agglomeration has yet to bring apparent ESG improvement effects. However, it may exacerbate regional imbalances and unfairness issues. Not only that, but external factors such as policy systems, market demand, and social supervision may drive enterprise ESG performance to a certain level. However, due to the lack of internal management systems, data collection, disclosure mechanisms, evaluation and improvement mechanisms, etc., enterprise ESG performance may not be systematic, standardized, and transparent enough (Chen and Liu, 2021) [30]. These factors reduce the social trust and cooperation of enterprises. Reducing the quality and quantity of industry associations, societies, and public welfare activities within the agglomeration region increases conflicts and contradictions between enterprises, the government, society, and stakeholders. These drawbacks are not conducive to improving enterprise performance in terms of environment, society, and governance, such as reducing environmental efficiency, increasing pollution emissions, deteriorating employee benefits, damaging consumer rights, violating laws and regulations, etc. (Du and Li, 2020) [31]. Therefore, improving enterprise ESG performance in the early stages of producer services agglomeration is not beneficial.

With the continuous aggregation of producer services enterprises, enterprises' production scale and market share will gradually saturate, and the marginal benefits will show a decreasing trend. At this point, the producer services have entered its mature stage, the competition and cooperation between enterprises have reached a balance, and a higher level of synergy has been formed. Against this backdrop, the producer services agglomeration initially plays an affirmative role in providing specialized, high-value-added, knowledge-intensive service succor for fundamental economic transformation and upgrading, pioneering innovative and eco-efficient low-carbon development models and streamlining governance through optimized resource allocation (Zhao and Dong, 2021) [32]. First, at elevated agglomeration, as market rivalry amplifies and consumer cognizance expands, enterprises progressively perceive ESG responsibility's pivotal impact on brand prestige, customer fidelity, investor confidence, and more. Under the premise of meeting primary economic benefits, producer services enterprises attach greater importance to enhancing their competitiveness and innovation capabilities by improving their ESG levels and obtaining external incentives such as policy support and capital favor. Secondly, with the clear and actionable sustainable development goals of the Chinese economy and society, the government and regulatory authorities advocate for establishing unified ESG information disclosure standards. They also strengthen supervision and inspection of ESG risk management and performance evaluation of enterprises through relevant laws, regulations, policy documents, and guidance. These institutional norms and regulatory constraints make it necessary for enterprises in the producer services agglomeration to improve their ESG levels to comply with legal and regulatory requirements, avoid punishment or sanctions, and safeguard their legitimate rights, interests, and reputation. In the stage of high agglomeration, there are a large number of enterprises. Regulatory efforts are strengthened,

making the effect of improving ESG performance more significant (Yang et al., 2020; Zhao and Dong, 2021) [33,34]. Finally, the scale effect of the producer services agglomeration can have a substitution effect on manufacturing, which is relatively more polluting. Producer services include research and development design, technical consulting, financial insurance, logistics, warehousing, etc. They can provide technical support, management optimization, resource conservation, and other services for traditional industries such as manufacturing, helping enterprises improve energy utilization efficiency, reduce waste emissions, and lower their carbon footprint (Shen and Peng, 2021) [35].

The above discussion leads to our hypothesis:

Hypothesis 2. *Producer Services Agglomeration and ESG performance may have a U-shaped relationship.*

3. Research Methods

3.1. Data and Sample

China's rapid economic development has made it have a large amount of corporate data, which provides a rich empirical basis for our research. Considering the completeness of time series data and the timeliness of industrial agglomeration, this study collected and organized data at both macro and micro levels. At the macro level, panel data from Chinese cities at the prefecture level and above, excluding Hong Kong, Macau, Taiwan, and the Tibet Autonomous Region, between 2005 and 2020 were selected as the research sample. The initial sample consisted of 291 cities, and after excluding samples with significant administrative changes within the time range, our study focused on 285 cities at the prefecture level and above. The macro-level data were obtained from sources such as the "China Urban Statistical Yearbook", "China Statistical Yearbook", "China Financial Statistical Yearbook", "China Industrial Statistical Yearbook", "China Industrial Economic Statistical Yearbook", provincial, autonomous regional, and direct-administered municipal statistical yearbooks and bulletins, as well as the China Research Data Services Platform (CNRDS). To ensure accuracy, these data were carefully reviewed, cross-checked, and supplemented with the Economy Prediction System (EPS) database. Linear interpolation was used to fill in missing values. At the micro level, financial data of A-share listed companies from 2004 to 2021 were collected, and companies from 2005 to 2020 were selected as the research sample. The micro-level financial data of listed companies were sourced from databases such as CSMAR, WIND, and the cninfo.com.cn website accessed on 1 March 2023. The information was meticulously verified against the company's annual reports to ensure data accuracy. The initial sample was subjected to the following screening criteria: exclusion of companies with incomplete or missing critical financial disclosures, companies with debt-to-equity ratios (LEV) exceeding 1, companies with abnormal listing statuses during the study period (e.g., ST/*ST/PT), companies that went public during the year, companies with cross-listings (A/H/N/B shares), and samples with apparent errors such as total assets being less than net fixed assets or current assets. The data from both levels were matched based on the companies' registered addresses at the prefecture-level city. A Winsorize process was applied to all continuous variables within the [1%, 99%] range to eliminate the interference of extreme outliers. Ultimately, a total of 30,518 valid research samples were obtained.

3.2. Operationalization of Critical Variables

3.2.1. Dependent Variable: Industrial Agglomeration

Industrial agglomeration mainly reflects the physical spatial concentration of enterprises and their corresponding industrial chain and supply chain. Existing studies have discussed the measurement methods of industrial agglomeration from different perspectives. The mainstream indicators are economic density, location entropy (AGG), spatial Gini coefficient (G), Herfindahl index (H), EG Index, and DO Index (Glenn and Edward, 1997; Combes, 2000; Gilles and Henry, 2005) [36–38]. Among them, location entropy (AGG)

can eliminate the potential concern of regional scale heterogeneity effect to a certain extent and relatively truly reflect the spatial distribution characteristics of regional industrial factors; thus, it is widely favored by the academic community. Therefore, this paper uses the location entropy index to measure the level of regional industrial agglomeration, and the calculation formula is:

$$AGG_{j,t} = Ln\left[\frac{\left(E_{m,j,t} - E_{i,j,t}\right)/\sum E_{j,t}}{\sum E_{m,t}/\sum E_t} + 1\right]$$

where $AGG_{j,t}$ represents the location entropy index of urban industrial agglomeration, and we select the manufacturing agglomeration ($Zagg_{j,t}$) and producer services agglomeration ($Sagg_{j,t}$) for representation in this study. $E_{m,j,t}$ represents the total employment of the manufacturing (producer services) in city j in year t, $E_{i,j,t}$ represents the total employment of the manufacturing enterprise (producer services enterprise) in city j and industry i in year t, and $\sum E_{j,t}$ represents the total employment in city j in year t. $\sum E_{m,t}$ represents the total employment of the manufacturing (producer services) in the country in year t, and $\sum E_t$ represents the total employment in the country.

According to existing research, the definition and scope of manufacturing in this article are based on the National Economic Industry Classification. The definition and scope of the producer services are based on the Statistical Classification of Producer Services (2019), which includes explicitly "the financial industry", "transportation, warehousing, and postal services", "information transmission, computer services, and software industry", "leasing and commercial services industry", "wholesale and retail industry", "environmental governance and public facility management industry" and "scientific research and technical services industry".

3.2.2. Independent Variable: Corporate ESG Performance

ESG performance. Due to the lack of standardization and mandatory micro ESG disclosure regulations in the Chinese capital market, researchers face challenges in finding and constructing multi-dimensional ESG variables. The selection of proxy variables may be severely restricted, leading to shortcomings. Academic circles use third-party rating agencies such as international mainstream rating agencies MSCI, Bloomberg, FTSE Russell, China's Huazheng, Shangdao Ronglv, and Runling Global to measure ESG performance. Due to differences in social, technological, and other external environments and the development level of the ESG evaluation system, there are significant differences in the rating results of different ESG rating agencies.

Considering that Sino-Securities Index Information Service (Shanghai) Co., Ltd. (Located in Shanghai, China, referred to as "Huazheng") has a fast update speed, comprehensive coverage, and high data credibility for ESG rating data, which is more in line with the actual situation of the Chinese market, this article uses Huazheng Index's environmental protection, social responsibility, and corporate governance rating to measure the ESG investment performance of banks. The Huazheng ESG rating index is calculated quantitatively. It has a three-level index evaluation system that combines traditional and alternative data based on the development experience of mainstream ESG systems and the characteristics of the Chinese market. This system can comprehensively cover the publicly disclosed data of listed banks, social responsibility reports, sustainable development reports, regulatory website data, and news media reports. Regarding data updates, the Huazheng ESG index uses a combination of regular quarterly evaluations and dynamic tracking for data adjustments, which has vital timeliness.

Moreover, the index can cover all A-share listed banks. It can be traced back to the first quarter of 2009, with solid representativeness. In terms of construction methods, environmental dimension indicators are based on critical factors such as bank environmental management systems, product environmental certification, and environmental violations; social dimension indicators are based on essential factors such as poverty alleviation, social

responsibility report quality, and adverse business events; corporate governance dimensions include vital variables such as related transactions, board independence, overall financial credibility, and information disclosure quality. Huazheng calculates the overall evaluation index of corporate ESG performance based on the three primary indicators of environment, social responsibility, and corporate governance, as well as the 14 secondary indicators and 26 tertiary indicators, and divides ESG performance into nine levels (AAA, AA, A, BBB, BB, B, CCC, CC, C).

Following the general practice of existing research, we assign the lowest level C a value of 1 and then add 1 to each level in sequence, and so on, to quantify the ESG score of the enterprise. The highest level, AAA, is assigned a value of 9.

3.2.3. Definition of Main Variables

Existing research suggests that factors such as asset size, capital structure, cash flow, growth potential, board size, board independence, dual roles, equity structure, property rights, and accounting information quality can all impact enterprise ESG performance. Therefore, to minimize the potential interference of omitted variables on research outcomes, we select the abovementioned factors as control variables in our study. The variables are defined in Table 1.

Table 1. Definition of primary variables.

Variable	Symbol	Definition
Industrial Agglomeration	Zagg Sagg	Manufacturing location quotient index Producer services location quotient index
ESG performance	ESG	The ESG rating of China Securities is assigned from low to high, from 1 to 9
Assets Size	Size	Ln (total assets at the end of the period)
Capital Structure	Lev	Total liabilities/total assets at the beginning of the period
Cash Flow	Flow	Net cash flow from operating activities/total assets at the end of the period
Growability	Grow	Tobin's Q = market value of the company/replacement cost of the company = (market value of equity + book value of liabilities at year-end)/book value of total assets at year-end
Board Size	Board	Ln (total number of board members)
Board Independence	Dir	Percentage of independent directors to the total number of board of directors
Two jobs in one	Dual	Dummy variable, takes the value of 1 when both the chairman and general manager are appointed, otherwise 0
Equity Structure	Share	Herfindahl index of top 10 shareholders' shareholdings
Property Right	Soe	Dummy variable, state-owned enterprises take 1; otherwise, take 0
Accounting Information Quality	Da	The absolute value of manipulable accrued profits based on the modified Jones model

3.2.4. Empirical Specification

In order to explore the impact of industrial agglomeration on the ESG performance of enterprises, this study sets the following benchmark regression model (Zhan et al., 2022) [39]:

$$ESG_{i,t} = \alpha_0 + \alpha_1 Zagg_{j,t} + \gamma Control_{i,t} + \sum \eta_j + \sum \mu_t + \varepsilon_{i,t} \quad (1)$$

$$ESG_{i,t} = \beta_0 + \beta_1 Sagg_{j,t} + \beta_2 Sagg\_sq_{j,t} + \gamma Control_{i,t} + \sum \eta_j + \sum \mu_t + \varepsilon_{i,t} \quad (2)$$

α_0 and β_0 represents the intercept term of the model; $Sagg\_sq_{j,t}$ is a quadratic term representing $Sagg_{j,t}$; $Control_{i,t}$ represents the control variable. To overcome the endogeneity problem caused by the omitted variables, $\eta_{j,t}$ and $\mu_{j,t}$ are the time-industry two-way fixed effects used in this study; $\varepsilon_{j,t}$ represents the random disturbance term.

To verify the non-linear relationship between manufacturing agglomeration and corporate ESG performance, referring to the existing studies on the non-linear relationship, we test the U-shaped relationship mainly based on the following three fronts: (1) $\beta_2 > 0$;

(2) $\beta_1 + 2\beta_2 Sagg_{MIN} < 0$, $\beta_1 + 2\beta_2 Sagg_{MAX} > 0$; (3) the inflection point falls within the interval of the independent variables' values. The statistical regressions in this study use a fixed effects model, with standard errors adjusted for clustering and robust adjustment at the firm level.

4. Results

4.1. Summary Statistics

Table 2 shows the descriptive statistics of the variables involved in the preliminary test.

Table 2. Summary statistics.

Variable	N	Mean	Median	Std.Dev.	Min	Max
Zagg	30,518	0.695	0.658	0.239	0.156	1.322
Sagg	30,518	0.711	0.698	0.245	0.197	1.180
ESG	30,518	4.179	4	1.097	1	8
Size	30,518	22.18	21.97	1.345	18.93	26.80
Lev	30,518	0.432	0.414	0.224	0.0490	1.552
Flow	30,518	0.005	0.005	0.052	−0.185	0.237
Grow	30,518	−0.388	−0.371	0.147	−0.743	6.586
Board	30,518	2.220	2.197	0.215	1.792	2.890
Dir	30,518	0.376	0.364	0.0600	0.250	0.571
Dual	30,518	0.265	0	0.442	0	1
Share	30,518	0.166	0.142	0.107	0.015	0.562
Soe	30,518	0.412	0	0.492	0	1
Da	30,518	0.064	0.045	0.064	0.001	0.443

The mean of *Zagg* is 0.711, with minimum and maximum values of 0.197 and 1.180, respectively. The mean of *Sagg* is 0.695, with minimum and maximum values of 0.156 and 1.322, respectively. These values suggest that the industrial agglomeration level among China's prefectural-level administrative units is generally widespread, with a slightly higher degree of producer services agglomeration than manufacturing. The mean ESG performance rating for listed companies is 4.179, indicating an average rating between B and BB, which is similar to existing research and reflects a medium-to-high level of attention to environmental, social responsibility, and corporate governance issues among Chinese listed companies. The standard deviation is 1.097, indicating significant differences in ESG performance between companies. The distribution of other variables is consistent with existing research.

4.2. Baseline Results

Table 3 reports the regression results of industrial agglomeration and corporate ESG performance. In columns (1)–(8), the study regressed the manufacturing agglomeration (*Zagg*) and producer services agglomeration (*Sagg*) on the corporate ESG performance (*ESG*).

Table 3 presents the benchmark test results for the degree of industrial agglomeration and the ESG performance of companies. The results indicate that both manufacturing and producer services agglomeration have significant valuation parameters for ESG responsibility performance, regardless of controlling individual and time-fixed effects. For instance, in column 7, the estimated parameter of manufacturing agglomeration is positive. It reaches a level of 1%, indicating that a 1% increase in manufacturing agglomeration will promote a 0.208% increase in ESG responsibility performance. This suggests that manufacturing agglomeration configuration enhances ESG performance, thereby proving a linear relationship between manufacturing agglomeration and ESG performance, which validates hypothesis H1. In column 8, *Sagg* and *ESG* are negatively correlated at the 1% significance level, while *Sagg_sq* and *ESG* are positively correlated at the 1% significance level. The inflection point of the non-linear curve relationship between *Sagg* and *ESG* is calculated to be 0.860, which falls within a reasonable range of independent variable sample values (0.757; 1.284), and the extreme slope values are of opposite signs (−1.204; 0.582) ($ESG_{i,t}$

took a partial derivative of $Sagg_{j,t}$ to obtain $\frac{ESG_{i,t}}{Sagg_{j,t}} = \beta_1 + \beta_2 Sagg_{j,t}$, and make it zero, then the inflection point as $-\beta_1/2\beta_2$). The UTEST test of *Sagg* and *ESG* has a T value of 2.39. It is significant at the 1% level, indicating that there is indeed a threshold for producer services agglomeration in terms of ESG responsibility for companies and that when this threshold is exceeded, the spillover effect of producer services agglomeration will promote the fulfillment of ESG responsibility. This proves the "U"-shaped relationship between producer services agglomeration and ESG realization, further validating hypothesis H2. According to Table 2, the mean of *Sagg* is 0.711, close to the inflection point level, indicating that the marginal effect of producer services agglomeration on ESG performance is gradually diminishing at the current stage. As the level of agglomeration increases, the marginal effect will evolve into promoting the fulfillment of ESG responsibility. Extant studies have not encompassed literature on the impact of industrial agglomeration on corporate ESG performance. However, summarizing the above analysis, the influence of industrial agglomeration on corporate ESG performance can be seen as predominantly salutary overall, which aligns with the conclusions of most existing research.

Table 3. Baseline effects test.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ESG	ESG	ESG	ESG	ESG	ESG	ESG	ESG
Zagg	0.232 ***		0.218 ***		0.224 ***		0.208 ***	
	(2.890)		(2.706)		(2.959)		(2.732)	
Sagg		−1.537 ***		−1.569 ***		−1.527 ***		−1.561 ***
		(−3.557)		(−3.628)		(−3.595)		(−3.674)
Sagg_sq		0.930 ***		0.948 ***		0.888 ***		0.908 ***
		(3.269)		(3.331)		(3.221)		(3.291)
Size	0.253 ***	0.246 ***	0.257 ***	0.250 ***	0.256 ***	0.249 ***	0.261 ***	0.254 ***
	(14.712)	(14.348)	(14.268)	(13.915)	(15.277)	(14.885)	(14.960)	(14.573)
Lev	−0.956 ***	−0.933 ***	−0.964 ***	−0.944 ***	−1.067 ***	−1.057 ***	−1.081 ***	−1.073 ***
	(−10.318)	(−10.080)	(−10.201)	(−10.003)	(−11.774)	(−11.680)	(−11.716)	(−11.673)
Flow	−0.581 **	−0.593 **	−0.583 **	−0.618 **	−0.126	−0.155	−0.134	−0.186
	(−2.200)	(−2.240)	(−2.191)	(−2.316)	(−0.501)	(−0.618)	(−0.531)	(−0.738)
Grow	−0.205 ***	−0.213 ***	−0.237 ***	−0.242 ***	−0.196 ***	−0.204 ***	−0.229 ***	−0.235 ***
	(−4.205)	(−4.407)	(−4.624)	(−4.779)	(−4.535)	(−4.807)	(−5.075)	(−5.291)
Board	−0.163 **	−0.186 **	−0.158 **	−0.178 **	−0.097	−0.120 *	−0.093	−0.112
	(−2.243)	(−2.566)	(−2.167)	(−2.449)	(−1.389)	(−1.711)	(−1.325)	(−1.600)
Dir	1.482 ***	1.512 ***	1.522 ***	1.555 ***	1.584 ***	1.625 ***	1.628 ***	1.671 ***
	(6.444)	(6.607)	(6.593)	(6.773)	(7.176)	(7.390)	(7.346)	(7.577)
Dual	0.004	0.009	0.002	0.006	0.002	0.008	0.002	0.006
	(0.101)	(0.236)	(0.057)	(0.170)	(0.066)	(0.212)	(0.049)	(0.171)
Share	0.446 **	0.453 **	0.419 **	0.428 **	0.429 **	0.439 ***	0.400 **	0.412 **
	(2.453)	(2.493)	(2.294)	(2.348)	(2.530)	(2.597)	(2.351)	(2.434)
Soe	0.073	0.068	0.073	0.071	0.113 ***	0.109 **	0.111 **	0.109 **
	(1.587)	(1.520)	(1.564)	(1.546)	(2.603)	(2.543)	(2.499)	(2.493)
Da	−0.499 ***	−0.521 ***	−0.424 **	−0.438 **	−0.743 ***	−0.765 ***	−0.675 ***	−0.690 ***
	(−2.630)	(−2.752)	(−2.221)	(−2.303)	(−4.206)	(−4.333)	(−3.803)	(−3.889)
μ	NO	NO	YES	YES	NO	NO	YES	YES
η	NO	NO	NO	NO	YES	YES	YES	YES
_cons	−1.523 ***	−0.612	−1.733 ***	−0.696	−2.614 ***	−1.703 ***	−2.819 ***	−1.798 ***
	(−3.816)	(−1.461)	(−4.335)	(−1.598)	(−6.274)	(−3.830)	(−6.737)	(−3.912)
adj. R2	0.085	0.087	0.090	0.093	0.134	0.137	0.140	0.143
N	30,518	30,518	30,518	30,518	30,518	30,518	30,518	30,518

Note: ***, **, * represents significance at the 1%, 5%, and 10% levels, respectively, with Z values in parentheses.

4.3. Robustness Checks

To ensure the robustness of the study, we further conducted the following tests:

(1) Replacement of the dependent variable. Drawing on existing literature, we selected the evaluation scores of the "Listed Company Social Responsibility Report" published by Hexun.com (accessed on 1 March 2023) as the dependent variable. This evaluation system examines five aspects of stakeholder responsibility, including shareholder responsibility, employee responsibility, supplier responsibility, customer and consumer rights and interests' responsibility, environmental responsibility, and social donation responsibility. This study merged the first three categories to obtain stakeholder

responsibility. In comparison, the last two categories were analyzed separately as environmental responsibility and charitable donation responsibility to investigate the performance of listed companies regarding environmental, social, and governance. We measured the overall ESG performance of listed companies by the total score of these three aspects (Score). In data processing, to avoid the problem of extreme regression coefficients caused by substantial explanatory variables, we added 1 to the explanatory variables, took the natural logarithm, and performed Winsorize processing before incorporating them into the econometric model for regression testing. The regression results are shown in columns (1) and (2) of Table 4.

(2) One-period lag regression of core variables. The possible lag effect of macro-industrial agglomeration on micro-enterprise ESG performance, and to avoid endogeneity problems related to contemporaneous correlation, we separately regressed the independent and dependent variables with a one-period lag in the benchmark model. The regression results are shown in columns (3)–(6) of Table 4.

(3) Adjustment of sample scope. Enterprises with a survival time of less than or equal to 3 years may have weaker competitiveness due to lower funding levels and insufficient technological innovation capabilities and, therefore, have little reference value. Thus, we excluded such enterprises from the robustness test. The regression results are shown in columns (7) and (8) of Table 4.

(4) Exclusion of sample self-random error. Differences in industrial agglomeration levels may affect the decision-making and efficiency of ESG performance of enterprises through the economic development level of the region, leading to biased estimation in the test results. In the robustness test, we found that the proportion of ESG responsibility performance of companies included in the top five industrial agglomeration-ranked cities exceeded the mean level. Therefore, we excluded five cities with higher levels of manufacturing agglomeration and producer services agglomeration from the sample. The regression results are shown in columns (9) and (10) of Table 4.

We repeated the above steps to conduct an empirical regression analysis of the original model, and the research conclusions did not change substantially, thus confirming the robustness of the study.

Table 4. Robustness tests.

Variable	(1)	(2)	(3)	(3)	(5)	(6)	(7)	(8)	(9)	(10)
	HXESG	HXESG	ESG	ESG	l.ESG	l.ESG	ESG	ESG	ESG	ESG
Zagg	0.058 *				0.204 ***		0.208 ***		0.210 ***	
	(1.731)				(2.652)		(2.732)		(2.754)	
Sagg		−0.619 ***				−1.514 ***		−1.561 ***		−1.552 ***
		(−3.472)				(−3.462)		(−3.674)		(−3.656)
Sagg_sq		0.400 ***				0.887 ***		0.908 ***		0.902 ***
		(3.358)				(3.145)		(3.291)		(3.274)
l.Zagg			0.213 **							
			(2.543)							
l.Sagg				−1.785 ***						
				(−3.628)						
l.Sagg_sq				0.948 ***						
				(3.331)						
Control	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
η/μ	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
_cons	0.278	0.558 **	−2.898 ***	−1.925 ***	−2.028 ***	−1.148 **	−2.819 ***	−1.798 ***	−2.818 ***	−1.799 ***
	(1.244)	(2.415)	(−6.400)	(−3.964)	(−4.651)	(−2.475)	(−6.737)	(−3.912)	(−6.735)	(−3.915)
adj. R2	0.168	0.170	0.144	0.148	0.125	0.127	0.140	0.143	0.140	0.143
N	8945	8945	9299	9340	9361	9361	30,518	30,518	30,515	30,515

Note: ***, **, * represents significance at the 1%, 5%, and 10% levels, respectively, with Z values in parentheses.

4.4. Endogeneity Problem

The agglomeration of industries is a macro-level change that is difficult for enterprises' micro-level decisions and efficiency to influence in reverse. Therefore, the relationship between industrial agglomeration and ESG responsibility performance of enterprises can be considered to be approximately non-existent in reverse causality. In addition, we adopt the instrumental variable method to alleviate endogeneity concerns to ensure this

study's rigor and to consider the possible existence of reverse causality and other potential omitted variables.

The results of the endogeneity test are shown in Table 5. Referring to existing research, we selected the average industrial agglomeration of other provincial cities as instrumental variables (*IVZagg*, *IVSagg*).

Table 5. Endogeneity tests.

Variable	Zagg	Sagg	ESG	ESG
IVZagg	0.884 ***			
	(45.14)			
IVSagg		0.921 ***		
		(8.68)		
Zagg			0.389 ***	
			(3.55)	
Sagg				−3.634 ***
				(−4.21)
Sagg_sq				2.183 ***
				(4.11)
Control	YES	YES	YES	YES
μ	YES	YES	YES	YES
_cons	0.352 ***	0.115	−1.819 ***	0.151
	(4.89)	(1.61)	(−4.38)	(0.29)
N	30,518	30,518	30,518	30,518

Note: *** represents significance at the 1% levels, with Z values in parentheses.

4.5. Influence Channel Analysis

Manufacturing agglomeration primarily promotes firms' ESG performance by alleviating financing constraints and increasing investment scale. On the one hand, financing constraints can influence firms' innovation and value creation. In contrast, manufacturing agglomeration can reduce firms' financing costs and risks. Additionally, it can enhance firms' credibility and collateral capacity, thereby increasing their chances and amounts of external financing, ultimately improving their ESG performance. On the other hand, manufacturing agglomeration can enhance firms' investment decision-making and implementation capabilities by promoting industrial chain synergy, market expansion, and resource allocation optimization. This can enhance firms' investment efficiency, returns, and level, ultimately improving their ESG performance.

Firstly, producer services agglomeration induces intensified competition, resource constraints, increased pollution, and social inequality, generating adverse effects. These negative effects undermine a firm's product competitiveness and lower internal control quality, diminishing corporate ESG performance. However, as knowledge spillovers progressively amplify, producer services agglomeration can provide specialized, diversified, and innovative intermediate products or services for enterprises, thereby augmenting product-added value and differentiation advantages; moreover, producer services agglomeration can also provide external oversight and constraint mechanisms for enterprises, promoting corporate governance structure and internal control system enhancement, ultimately elevating enterprise ESG performance.

The intrinsic transmission mechanisms need to be classified and discussed to fully grasp the theoretical logic between industrial agglomeration and corporate ESG performance. This paper conducts a mechanism test by observing the impact of the core independent variables on the mediating variables. To further explore the possible transmission paths of the degree of industrial agglomeration on corporate ESG performance and test the logical channels constructed in the previous text, this paper constructs the following mechanism analysis model (Liu and Mao, 2019) [40]:

$$M_{i,t} = \alpha_0 + \beta_1 Zagg_{j,t} + \gamma \text{Control}_{i,t} + \sum \eta_j + \sum \mu_t + \varepsilon_{i,t} \quad (3)$$

$$M_{i,t} = \alpha_0 + \beta_1 Sagg_{j,t} + \alpha_2 Sagg\_sq_{j,t} + \gamma \text{Control}_{i,t} + \sum \eta_j + \sum \mu_t + \varepsilon_{i,t} \quad (4)$$

$$ESG_{i,t} = \alpha_0 + \beta_1 M_{i,t} + \gamma \text{Control}_{i,t} + \sum \eta_j + \sum \mu_t + \varepsilon_{i,t} \quad (5)$$

Here, $M_{i,t}$ represents the possible mechanism variables, more precisely, enterprise financing constraint (*KZ*), investment scale (*Inv*), product market competitiveness (*Ler*), and internal control quality (*IC*), with the definitions of other variables remaining the same as in the previous formula.

According to the research method of Kaplan and Zingales (1997) [41], we select cash dividends, cash holdings, net cash flows from operating activities, debt-to-asset ratio, and Tobin's Q value as critical indicators and use the median to construct virtual variables for summation, and use it as the dependent variable, and use the above five indicators as independent variables to perform a regression analysis to estimate the corresponding coefficients. Calculate the *KZ* index of each enterprise.

We use cash flow statement items to calculate the investment size of sample firms. The financial statement shows "cash flow paid for the purchase of fixed, intangible, and other long-term assets". Standardized processing (Duchin, 2010) prevents extreme values from interfering with the research [42].

Product market competitiveness directly reflects enterprise innovation and progress (Li et al., 2019) [43]. To measure the competitiveness of enterprises at the industry level, we select the proportion of the Lerner index (*LER*) to the industry average to calculate the product market competitiveness of enterprises. Lerner index LER = (operating income − operating costs − selling expenses − management expenses)/operating income. The smaller the Lerner index is, the weaker the bargaining power of the enterprise is, and the more intense the competition is (Peress, 2010) [44].

Considering that the "internal control index" evaluation system announced by the DIB database has comprehensive coverage, strong comprehensiveness, and high recognition, this study selects this index as the proxy variable of internal control quality (IC). The internal control index is divided by 100, IC = internal control index/100, and standardized processing is performed.

The results of the mechanism test are shown in Table 6. *Zagg* is positively correlated with *Inv* at the 1% significance level and negatively correlated with *KZ* at the 5% significance level. This indicates that the manufacturing agglomeration contributes to increasing the scale of enterprise investment and mitigating financing constraints. After including the intermediate variables *Inv* and *KZ* in the baseline effects test model, *Inv* is positively correlated with *ESG* at the 1% significance level, while *KZ* is negatively correlated with *ESG* at the 1% significance level. This suggests that as the degree of financing constraints on enterprises increases, their cash flow gradually tightens, thereby inhibiting the fulfillment of their ESG responsibilities at the financial level. The rise in enterprise investment scale leads to a corresponding increase in investment projects, thus promoting the fulfillment of their ESG responsibilities at the investment level. These results demonstrate that financing constraints and investment scale are the transmission mechanisms that affect enterprises' fulfillment of ESG responsibilities in manufacturing agglomeration.

Sagg_sq, *Ler*, and *IC* are all positively correlated with each other at the 5% significance level, indicating a "U"-shaped relationship between the producer services agglomeration and the competitiveness of enterprise products and the quality of internal control. Specifically, as the level of producer services agglomeration increases, the competitiveness of enterprise products and the quality of internal control first decrease and then increase. After including the intermediate variables *Ler* and *IC* in the baseline effects test model, *Ler* and *IC* are positively correlated with *ESG* at the 1% significance level, indicating that improving enterprise product competitiveness and internal control quality promotes the fulfillment of their ESG responsibilities. This proves that product competitiveness and internal control quality are the transmission mechanisms that affect enterprises' fulfillment of ESG responsibilities in the context of producer services agglomeration.

Table 6. Mechanism test.

Variable	Inv	KZ	ESG	Ler	IC	ESG
Zagg	0.004 *** (2.670)	−0.156 * (−1.736)				
Inv			−0.105 *** (−10.242)			
KZ			3.508 *** (7.470)			
Sagg				−1.512 ** (−2.508)	−0.728 ** (−2.046)	
Sagg_sq				0.894 ** (2.165)	0.532 ** (2.255)	
Ler						0.008 *** (2.950)
IC						0.163 *** (15.384)
Control	YES	YES	YES	YES	YES	YES
η/μ	YES	YES	YES	YES	YES	YES
_cons	0.035 *** (3.883)	4.102 *** (8.075)	−2.243 *** (−5.341)	−4.833 *** (−5.623)	2.929 *** (6.225)	−2.963 *** (−7.306)
adj. R2	0.148	0.564	0.170	0.171	0.062	0.166
N	25,013	25,013	25,013	29,638	29,638	29,638

Note: ***, **, * represents significance at the 1%, 5%, and 10% levels, respectively, with Z values in parentheses.

5. Heterogeneity Test: Exploring the Classification for Macro and Micro Perspectives

The above analysis conducted a benchmark analysis and relevant tests on industrial agglomeration, corporate ESG performance, and their mechanisms. The study has identified the heterogeneous dynamic relationship between agglomeration in the manufacturing and productive service sectors and corporate ESG performance. Furthermore, does the impact of industrial agglomeration on corporate ESG performance differ across different industry types? Does the effect of industrial agglomeration on corporate ESG performance vary under different micro-level characteristics of firms? Given these considerations, to identify and deeply explore the interference caused by different industry and firm characteristics in our research, a comprehensive classification discussion will be conducted based on the industry differences from a macro perspective and the firm differences from a micro perspective.

5.1. Industry Heterogeneity Test

Regarding manufacturing classification, existing research mainly measures the manufacturing structure using the proportion of different types of industries, then divides the manufacturing into categories. However, we focus on analyzing the process of adjusting the manufacturing structure in various regions, i.e., the evolution of the manufacturing structure from low-end to mid-end and high-end. According to the classification standards of the World Input-Output Database (WIOD), this study divides manufacturing into "high-tech", "mid-tech", and "low-tech" based on their technological level. Moreover, the level of industrial development and resource endowment both, to some extent, constrain the subjective initiative of corporate ESG responsibility, resulting in an unstable situation in the production activities of enterprises with different resource backgrounds in various industry types and stages. Therefore, this paper divides manufacturing into "labor-intensive", "capital-intensive", and "technology-intensive" based on factor intensity. Subsequently, this paper conducts a heterogeneous test based on different types of manufacturing industries to examine the impact of industrial clustering on corporate ESG performance.

Regarding the classification of producer services, there is significant heterogeneity among various sub-sectors due to differences in production activity types, knowledge, and technological content, which leads to differences in their impact on corporate ESG responsibility. In addition, spatial agglomeration of producer services can produce specific external effects, but they are not entirely positive. Since different stages of industry development can have heterogeneous effects on industrial clustering and promote corporate ESG responsibility, it raises the question: Do different types of producer services

clusters have different impacts on corporate ESG performance? Based on the classification of the Organization for Economic Cooperation and Development (OECD) and the Development Research Center of the State Council, this study divides producer services into "knowledge-intensive" and "resource-intensive" and investigates their heterogeneous impact on corporate ESG responsibility.

According to the grouped examination of different manufacturing types in various regions, the results are shown in Table 7. Analysis of Panel A finds that in the technology level grouping, the estimated coefficient of *Zagg* on *ESG* is not significant in the low-tech and mid-tech groupings but exhibits an increasing trend. In the mid-tech grouping, *Zagg* and *ESG* are positively correlated at the 1% significance level, consistent with the baseline effects test. In the factor intensity grouping, *Zagg*'s estimated coefficient on *ESG* is insignificant in the labor-intensive industry grouping. However, *Zagg* and *ESG* are positively correlated at the 1% significance level in the capital-intensive and technology-intensive industry groupings, consistent with the baseline effects test, and the estimated coefficient is more significant in the capital-intensive industry grouping. It is evident that the influence of manufacturing agglomeration level on corporate ESG responsibility performance overall presents a high-tech industry > mid-tech industry > low-tech industry trend in terms of development and a capital-intensive industry > technology-intensive industry > labor-intensive industry trend as production efficiency and technological level increase, and manufacturing agglomeration exhibits an increasing trend in its effect on corporate ESG responsibility performance.

Table 7. Industrial Heterogeneity Test.

Panel A	**Low-Tech**	**Mid-Tech**	**High-Tech**	**Labor-Intensive**	**Capital-Intensive**	**Technology-Intensive**
	ESG	**ESG**	**ESG**	**ESG**	**ESG**	**ESG**
Zagg_sq	0.104	0.221	0.198 *	0.037	0.315 *	0.203 *
	(0.361)	(0.857)	(1.849)	(0.148)	(1.661)	(1.723)
Control	YES	YES	YES	YES	YES	YES
φ/η/μ	YES	YES	YES	YES	YES	YES
_cons	−1.834	−1.137	−1.432 **	−0.758	−0.668	−1.877 ***
	(−1.231)	(−0.813)	(−2.283)	(−0.578)	(−0.587)	(−2.746)
adj. R2	0.121	0.120	0.074	0.076	0.102	0.084
N	2190	2657	13750	2979	4788	10689

Panel B	**Knowledge−Intensive**	**Resource−Intensive**
	ESG	**ESG**
Sagg	−2.398	0.342
	(−1.543)	(0.207)
Sagg_sq	1.537 *	−0.218
	(1.671)	(−0.215)
Control	YES	YES
η/μ	YES	YES
_cons	−1.262	−3.240 ***
	(−0.833)	(−2.903)
adj. R2	0.127	0.235
N	3429	3499

Note: ***, **, * represents significance at the 1%, 5%, and 10% levels, respectively, with Z values in parentheses.

According to the grouped examination of different producer service types in various regions, the results are shown in Table 7. Analysis of Panel B finds that the estimated coefficient of *Sagg_sq* on *ESG* is insignificant in the resource-intensive industry grouping. However, in the knowledge-intensive industry grouping, *Sagg_sq* and *ESG* are positively correlated at the 10% significance level, consistent with the baseline effects test. The estimated coefficient exhibits an increasing trend. The influence of producer services agglomeration on corporate ESG responsibility performance presents a knowledge-intensive industry > resource-intensive industry trend consistent with Panel A analysis.

Possible explanations for the results are that compared to labor-intensive manufacturing, low-tech manufacturing, and resource-intensive producer services, capital-intensive manufacturing, high-tech manufacturing, and knowledge-intensive producer services industries have higher requirements for technology and capital at higher levels, demanding

higher standards for industrial agglomeration and consequent coupling effects. Via scale advantages and R&D innovation, industrial agglomeration stimulates its positive role in corporate ESG responsibility performance. The results show that technology development level differences and factor intensity have heterogeneous effects on corporate ESG responsibility performance. The influence of industrial agglomeration on corporate ESG responsibility performance exhibits staged characteristics along with industrial evolution, following the law of industrial development and conforming to expected cognition, wherein the positiveness of corporate ESG responsibility performance increases with technology development level and factor intensity.

5.2. Corporate Heterogeneity Test

Existing research suggests that differences in financial conditions, financing capabilities, property rights, technological levels, and carbon emissions levels can affect the fulfillment of ESG responsibilities by different types of companies in industrial agglomerations. Therefore, further classification and discussion are needed. This section will conduct grouped tests based on company characteristics, analyze and explore the economic consequences of industrial agglomeration on different company characteristics, and provide further elaboration.

On the one hand, competition among companies encourages them to pay more attention to environmental protection and social responsibility to meet consumers' and investors' demands for sustainability. On the other hand, cooperation among companies can promote resource sharing and technological innovation, thus improving ESG performance. Therefore, to achieve the "insurance effect," companies with high financial risks are more inclined to fulfill their ESG responsibilities to reduce the possibility of financial difficulties. We use the modified Altman Z-score to measure a company's financial risk and group the samples according to the median, dividing the top 50% of companies in the industry with the highest financial risks and the bottom 50% with the lowest financial risks.

Companies with high financing constraints pay more attention to investors' needs and investment behavior. These companies need to improve their reputation to gain support and favor from the capital market, including their ESG performance. In industrial agglomerations, the mutual influence and interaction among companies are strengthened. Companies are more likely to accept and adopt the industry's best practices and standards to attract investors' attention and support, thus improving their ESG performance. We select the median of the *KZ* index of the same industry in the same year as the target financing constraint level and divide the top 50% of companies in the industry with high financing constraints and the bottom 50% with low financing constraints.

In a manufacturing agglomeration area, industry competition will force companies to adopt more environmentally friendly measures to maintain sustainable competitiveness. Private enterprises are more susceptible to market and local government pressures in a market-oriented and competitive environment. Thus, they are more motivated to fulfill ESG responsibilities actively. In contrast, producer services typically require higher technical content and innovation capabilities, which can enhance a company's performance in environmental protection, social responsibility, and other aspects.

Local industrial environments more easily influence non-high-tech enterprises, and their environmental protection and social responsibility requirements may be relatively low. According to existing research, the industry classification is based on the standards of high-tech industries in the Classification of National Economic Industries under the Statistics Law of the People's Republic of China. Six major categories of industries, including aircraft and spacecraft manufacturing, pharmaceutical manufacturing, electronic and communication equipment manufacturing, medical device manufacturing, information chemical manufacturing, and computer and office equipment manufacturing, are defined as high-tech enterprises.

Enterprises in agglomerated manufacturing regions often require large amounts of natural resources and energy, so they are more motivated to take environmentally friendly

ESG measures to reduce their carbon emissions and environmental impacts to meet policy and social pressure requirements. Enterprises in agglomerated service industries that produce knowledge- and technology-intensive business models typically have a relatively little environmental impact, giving them inherent advantages in social and governance aspects of ESG performance. According to the definitions of energy-intensive and highly polluting industries by the Ministry of Ecology and Environment of China in April 2021 and the Announcement on Matters Related to the National Carbon Emission Trading by the Shanghai Environment and Energy Exchange in June 2021 (https://www.cneeex.com/c/2021-06-22/491198.shtml, accessed on 1 March 2023), the eight included high-energy-consuming industries in the Chinese carbon market are power, petrochemicals, chemicals, building materials, steel, nonferrous metals, papermaking, and civil aviation. The remaining enterprises are defined as low-carbon enterprises.

Grouping tests were conducted according to different representative characteristics of enterprises, and the results are shown in Table 8. The effect of industrial agglomeration on the ESG performance of different representative characteristics of enterprises is consistent with the main test effect, indicating that the linear or non-linear relationship between industrial agglomeration and corporate asset structure adjustment holds in different sub-samples. Further comparison of the high and low groups revealed that the effect of industrial agglomeration on corporate ESG responsibility was more significant in high financial risk, high financing constraints, and high-tech; in the ownership property group, the promotion of industrial agglomeration on non-state-owned enterprises' ESG responsibility was more significant, and the influence of industrial agglomeration on state-owned enterprises' ESG responsibility was more significant in the producer services; in the carbon emission group, the promotion of industrial agglomeration on high-carbon-emitting enterprises' ESG responsibility was more significant. The influence of industrial agglomeration on low-carbon-emitting enterprises' ESG responsibility was more significant in the producer services. The above results are basically consistent with the existing research conclusions.

Table 8. Corporate Heterogeneity Test.

Group	High Financial Risk		Hight Financing Constraints		State-Owned		High-Tech		High-Carbon	
	ESG	ESG	ESG	ESG	ESG	ESG	ESG	ESG	ESG	ESG
Zagg	0.263 ** (2.565)		0.239 ** (2.406)		0.149 (1.101)		0.057 (0.399)		0.382 ** (2.131)	
Sagg		−1.941 *** (−3.568)		−2.261 *** (−4.236)		−1.751 ** (−2.568)		−0.660 (−0.824)		−0.784 (−0.833)
Sagg_sq		1.216 *** (3.408)		1.402 *** (4.046)		1.071 ** (2.475)		0.394 (0.728)		0.443 (0.722)
Control	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
η/μ	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
_cons	−2.689 *** (−4.938)	−1.744 *** (−2.963)	−3.277 *** (−6.282)	−2.128 *** (−3.754)	−3.590 *** (−6.250)	−2.591 *** (−4.024)	−1.981 ** (−2.183)	−1.505 (−1.587)	−3.045 *** (−3.206)	−1.544 (−1.488)
adj. R2	0.151	0.153	0.154	0.159	0.228	0.232	0.074	0.073	0.145	0.132
N	14,916	14,916	14,989	14,989	12,583	12,583	7675	7711	5800	5807
Group	**Low Financial Risk**		**Low Financing Constraints**		**Non-State-Owned**		**Non-High-Tech**		**Low-Carbon**	
	ESG	ESG	ESG	ESG	ESG	ESG	ESG	ESG	ESG	ESG
Zagg	0.144 (1.512)		0.183 ** (1.994)		0.189 ** (2.079)		0.245 *** (2.772)		0.170 ** (2.066)	
Sagg		−1.231 ** (−2.201)		−0.748 (−1.352)		−1.410 *** (−2.646)		−1.730 *** (−3.478)		−1.651 *** (−3.508)
Sagg_sq		0.637 * (1.774)		0.312 (0.868)		0.749 ** (2.126)		1.004 *** (3.150)		0.958 *** (3.134)
Control	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
η/μ	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
_cons	−3.058 *** (−5.138)	−2.078 *** (−3.183)	−1.811 *** (−3.192)	−1.087 * (−1.740)	−1.884 *** (−3.074)	−0.909 (−1.394)	−2.800 *** (−6.164)	−1.675 *** (−3.343)	−2.544 *** (−5.566)	−1.738 *** (−3.419)
adj. R2	0.141	0.145	0.121	0.124	0.089	0.093	0.164	0.167	0.144	0.148
N	15,390	15,390	14,674	14,674	17,935	17,935	22,965	22,965	24,826	24,826

Note: ***, **, * represents significance at the 1%, 5%, and 10% levels, respectively, with Z values in parentheses.

6. Extensibility Test

Previous research has proven the promoting effect of industrial agglomeration on enterprise ESG responsibility fulfillment and the differences in this effect under different macro and micro perspectives. Existing research mainly focuses on the impact of industrial agglomeration on enterprise economic performance, and research on its effects on enterprise ESG is relatively limited. Although this study has supplemented and improved this, some issues still cause us to think deeply: (1) What aspects of enterprise environment, social, and governance performance does industrial agglomeration specifically promote? (2) Given that capital markets currently attach so much importance to enterprise ESG performance, what benefits can good ESG performance actually bring to enterprises? This section will explore in depth the impact of industrial agglomeration on different aspects of enterprise environment, social and governance performance to address the above issues, as well as the economic benefits, social reputation, and governance structure of good ESG performance for enterprises.

6.1. What Aspects of ESG Does Industrial Agglomeration Promote for Enterprises?

This section will further analyze and discuss in depth the impact of industrial agglomeration on enterprise ESG performance from the three perspectives of environment, society, and corporate governance and explore the differences in the effect of different industrial agglomeration on enterprise ESG responsibility fulfillment. Regarding variable selection, we assign values according to Huaxia's subdivided ratings (i.e., environmental responsibility rating, social responsibility rating, and governance responsibility rating), and the assignment rules are consistent with the previous section. The detailed regression results are shown in Table 9, which shows the impact of industrial agglomeration on enterprise ESG performance and the specific situations of responsibility fulfillment at different levels (Fatima and Said, 2023; Koh et al., 2023) [45,46].

Table 9. What aspects of ESG does industrial agglomeration promote for enterprises?

Variable	Environmental	Environmental	Social	Social	Governance	Governance
Zagg	0.178 *		0.298 **		0.125	
	(1.896)		(2.340)		(1.567)	
Sagg		−1.706 ***		−1.050		−1.273 ***
		(−2.898)		(−1.536)		(−3.020)
Sagg_sq		0.868 **		0.395		0.935 ***
		(2.267)		(0.886)		(3.395)
Control	YES	YES	YES	YES	YES	YES
η/μ	YES	YES	YES	YES	YES	YES
_cons	−3.593 ***	−2.151 ***	−5.882 ***	−4.167 ***	2.951 ***	2.741 ***
	(−7.149)	(−3.763)	(−9.395)	(−6.150)	(5.753)	(4.990)
adj. R2	0.111	0.119	0.297	0.299	0.197	0.198
N	30,518	30,518	30,518	30,518	30,518	30,518

Note: ***, **, * represents significance at the 1%, 5%, and 10% levels, respectively, with Z values in parentheses.

The results of the verification of ESG performance differentiation are shown in Table 9. *Zagg* is positively correlated with *Environmental* at a significant level of 10% and with *Social* at a significant level of 5%, with a coefficient more remarkable than the former. However, there is no significant correlation between *Zagg* and *Governance*. These results indicate that promoting corporate social responsibility is most significant for manufacturing agglomeration, followed by environmental responsibility. At the same time, there is no significant promotion of governance responsibility.

In contrast, *Sagg_sq* is positively correlated with the *Environmental* at a significant level of 1%. However, there is no significant correlation between *Sagg_sq* and *Social*. However, *Sagg_sq* is positively correlated with *governance* at a significant level of 1%, and the coefficient is greater than the former. These results indicate that the impact of producer services agglomeration on corporate ESG performance is opposite to that of manufacturing, i.e., governance responsibility is the most significant, followed by environmental responsibility. At the same time, there is no significant relationship with social responsibility.

6.2. What Benefits Does Good ESG Performance Bring to the Enterprise?

This section will further analyze and explore the economic consequences of good ESG performance for enterprises from the environment, society, and corporate governance levels. Regarding variable selection, we also based the analysis on the economic consequences of environmental, social, and governance factors. We first re-selected the sample regarding environmental and economic consequences by removing companies that did not disclose environmental and sustainable development information in their annual reports. Then, we selected the natural logarithm of the total amount of social donations (*Dona*) as the proxy variable for their environmental and economic consequences. In terms of social and economic consequences, to reflect the evaluation of the capital market on the value and development potential of enterprises, we selected earnings per share (*EPS*) as the proxy variable for their social-economic consequences to comprehensively measure whether there is a conflict between the fulfillment of ESG responsibilities and the economic benefits obtained by the enterprise. In terms of governance economic consequences, equity structure is the basis of governance structure, and optimizing equity structure is the key to solving internal governance problems of the company (Min et al., 2023; Guan et al., 2023) [47,48].

On the one hand, equity structure influences the company's decision-making and operation via management. On the other hand, it determines the distribution of control rights by forming the board of directors. Therefore, improving the equity balance can strengthen the restraint on major shareholders, enhance corporate efficiency, and optimize corporate governance mechanisms. We selected the degree of balance between the second to tenth largest shareholders exercising power over the largest shareholder, i.e., the equity ratio (*Bal*), to measure it.

The results of the verification of the economic consequences of *ESG* responsibility fulfillment are shown in Table 10. *ESG* is positively correlated with *Bal*, *EPS*, and *Dona* at a significant level of 1%, and the estimated coefficients increase in order. These results indicate that good ESG performance optimizes the company's equity structure, improves earnings per share, and actively attracts the company to participate in public welfare donations.

Table 10. What benefits does good ESG performance bring to the enterprise?

Variable	*Bal*	*EPS*	*Dona*
ESG	0.031 ***	0.075 ***	0.105 ***
	(3.329)	(11.122)	(2.796)
Control	YES	YES	YES
η/*μ*	YES	YES	YES
_cons	0.260	−2.127 ***	−12.553 ***
	(0.919)	(−10.045)	(−12.096)
adj. R2	0.367	0.163	0.306
N	30076	26162	5161

Note: *** represents significance at the 1%, with Z values in parentheses.

7. Discussion and Conclusions

7.1. Conclusions and Policy Implications

In 2006, the United Nations Principles for Responsible Investment Organization (UNPRI) introduced the concept of ESG as a pivotal tool for measuring sustainable development. Therefore, studying the impact of industrial agglomeration on corporate ESG performance has far-reaching implications for policy formulation and sustainable economic development. This study selects the financial data of prefecture-level cities and listed companies from 2005 to 2020 as the research sample. Based on examining and demonstrating the impact of industrial agglomeration on corporate ESG performance, the study reveals the relationship between the two and their external heterogeneity and internal micro-conduction mechanism. The study found that: (1) The agglomeration of the manufacturing significantly promotes corporate ESG performance; (2) The producer services agglomeration industries has a "U-shaped" relationship with corporate ESG performance; (3) The agglomeration of the manufacturing affects corporate ESG performance by alleviating financing constraints

and improving investment levels, while the producer services agglomeration industries affects corporate ESG performance by influencing market competitiveness and internal control; (4) The impact of manufacturing agglomeration on corporate ESG performance is significant in capital-intensive and high-tech industries, while the impact of producer services agglomeration on corporate ESG performance is more significant in knowledge-intensive industries; (5) The effect of the degree of industrial agglomeration on corporate ESG performance varies according to different enterprise characteristics; (6) The agglomeration of the manufacturing mainly promotes the fulfillment of corporate environmental responsibility and social responsibility, while the producer services agglomeration primarily affects the fulfillment of corporate environmental responsibility and governance responsibility; (7) Good ESG performance has a significant positive effect on enterprises' economic, socio-economic, and governance economic consequences.

According to the above research conclusions, the following insights are obtained:

(1) In elevating enterprise ESG performance, government departments, industry associations, and investment institutions should jointly encourage enterprises to adopt cleaner production technologies and energy, lowering energy consumption, waste emissions, and pollutant governance costs, promoting the circular economy and green development, and elevating enterprise environmental performance; simultaneously formulating stringent environmental protection laws and policies, such as reducing emissions, recycling waste and using clean energy, to encourage manufacturing enterprises to advance environmental protection actions proactively. Support manufacturing enterprises in environmental technology research, promotion, and application investment using fiscal subsidies and tax reductions. On the other hand, government departments, industry associations, and investment institutions should encourage enterprises to participate in social public welfare activities and poverty alleviation projects, increasing employee, customer, supplier, and community satisfaction and loyalty, elevating enterprise social reputation and trust, and elevating enterprise social performance. Encourage enterprises to establish and improve governance structures and mechanisms, strengthen enterprise transparency and accountability, and promote enterprise governance performance. Formulate and guide the establishment of ESG assessment standards, evaluate enterprise ESG performance using assessments, publicize enterprise ESG performance, incentivize enterprises to proactively fulfill social responsibility, and elevate enterprise sense of social responsibility and environmental awareness.

(2) For manufacturing, first, local governments should formulate stricter environmental protection laws and regulations, strengthen supervision over enterprises, reduce enterprise environmental pollution and resource waste, and elevate enterprise environmental responsibility and social responsibility fulfillment. Second, governments should grant manufacturing enterprises specific preferential policies in taxation, such as tax reductions, lowering enterprise financing costs, and easing financing constraints. Furthermore, governments should strengthen technological support for manufacturing enterprises, promote enterprise innovation ability, and accelerate enterprise technical upgrades and industrial upgrades, thereby elevating enterprise ESG performance.

(3) For producer services, first, governments should encourage producer services enterprises to strengthen internal management and elevate industry entry thresholds, punishing enterprises violating environmental, social, and governance norms, encouraging outstanding enterprises, and promoting enterprise governance responsibility fulfillment. Second, governments can strengthen market regulation over producer services enterprises, ensuring enterprises conduct operations according to norms, preventing malicious competition and irregularities, strictly regulating enterprise market behavior, formulating ESG standard assessment indexes, and granting compliant enterprises rewards and preferential policies, guiding and encouraging enterprises to achieve sustainability in agglomerated regions, elevating enterprise market competitiveness and brand image, thereby elevating enterprise ESG performance. Addition-

ally, governments can establish public service platforms, providing complementary services and support, encouraging producer services enterprises to cooperate, and helping enterprises achieve ESG targets using joint research and experience sharing.

7.2. Limitations and Future Potentials

This study has some limitations that need to be acknowledged and addressed in future research. First, measuring manufacturing agglomeration and producer services agglomeration at the prefecture-level city may need revision and refinement, as it may not capture all aspects of the economic correlation between industries. Future research could use more comprehensive and refined indicators, such as the specialization index, localization index, or urbanization index, to measure different dimensions of industrial agglomeration and explore their differential effects on corporate ESG performance. Second, this study only examines the heterogeneity effects of industrial agglomeration on corporate ESG performance across different industries and enterprises without considering the potential moderating effects of other factors, such as regional characteristics, institutional environment, or market competition. Future research could introduce more contextual variables and interaction terms to examine how industrial agglomeration interacts with other factors to influence corporate ESG performance. Third, this study only uses the ESG score as a proxy for corporate ESG performance, which may not fully reflect corporate social responsibility's multi-dimensional and dynamic nature. Future research could use more specific and disaggregated indicators, such as environmental disclosure, social contribution, or governance quality, to measure different aspects of corporate ESG performance and explore their determinants and consequences. While this study focuses on exploring the manifestation of corporate ESG performance, how to effectively incorporate the broader CSR-related literature is also a focus for future research. Fourth, this study only analyzes the data of listed companies in China, which may limit the generalizability and applicability of the findings to other countries or regions. Future research could use cross-country or cross-regional data to compare and contrast the impact of industrial agglomeration on corporate ESG performance in different institutional and cultural contexts.

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