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## Article

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## Article

# The Determinants of the Concentration of Superstar Firms: Cluster Analysis and Its Relationship with Economic Development and Artificial Intelligence

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**Abstract:** This study analysed the determining factors of the concentration of “superstar firms” in specific economies, with a focus on the interaction between technological innovation, economic development, and market structures. Using global data from Statista on superstar firms for the year 2022, statistical methods such as correlation analysis, an ANOVA, and cluster analysis were applied to identify patterns and relationships between variables like the GDP, market capitalization, and the development of artificial intelligence (AI). The analysis in this paper revealed significant positive correlations between the number of superstar firms and key economic indicators such as the GDP and market capitalization, suggesting that these firms drive economic growth and technological advancement. The cluster analysis identified groupings of countries based on their technological capabilities and economic performance, highlighting that a great number of these firms are concentrated in advanced economies. This work emphasizes the importance of technological infrastructure, innovation policies, and regulatory frameworks in promoting competitive environments for superstar firms. Additionally, it addresses the socioeconomic implications, including challenges related to wealth concentration, inequality, and the transformation of the labour market. Public policies are recommended to foster inclusive innovation, STEM education, and international governance to balance global competitiveness with equitable economic growth.

**Keywords:** superstar firms; technological innovation; economic development; artificial intelligence; regulatory policies



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## 1. Introduction

Superstar firms have become dominant in the global economy, reshaping industries and concentrating wealth (Amiti et al., 2024). With high productivity, innovation, and market leadership, they use global value chains (GVCs) and Global Wealth Chains (GWCs) to optimize production and consolidate influence (Bair et al., 2023). Their dominance has grown with digitalization, especially post-COVID-19 (Yoon, 2020). This phenomenon is analyzed through theories and case studies across industries like entertainment and logistics (Guan, 2023).

The rise in superstar firms has drawn academic interest, focusing on their concentration and expansion. Key factors include market power, consumer behaviour, technology,

and human capital (Eeckhout, 2022), which have widened income disparities, highlighting the need for structural analysis (Autor et al., 2020). Countries that promote technological innovation attract and foster leading firms (Bloom et al., 2017).

The literature highlights the impact of national contexts on superstar firms' success. In Europe, these firms capture larger market shares while reducing labour participation by spreading fixed costs efficiently (Stiel & Schiersch, 2020). Policies, technological infrastructure, and R&D funding are crucial for fostering innovation (Carrera Mora et al., 2021). The AI Readiness Index developed by the IMF measures a country's capacity for technological advancement (Oxford Insights, 2023). Recently, governments have aimed to attract tech firms through investments in data infrastructure, trade liberalization, and AI promotion (McKinsey Global Institute, 2022).

The concentration of superstar firms in certain economies can heighten inequality by concentrating profits and market power (Philippon, 2019). Digitalization has provided advanced tools for data analysis and market segmentation, driving global expansion (Morillo-Aguilar, 2022). Beyond innovation, economic sustainability—measured by the per capita GDP, labour productivity, and data infrastructure—also influences their growth. High-productivity economies with strong domestic markets facilitate expansion by lowering costs and increasing efficiency (Autor et al., 2020).

This study introduces the Innovation Capabilities Index and the Economic Sustainability Index to analyze factors driving the concentration of superstar firms across different national contexts. Despite their global relevance, gaps remain in the understanding of the conditions that enable their emergence and sustainability, with limited research integrating innovation, economic development, and the role of national policies and market structures. This research aimed to address the question of what factors determine the concentration of superstar firms in specific economies, with three main objectives: analyzing the impact of these firms on economic growth and market capitalization, particularly regarding AI development; exploring their sectoral distribution in technology, finance, industry, and energy; and offering policy recommendations to help governments foster environments that support firm growth while tackling inequality and wealth concentration.

By integrating technological, economic, and policy aspects, this study contributes to the ongoing debate on the role of superstar firms in global economic dynamics. As these firms reshape industries, regulatory frameworks must evolve to balance innovation-driven growth with sustainable development. Additionally, research has shown that corporate sustainability initiatives play a role in the expansion of superstar firms, as they adopt green supply chains, energy-efficient products, and renewable energy projects. However, challenges like “greenwashing”, where firms exaggerate their environmental efforts without meaningful change, have also been noted (Paluš et al., 2024; Lyon & Montgomery, 2015).

In global economic governance, there is a growing call for a cohesive, multilateral regulatory framework to address the transnational challenges posed by superstar firms (Mazur, 2023). Additionally, a new research field is emerging on how these firms are reshaping labour markets, driving a transition toward highly digitized and specialized employment, and altering global skill demands (Biondo et al., 2024).

In contrast to previous studies examining the impact of superstar firms on income distribution (Piketty, 2014) or the labour market structure (Biondo et al., 2024), our research enhances understanding by introducing two key indices: the Innovation Capabilities Index and the Economic Sustainability Index. These indices assess the presence of superstar firms based on a country's technological and economic environment and allow for the segmentation of economies into homogeneous groups according to their development and competitiveness.

Our findings support previous studies on the role of AI and technological infrastructure in the concentration of these firms (Acemoglu & Restrepo, 2018) but challenge the conventional view by showing that the correlation between superstar firms and AI development is moderate, suggesting other structural factors are involved.

This study contributes to the literature by offering an innovative methodology to segment economies based on the superstar firm presence and providing an analytical framework to evaluate the conditions favouring their concentration. It also presents public policy recommendations supported by empirical data, offering tools to design strategies that enhance competitiveness while addressing economic inequality. Building on existing research on the impact of superstar firms on economic development and innovation (Autor et al., 2020; Brynjolfsson et al., 2019), our study took a novel approach by applying quantitative methods, including cluster analysis, correlations, and statistical models, using recent data from Statista for the year 2022.

The article is organized as follows: Section 2 reviews the literature on superstar firms, examining their definition, characteristics, and global economic impact, along with the factors promoting their concentration in specific countries and sectors and the implications for inequality and competitiveness. Section 3 outlines the methodology, including the Statista dataset and statistical methods used to identify patterns and significant relationships. Section 4 presents the analysis results, while Section 5 discusses the findings in relation to the existing literature. Finally, Sections 6–8 offer conclusions and public policy recommendations, highlighting the need for a supportive environment for these firms while addressing the challenges of their economic concentration.

## 2. Theoretical Framework

The concentration of superstar firms in certain economies has captured the interest of academics and investment groups due to their significant impact on the global economy and the structure of local markets (Yoon, 2020). These firms, characterized by their leadership in innovation, high market capitalization, and competitive advantages in terms of profitability and productivity, represent a distinctive phenomenon in the contemporary economy (Autor et al., 2020). However, the emergence and prevalence of superstar firms are not uniform across all contexts; instead, they are heavily influenced by the specific structural characteristics of each country, such as the innovation environment, competitiveness in attracting foreign direct investment (FDI), and economic sustainability (Brynjolfsson et al., 2019).

The phenomenon of superstar firms not only redefines competitive dynamics at a global level but also has direct implications for the economic structure, such as the market concentration and income distribution (De Loecker et al., 2020). These firms often consolidate in specific sectors where their competitive advantages allow them to capture disproportionate market shares, contributing to increased income inequality and a decline in the labour's share of the GDP (Autor et al., 2020; Abraham & Bormans, 2020). This phenomenon is exacerbated by the growing digitalization of the economy and the effects of markets concentrating success in a few highly innovative and productive firms (Schulz & Mayerhoffer, 2021).

On the other hand, superstar firms also generate spillover effects in local and global markets. Recent research has suggested that these firms, by integrating with local firms through global value chains or foreign direct investment, significantly boost the productivity of linked firms, although these benefits are often accompanied by higher levels of concentration and unequal competition (Vrolijk, 2021; Amiti et al., 2024). However, their high capacity for capital accumulation and low dependence on external financing can re-

duce the resource allocation efficiency in global markets, exacerbating economic inequality (Xu et al., 2020).

For this reason, the impact of superstar firms extends beyond the economic sphere to decision-making in education and employment (Choi et al., 2021). The visibility and success of these firms have influenced the choice of university careers, which, in the long term, can create imbalances between the supply and demand for certain types of human capital, negatively affecting initial wages in some sectors.

As noted in Schumpeter's seminal work, the development of innovation capabilities is highlighted as a fundamental element for creating leading firms, as innovative economies tend to generate favourable conditions for product and service differentiation, which is crucial to competing in highly dynamic markets (Aghion et al., 2019; Endzejczyk & Schmitka, 2020). Similarly, a country's capacity to attract investment and the stability of government support are decisive factors in the location of superstar firms, as a competitive investment environment allows these firms to access financial resources and achieve long-term stability (Globerman & Shapiro, 2021). Thus, political stability plays a crucial role in attracting foreign direct investment (FDI), as it creates a predictable environment, improves investor confidence, and ensures property rights protection, fostering long-term stability for firms in competitive investment climates (Jansen, 2024).

Moreover, economic sustainability, reflected in labour market stability and high productivity, is essential for superstar firms to operate efficiently and project sustained growth (McKinsey Global Institute, 2022). Consequently, economic sustainability, characterized by a stable labour market and high productivity, is crucial for firms to thrive. Increased labour productivity enhances economic growth and safeguards against external challenges by supporting operational efficiency and sustained growth for superstar firms (Fedulova et al., 2019).

The relationship between the number of superstar firms—firms noted for their market influence and leadership—and a country's economic and technological development has been extensively explored in the economic and business literature. Superstar firms, typically characterized by a high market capitalization and innovative capacity, not only lead in their respective sectors but also have a notable impact on the economies of their home countries. They also play a crucial role in generating productivity within their ecosystems, with positive spillover effects on other firms through their supply chains. These interactions not only improve the performance of collaborating firms but also encourage the adoption of advanced technologies and better business practices across industries (Amiti et al., 2024). Thus, superstar firms act as catalysts for economic and technological growth, promoting competitiveness in an increasingly dynamic global environment.

Hence, it is suggested that the growth of these firms is associated with market concentration and productivity increases, which in turn reinforce their role in developing more robust and competitive economies globally (Autor et al., 2020).

The literature shows that the presence of superstar firms is correlated with key economic variables such as the Gross Domestic Product (GDP) and corporate market capitalization. It has been confirmed that economies with higher market capitalization host more leading firms in strategic sectors, indicating a symbiotic relationship between GDP growth and the expansion of standout firms (Freund & Sidhu, 2017).

Recent studies have reinforced this connection, highlighting that a developed capital market not only drives economic growth but also fosters the expansion of key firms in strategic sectors. This is because superstar firms, by leading in market capitalization, contribute to sustainable economic growth while facilitating the adoption of advanced technologies and attracting capital. Consequently, the strengthening of financial markets

and their interaction with the GDP is positioned as a key driver of economic development (Bekhti et al., 2022).

Similarly, economic growth and market capitalization often accompany the emergence of these firms in advanced economies, suggesting a reciprocal relationship: while economic development drives the growth of superstar firms, these firms in turn contribute to GDP growth (Cabral, 2021).

Beyond traditional economic variables, the growth of superstar firms has been linked to the development and adoption of emerging technologies, particularly in AI. Investments in AI reflect nations' commitment to incorporating cutting-edge technologies into their productive and governmental sectors. For this reason, leading firms tend to allocate significant resources to AI development and data management (DataAI), leveraging their financial capacity to remain at the technological forefront (Agrawal et al., 2018). The adoption of AI by the most influential firms in an economy can have a multiplier effect, contributing to the country's technological advancement and strengthening the overall economic ecosystem (Acemoglu & Restrepo, 2018).

This leads to the formulation of the first hypothesis, which outlines whether the existence of superstar firms positively impacts their country of origin. The hypothesis to be addressed is as follows:

**Hypothesis 1.** *The number of superstar firms in a country is positively associated with higher market capitalization, GDP, and AI development.*

Classifying firms by their sector allows for a better understanding of how superstar firms are distributed and specialized across different sectors, which in turn can impact the economies in which they operate. In the literature, superstar firms are typically those firms that, due to their size, innovation, and market capitalization, exert disproportionate influence over the market and, at times, the regulatory framework of their sectors (Autor et al., 2020). The sectors in which these firms operate can determine their ability to innovate, attract significant capital, and develop and implement specific types of technologies.

According to recent studies, the types of predominant firms in a country can significantly influence the presence of superstar firms, suggesting that these leading firms tend to be concentrated in certain sectors like technology and finance (Bessen, 2019). Superstar firms in technological and financial sectors demonstrate a notable ability to attract capital and dominate in terms of the market share, while other sectors like industry and energy also hold considerable weight, albeit with different growth and competition dynamics (Bessen, 2019). In line with this approach, the typology of a firm can be understood as a relevant variable for comprehending the distribution patterns of superstar firms across different countries.

Based on the theoretical review, the following hypothesis was proposed:

**Hypothesis 2.** *The presence of superstar firms varies significantly according to the type of firm, being higher in technology and finance sectors compared to industrial and energy sectors.*

The segmentation of countries into groups or clusters based on their economic and technological characteristics is a common methodology in international economics studies to understand patterns of development and competitiveness. An approach that integrates the number of superstar firms—leading firms dominating the market in terms of capitalization and their innovation capacity—along with economic and technological development variables allows for the creation of country groupings with similar characteristics, facilitating comparisons of their development levels (Rodrik, 2016). Thus, the presence of standout firms in an economy reflects not only a high level of competitiveness but also a robust

technological infrastructure and an economic policy that fosters innovation and business growth (López-Rubio et al., 2024).

Using cluster analysis in this context helps group countries according to the number of superstar firms and key economic variables such as the GDP and market capitalization, as well as AI development indicators. Previous studies have demonstrated that the number of superstar firms is often associated with economies that exhibit greater technological sophistication and highly competitive business ecosystems (Freund & Sidhu, 2017). Particularly, more superstar firms tend to be concentrated in countries with a higher adoption of advanced technologies, especially AI, fostering clusters of innovation and sustained economic growth (Acemoglu & Restrepo, 2018).

Aligned with this, cluster analysis has been applied to identify patterns and similarities among economies with a high degree of AI development and concentration of high-performing firms. This suggests that clusters based on AI indicators and the concentration of leading technology firms allow for a better understanding of national innovation strategies and investment policies. According to the literature, certain groups of countries may share distinctive characteristics in terms of the number of superstar firms and levels of AI development, resulting in clusters defined by a combination of economic power and advanced technological capabilities (Agrawal et al., 2019).

AI is therefore seen to play a key role in transforming the global business landscape and in the concentration of superstar firms, as it enables process automation, value chain optimization, and the mass customization of products and services (Brynjolfsson & McAfee, 2023). In this study, AI was conceptualized as an indicator of technological development that influences the competitiveness and growth of market-leading companies. To measure this variable, data from Oxford Insights' AI Readiness Index 2023 (Oxford Insights, 2023), which assesses the ability of governments and private sectors to adopt AI, as well as information from Statista (2022) on AI investment in different economies, were used.

Recent research has indicated that the presence of superstar firms is correlated with high levels of AI adoption, as these companies have the infrastructure, capital, and organizational capacity to lead the implementation of advanced technologies (Howard, 2019). However, this study challenges the traditional view that directly associates AI development with the concentration of these firms, finding that the correlation between both variables is moderate, suggesting that there are other structural factors, such as market regulation and economic infrastructure, which also play a key role in shaping the global business ecosystem.

Based on the theoretical review, the following hypothesis was proposed:

**Hypothesis 3.** *Countries group into homogeneous clusters based on their number of superstar firms, economic development, and AI advancement, with more superstar firms and AI advancements concentrated in the most competitive and developed countries.*

### 3. Methodology

#### 3.1. Variables and Methodology

The analysis incorporated a set of key variables essential for understanding the impact of superstar firms across various economic sectors. Below is an outline of these variables, along with their descriptive statistical characteristics, summarized in Table 1. Additionally, for insights into the distribution of superstar firms by country, refer to Table A1 (Appendix A).

To evaluate this relationship, firms were classified into categories or typologies based on their predominant sector, represented by dichotomous variables: T1 for energy firms (including oil, natural gas, and petrochemicals), T2 for technology firms, T3 for industrial

and pharmaceutical firms, and T4 for the financial and investment sector. Each of these categories is associated with different business models, growth expectations, and sectoral regulations—factors that can impact each sector’s capacity to produce superstar firms (Koller et al., 2020).

**Table 1.** Definition and description of key variables in analysis of superstar firms.

Dep. Variable	Nomenclature	Total			
Superstar Firms	Superstar Firms	100			
Indep. Variable	Nomenclature	Mean	Std. Des.	Kurtosis	Skewness
Gross Domestic Product	GDP	3994.987	7040.427	7.779	2.838
Market Capitalization	MC	2751.748	8961.095	17.847	4.217
Total Artificial Intelligence <sup>1</sup>	Total IA	72.618	5.026	0.792	0.299
Energy Firms (Including Oil, Natural Gas, Petrochemicals)	T1	0.441	0.5111	−2.199	0.244
Technology Firms	T2	0.444	0.615	0.387	1.085
Industry and Pharmaceuticals	T3	0.667	0.485	−1.594	−0.773
Financial and Investment Sector	T4	0.388	0.501	1.987	0.498

<sup>1</sup> where STATISTA defines AI as the following: “AI refers to the ability of a computer or machine to mimic the competencies of the human mind, which often learns from previous experiences to understand and respond to language, decisions, and problems”.

Additionally, it was noted that the technology sector (T2) has exhibited exponential growth in the concentration of superstar firms, while the financial sector (T4) maintains a significant presence due to its ability to mobilize large volumes of capital (Freund & Sidhu, 2017). In comparison, the industrial (T3) and energy (T1) sectors may have a lower concentration of superstar firms but remain relevant in emerging economies and nations with abundant natural resources.

### 3.2. Methodology

The present study employed a combination of statistical analyses to explore the relationships between the number of superstar firms (leading firms) and various economic and technological variables. The methodology was divided into the following subsections: correlation analysis, a T-test for independent samples, an analysis of variance (ANOVA), and cluster analysis. The analyses were conducted using SPSS software, version 29.

#### 3.2.1. Correlation Analysis Between Superstar Firms and Continuous Variables

The purpose of this analysis was to determine whether there was a significant association between the number of superstar firms in a country and key continuous variables such as market capitalization (MC), the Gross Domestic Product (GDP), and the Artificial Intelligence Development Indicator (Total AI). Pearson’s correlation coefficient was used for this purpose, a statistical method that quantifies the strength and direction of linear relationships between variables. This is why we investigated part of the relationship between the market concentration and the decline in labour participation in the GDP (Autor et al., 2020).

The calculation was performed using the following equation:

$$r = \frac{\sum (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum (X_i - \bar{X})^2 \sum (Y_i - \bar{Y})^2}} \tag{1}$$

where  $X_i$  and  $Y_i$  represent the scores of each country in terms of the number of superstar firms and the selected continuous variables (market capitalization, GDP, Total AI), respectively.  $\bar{X}$  and  $\bar{Y}$  are the means of the corresponding variables.

### 3.2.2. T-Test for Independent Samples: Superstar Firms and Firm Typology

The purpose of this analysis was to understand the relationship between the number of superstar firms and the firm typology, represented by dichotomous variables (T1, T2, T3, T4), as outlined in Table 1. We evaluated both the differences in the average number of superstar firms based on the presence of each firm type and the impact of each typology on the likelihood of having a high number of leading firms (Church & Ware, 2000).

Here, the dichotomous variables (T1, T2, T3, T4) were configured as grouping variables to analyze whether significant differences existed in the number of superstar firms. For this purpose, a T-test for two independent samples was defined as follows:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \quad (2)$$

where  $\bar{X}_1$  and  $\bar{X}_2$  are the means of the superstar firms for each firm typology group. Thus,  $s_1^2$  and  $s_2^2$  are the variances for each group. Finally,  $n_1$  and  $n_2$  are the sample sizes for each group.

### 3.2.3. Analysis of Variance (ANOVA) Between Superstar Firms and Industry Types

To further investigate the impact of superstar firms, the goal was to examine whether there were significant differences in the number of superstar firms across different industry types and if these differences were associated with variations in economic indicators such as market capitalization or the GDP. The analysis sought to identify which sectors, represented by categories such as T1, T2, T3, and T4, exhibited higher levels of market capitalization or the GDP based on the number of superstar firms present, shedding light on the sectorial impact of these leading firms on the studied economies.

The methodological procedure was based on an analysis of variance using an ANOVA table, where industries were set as the categorical independent variable and the number of superstar firms as the dependent variable. This approach allowed for the modelling of the average differences in the number of superstar firms across industry types, with the equation used describing the relationship between the industrial categories and the dependent variable to assess the statistical significance of the observed variations (Ližbetinová et al., 2019). The equation was as follows:

$$F = \frac{\text{Between - group variation}}{\text{Within - group variation}} = \frac{\sum_{k=1}^K n_k (\bar{X}_k - \bar{X})^2}{\sum_{k=1}^K \sum_{i=1}^{n_k} (X_{ik} - \bar{X}_k)^2} \quad (3)$$

where  $K$  is the number of groups (industries),  $n_k$  is the sample size of the group  $k$ ,  $\bar{X}_k$  is the mean of group  $k$ , and  $\bar{X}$  is the overall mean.

### 3.2.4. Cluster Analysis: Grouping Countries Based on Superstar Firms and Economic and Technological Development Variables

The cluster analysis aimed to group countries based on their level of economic, technological, and business development, considering the number of superstar firms and other key variables such as AI development, the GDP, and market capitalization. This methodology allowed for the identification of similarities in development profiles between countries, revealing patterns that link the number of leading firms with economic and technological indicators and facilitating the classification of economies into homogeneous groups.

To perform the analysis, a hierarchical clustering method was used, which allowed for the observation of how groups of countries formed at different levels of similarity. This approach used hierarchical cluster analysis, which typically measures the similarity

between countries through the Euclidean distance, a method that calculates the proximity of observations in a multidimensional space defined by the selected variables. The hierarchical representation facilitated the interpretation of the similarity levels between countries and the identification of common patterns in their economic and technological development trajectories (Ližbetinová et al., 2019). The resulting equation is as follows in Equation (4):

$$d_{ij} = \sqrt{\sum_{k=1}^p (X_{ik} - X_{jk})^2} \quad (4)$$

where  $d_{ij}$  is the distance between countries  $i$  and  $j$  and  $X_{ik}$  and  $X_{jk}$  are the values of the selected variables for countries  $i$  and  $j$ , respectively, in each of the  $p$  dimensions (economic and technological development variables).

In order to provide a clear and structured overview of the methodological process followed in our analysis, we prepared the following summary table (Table 2). This table details each of the stages carried out in the estimation of our main variables, allowing readers to more easily understand the steps and approaches applied in the research to analyze the influence of superstar firms on economic and technological development.

**Table 2.** Summary of stages of methodological analysis.

Analysis Step	Description
Correlation Analysis	Evaluated the association between the number of superstar firms and continuous variables (e.g., the GDP, Market Cap, IA). Pearson's correlation coefficient was used.
Independent Samples T-Test	Compared the averages of the number of superstar firms according to the business typologies (T1, T2, T3, T4). Facilitated the analysis of significant differences.
Analysis of Variance (ANOVA)	Modelled the average differences in the number of superstar firms across different industries. Used to assess the statistical significance of the observed variations.
Cluster Analysis Grouping	Grouped countries according to their economic and technological development, considering the number of superstar firms. A hierarchical method was used to identify patterns and similarities.

## 4. Results

### 4.1. Correlation Analysis Between Superstar Firms and Key Economic Variables

Table 3 shows the correlations between the number of superstar firms and three key variables: the market capitalization, GDP, and Total AI. Significant correlations were observed between superstar firms and the other variables analyzed, suggesting an important association between the number of leading firms and these economic and technological development indicators.

First, the correlation between superstar firms and market capitalization was very high ( $r = 0.993$ ,  $p = 0.001$ ), indicating a positive relationship. This result suggests that a greater number of superstar firms in a country is associated with an increase in market capitalization, supporting the hypothesis that these firms are key drivers of financial market wealth.

Similarly, the relationship between superstar firms and the GDP was strong and significant ( $r = 0.894$ ,  $p = 0.001$ ). This finding reinforces the idea that countries with a higher

number of superstar firms tend to have a high GDP, possibly due to the contribution of these firms to the national economy through their productive and innovative activities.

**Table 3.** Correlations between the number of superstar firms and critical economic variables.

	Superstar Firms	Market Capitalization	GDP	Total IA
Superstar firms	1	0.993 ** (0.001)	0.894 ** (0.001)	0.590 ** (0.010)
Market capitalization	0.993 ** (0.001)	1	0.847 ** (0.001)	0.579 * (0.012)
GDP	0.894 ** (0.001)	0.847 ** (0.001)	1	0.497 * (0.036)
Total IA	0.590 ** (0.010)	0.579 * (0.012)	0.497 * (0.036)	1

\* Significant at 10%, \*\* significant at 5%, \*\*\* significant at 1%.

The correlation between superstar firms and the Total AI was also significant, although of a smaller magnitude ( $r = 0.590$ ,  $p = 0.010$ ). This result suggests a moderate association between the number of leading firms and AI development. The positive correlation may indicate that nations with a higher presence of superstar firms also invest in advanced technologies such as AI, although to a lesser extent than in market capitalization and the GDP.

Regarding the correlations between the other variables, a strong relationship was observed between market capitalization and the GDP ( $r = 0.847$ ,  $p = 0.001$ ), as well as moderate correlations between market capitalization and the Total AI ( $r = 0.579$ ,  $p = 0.012$ ) and between the GDP and Total AI ( $r = 0.497$ ,  $p = 0.036$ ). These results suggest that, although all variables were associated to some extent, market capitalization and the GDP exhibited the strongest relationships with the number of superstar firms.

#### 4.2. Sectoral Distribution of Superstar Firms

Table 4 presents the group statistics for the number of superstar firms based on the firm typology, represented by four dichotomous categories (T1, T2, T3, and T4). These categories indicate the predominant industry type (T1: oil/natural gas; T2: advanced technology; T3: pharmaceutical/industrial; T4: financial/banking), with a value of 1 for countries that had a significant number of firms in each type and 0 for those that did not.

Regarding typology T1 (oil/natural gas firms), countries with a presence of superstar firms in this industry (T1 = 1) showed an average of 10.63 superstar firms (SD = 2.121), while those without a significant presence of superstar firms in this category (T1 = 0) had a much lower average of 1.50 superstar firms (SD = 0.850). This notable difference suggests that countries with a strong presence of oil and natural gas firms tend to house a higher number of superstar firms.

In typology T2 (advanced technology), a similar difference was observed. Countries with a significant presence of superstar firms in technology (T2 = 1) had an average of 11.29 superstar firms (SD = 2.654), compared to an average of 1.91 superstar firms (SD = 1.446) in countries without this presence (T2 = 0). This reinforces the hypothesis that economies with advanced technological sectors have a higher concentration of superstar firms.

Typology T3 (pharmaceutical and industrial) also showed notable differences. Countries with a significant number of superstar firms in this sector (T3 = 1) had an average of

7.58 superstar firms (SD = 1.676), while those without this presence (T3 = 0) had an average of only 1.50 superstar firms (SD = 0.837).

**Table 4.** Group statistics by business type: superstar firm comparison.

Dep. Variable: Superstar Firms		
Sector		Mean
T1	0	1.50 (0.850)
	1	10.63 (2.121)
T2	0	1.91 (1.446)
	1	11.29 (2.654)
T3	0	1.50 (0.837)
	1	7.58 (1.676)
T4	0	1.73 (1.104)
	1	11.57 (1.540)

Finally, in typology T4 (finance/banking), countries with superstar firms in this category (T4 = 1) reported an average of 11.57 superstar firms (SD = 1.540), while countries without a significant presence of superstar firms in this sector (T4 = 0) had an average of 1.73 (SD = 1.104). This difference is consistent with the trend observed in the other typologies: the financial and banking sectors are also associated with a higher concentration of superstar firms.

#### 4.3. Variance Analysis (ANOVA) of Superstar Firms Across Industries

Table 5 shows the results of the Levene test, conducted to assess the equality of variances in the number of superstar firms between countries with and without a significant presence in different firm typologies (T1, T2, T3, and T4). This test helped determine if there were differences in the variability of the number of superstar firms between the groups, a necessary step for interpreting the consistency of the observed differences.

For typology T1 (oil/natural gas), a significant Levene statistic was obtained ( $F = 5.964$ ,  $p < 0.01$ ), indicating that there was a significant difference in the variance of the number of superstar firms between countries with and without a presence in this typology. This suggests that the dispersion of the number of superstar firms differs depending on the presence or absence of oil and natural gas firms, which could be linked to the concentration of prominent firms in this sector.

In the case of typology T2 (advanced technology), the Levene test was also significant ( $F = 7.616$ ,  $p < 0.01$ ). This result indicated significant differences in the variance of superstar firms between the groups, which could reflect that countries with a strong technological sector exhibit greater variability in the number of prominent firms.

**Table 5.** Analysis of variance (ANOVA) results for the concentration of superstar firms.

Superstar Firms	Levene Test
	F
T1	5.964 **
T2	7.616 **
T3	2.109
T4	7.889 **

\* Significant at 10%, \*\* significant at 5%, \*\*\* significant at 1%.

For typology T3 (pharmaceutical/industrial), the Levene result was not significant ( $F = 2.109$ ), suggesting that there were no differences in the variance of the number of superstar firms between countries with and without a presence in this category. This indicates that the dispersion of the number of superstar firms is homogeneous within this industry type.

In typology T4 (financial/banking), the Levene test was again significant ( $F = 7.889$ ,  $p < 0.01$ ), indicating a notable difference in the variability of superstar firms between countries with and without a presence in the financial sector. This could reflect considerable dispersion of the number of superstar firms in countries with a prominent banking or investment industry.

#### 4.4. The Variability in the Concentration of Superstar Firms: Insights from the Levene Test

Table 6 presents the results of the between-subjects effects tests, analyzing the impact of the superstar firms variable on the GDP and market capitalization (MC) as dependent variables. These tests assessed whether the presence of superstar firms was significantly associated with the GDP and market capitalization, considering model adjustments to explain the variance of each dependent variable.

**Table 6.** Tests for between-subject effects.

Origin	Dep. Var.: GDP		Dep. Var.: MC	
	F	Sig.	F	Sig.
Corrected model	146.399	0.000	992.867	0.000
Intersection	681.990	0.000	1708.741	0.000
Superstar firms	146.399	0.000	992.867	0.000
Adj. R <sup>2</sup> *	0.981		0.997	

\* A statistical measure used in regression to assess how well a model explains the variability of the dependent variable, adjusting for the number of predictors in the model.

For the GDP as the dependent variable, the corrected model showed a significant F statistic of 146.399 ( $p < 0.001$ ), indicating that the presence of superstar firms explained a significant proportion of the variance in the GDP. The adjusted R<sup>2</sup> value was 0.981, suggesting that 98.1% of the variance in the GDP could be explained by the model, which implies a good fit. These results support the hypothesis that the number of superstar firms in a country has a strong association with its GDP, suggesting that these firms contribute significantly to the size of the national economy.

Similarly, for market capitalization as the dependent variable, the corrected model showed a notably high F statistic ( $F = 992.867$ ,  $p < 0.001$ ), with an adjusted R<sup>2</sup> of 0.997. This means that the model explained 99.7% of the variation in market capitalization, indicating an extremely strong relationship between the presence of superstar firms and

market capitalization. This result suggests that in countries where more superstar firms are concentrated, market capitalization tends to be significantly higher, reflecting the central role these firms play in financial market activities.

The intersection in both models was also significant, indicating that the dependent variables (GDP and market capitalization) maintained high mean values regardless of the influence of superstar firms. However, the results in both tests reinforced the importance of superstar firms as a significant factor affecting economic indicators.

The cluster analyses conducted in this study allowed countries to be grouped based on the characteristics of their superstar firms, development in AI, market capitalization (MC), and GDP. These results provide a structured view of how countries with high-tech and AI-intensive economies are distributed and differentiated.

#### 4.5. Cluster Classification of Countries Based on Superstar Firm Distribution

Table 7 shows the assignment of countries to each of the four clusters obtained in the analysis. Cluster 1 included only the United States, Cluster 2 included China, and Clusters 3 and 4 grouped the remaining countries. The distance of each country to the centroid of its cluster indicated its proximity to the representative profile of that group. Thus, the United States and China had a distance of 0, indicating that they were representative countries of their respective clusters. Countries in Cluster 3 (the United Kingdom, France, and Germany, among others) and Cluster 4 (India, Switzerland, and Hong Kong, among others) showed relatively small distances to their respective centroids, suggesting a certain internal homogeneity.

**Table 7.** Cluster membership.

Case N°	Country	Cluster	Distance
1	U.S.	1	0.000
2	China	2	0.000
3	UK	3	4.171
4	France	3	2.030
5	Germany	3	1.222
6	Australia	3	1.799
7	Canada	3	2.222
8	Denmark	3	2.647
9	Netherlands	3	1.775
10	South Korea	3	1.262
11	India	4	6.108
12	Switzerland	4	1.473
13	Hong Kong	4	2.688
14	Belgium	4	1.725
15	Ireland	4	1.857
16	Saudi Arabia	4	2.118
17	Taiwan	4	2.058
18	UAE	4	2.232

#### 4.6. Cluster Characteristics of Superstar Firms, AI, Market Capitalization, and GDP

Table 8 presents the final cluster centres for the variables of superstar firms, the Total AI, MC, and the GDP. Regarding superstar firms, Cluster 1 (U.S.) showed the highest value with 60 prominent firms, followed by Cluster 2 (China) with 9. Clusters 3 and 4, which included most countries from Europe, Asia, and other regions, showed a considerably lower average, with two firms each. In terms of AI, Cluster 1 again stood out with the highest Total AI level (84.40), followed by Cluster 3 (75.61), while Cluster 4 had the lowest AI level (68.36).

**Table 8.** Final cluster centres.

	Cluster			
	1	2	3	4
Superstar firms	60	9	2	2
Total AI	84.40	70.94	75.61	68.36
MC	10.56	7.57	6.12	6.04
GDP	10.22	9.78	7.51	6.79

As for market capitalization (MC) and the GDP (GDP), Cluster 1 (U.S.) once again reached the highest values (MC = 10.56 and GDP = 10.22). China, in Cluster 2, followed with high values (MC = 7.57 and GDP = 9.78), although they were still below those of the U.S. Clusters 3 and 4 showed lower values in these variables, with Cluster 3 slightly ahead of Cluster 4 in both indicators. These results reinforce the segmentation between countries with economies dominated by superstar firms and a strong technological base and those with emerging or developing economies.

#### 4.7. Euclidean Distances Between Clusters and Economic and Technological Divergence

Table 9 shows the Euclidean distances between the final cluster centres. The most notable distance was the one separating Cluster 1 from the other clusters, especially Cluster 3 (58.646) and Cluster 4 (60.803), which reflected a significant difference in the economic and technological profile of the United States compared to these groups of countries. Among Clusters 2, 3, and 4, the distances were smaller, indicating greater similarity in their profiles.

**Table 9.** Distances between final cluster centres.

Cluster	1	2	3	4
1		52.833	58.646	60.803
2	52.833		8.640	8.503
3	58.646	8.640		7.311
4	60.803	8.503	7.311	

#### 4.8. ANOVA Results Confirming Significant Differences in Cluster Profiles

Table 10 shows the results of the ANOVA tests for each variable in the cluster model, providing evidence of significant differences between the clusters. The variable superstar firms presented an F statistic of 636.278 ( $p < 0.001$ ), indicating a significant difference in the number of superstar firms between clusters. Similarly, the Total AI, MC, and GDP also showed significant differences between the groups (F = 23.430 ( $p < 0.001$ ), F = 11.972 ( $p < 0.001$ ), and F = 10.856 ( $p < 0.001$ ), respectively). These results reinforced that the obtained clusters represent groups with distinctive profiles in terms of the number of superstar firms, AI development, market capitalization, and the GDP.

**Table 10.** ANOVA.

	Cluster		Error		F	Sig.
	Root Mean Square	gl	Root Mean Square	gl		
Superstar firms	1067.676	3	1.670	14	636.278	0.000
Total AI	119.394	3	5.096	14	23.430	0.000
MC <sup>1</sup>	6.788	3	0.567	14	11.972	0.000
GDP <sup>1</sup>	5.515	3	0.508	14	10.856	0.001

<sup>1</sup> are worked in logarithms.

## 5. Discussion

The results obtained in this study provide an interesting insight into the relationship between superstar firms and economic and technological variables, as well as the grouping patterns of countries. First, the findings indicate a strong correlation between superstar firms and other key variables, such as market capitalization (MC), the Gross Domestic Product (GDP), and artificial intelligence development (Total AI). Additionally, the cluster analysis and ANOVA tests revealed significant differences between groups of countries based on their performance on these variables. In the following, we will discuss these results in relation to the specialized literature.

### 5.1. Correlation Between Superstar Firms and Economic Variables

The correlation analysis showed that superstar firms are closely linked with the GDP and market capitalization, supporting the idea that these firms are key players in national economies and their development. This relationship aligns with previous studies that have highlighted the impact of large firms on economic growth. Therefore, a significant portion of the economic output tends to be concentrated in superstar firms, as they not only generate a substantial share of employment and wealth but also lead technological innovations that drive economic growth (Autor et al., 2019).

Additionally, the positive correlation with AI variables, especially the Total AI, suggests that the presence of superstar firms is linked to the technological development of countries. These findings align with what the literature suggests: large technological firms are not only drivers of economic growth but also catalysts for the advancement in the adoption of emerging technologies such as AI (Brynjolfsson & McAfee, 2014).

### 5.2. Cluster Analysis: Grouping Countries Based on Economic and Technological Characteristics

The cluster analysis revealed that countries were grouped into four distinct categories based on their performance on variables such as superstar firms, market capitalization, the GDP, and the Total AI. Cluster 1, which included the United States, stood out for its high concentration of superstar firms and significant development in AI, reinforcing the notion that countries with advanced technological sectors tend to have a higher concentration of prominent firms. This pattern aligns with the literature suggesting that countries with a competitive business environment and a robust technological sector are more likely to have a high number of outstanding firms (Cunningham et al., 2020).

Cluster 2, which included China, showed a similar economic profile, although with fewer superstar firms. This could reflect the phenomenon of economic power being concentrated in a small number of technological firms, such as the large tech firms in China, which, despite their size, have not yet reached the concentration of firms like those in the United States. Thus, China has experienced explosive growth in technology and superstar firms, but the business concentration is still somewhat lower than in more developed countries, like the U.S. (Xu et al., 2020).

As for Clusters 3 and 4, which grouped European and emerging countries, the lower presence of superstar firms and the reduced development in AI and market capitalization suggest a different economic structure, more distributed among medium and small enterprises. This observation allows us to see that in countries with more diversified and less concentrated economies, growth is more balanced, and the impact of superstar firms is smaller (Acemoglu et al., 2020).

The results of the ANOVA tests show significant differences between the clusters in the variables of superstar firms, the Total AI, market capitalization, and the GDP, further reinforcing the idea that countries are grouped according to distinctive characteristics. This supports the notion that the concentration of wealth (in this case, represented by superstar firms) is strongly linked to economic development and the market structure (Piketty, 2014). The difference in the means of superstar firms between the clusters underscores the central role of large firms in dominant economies, while the greater heterogeneity in the countries in Clusters 3 and 4 reflects less concentrated economies.

The fact that superstar firms are associated with a higher GDP and market capitalization in Clusters 1 and 2 is also consistent with theories on the “economy of the few” (Gabaix, 2016), which argues that a small number of large firms have a disproportionate impact on key economic variables in a country. The differences in the variability of market capitalization and the GDP across the clusters highlight the relevance of these firms in the global economic and financial structure.

## 6. Policy Implications

It is essential that public policies promote a competitive environment through antitrust regulations that limit the excessive concentration of market power and encourage inclusive innovation through tax incentives and subsidies for emerging sectors and small businesses that have not yet reached a robust level of global competition. Additionally, it is recommended to invest in advanced technological infrastructure and human capital development, particularly in areas such as artificial intelligence and digital technology, to help less developed economies close technological gaps between them and leading countries. Public policies should also consider the creation of international governance frameworks to address tax evasion and harmonize regulations between countries to avoid regulatory arbitrage and ensure fair competition conditions. Furthermore, it is crucial to develop educational and continuous training programmes focused on STEM skills to prepare the workforce for the demands of digitized economies and minimize the adverse effects of labour displacement caused by automation and advanced technologies. In this context, sustainability should be integrated as a strategic axis through policies that encourage responsible and transparent business practices, avoiding phenomena like greenwashing and promoting business models that balance profitability with environmental and social responsibility. Finally, a balanced approach is required that prioritizes both global competitiveness and economic inclusion, ensuring that the benefits generated by superstar firms are distributed equitably and contribute to sustainable development.

## 7. Limitations and Future Directions

While this study offers a significant contribution to the analysis of the concentration of superstar firms and its impact on economic development and technological innovation, it presents some limitations that should be considered.

First, although the study employed recent data from Statista (2022) and applied rigorous statistical methodologies such as cluster analysis and a correlation analysis of economic variables, data availability remained a challenge. The research relied on a limited set of macroeconomic and technological indicators, which may not capture all dimensions that influence the concentration of these firms, such as fiscal policies, investment in education, or institutional stability.

Second, this study focused on a country-level analysis, which allowed for the identification of general patterns in the distribution of superstar firms but did not address sectoral or regional dynamics within countries. Future research could delve deeper into the role of specific industrial clusters or the relationship between these firms and small- and medium-sized enterprises (SMEs) in different economic environments.

Third, the methodology used allowed for the establishment of associations between variables, but not causality. Although we found strong correlations between the presence of superstar firms, the development of artificial intelligence, and GDP growth, we cannot claim that the existence of these firms is the direct cause of economic or technological development. Future studies could employ more advanced approaches, such as panel econometric models or causality analysis, to refine this relationship.

Finally, this study integrated the impact of superstar firms on the global economy into academic debates, aligning itself with previous research highlighting their role in capital concentration and innovation (Autor et al., 2020; Bessen, 2019), but also challenging certain traditional approaches by showing that the relationship with artificial intelligence is more complex than has been suggested. By proposing an analytical framework based on indices of innovation and economic sustainability, this article opens new lines of research on the interaction between public policy, technology, and the business concentration in the global economy.

## 8. Conclusions

Superstar firms are emerging as key players in global economic dynamics, and their ability to concentrate wealth and generate technological innovation represents a major phenomenon. This study highlights that the concentration of these firms is not only linked to their size and market power, but also to their fundamental role in the adoption and development of advanced technologies, especially artificial intelligence.

AI acts as a driver of transformation, allowing superstar firms to optimize processes, reduce costs, and improve the quality of their products and services. Significant investments in AI by these firms not only increase their competitiveness but also consolidate their dominant position in the market. This translates into a virtuous cycle where technological superiority fuels market growth and, in turn, allows superstars to explore new business opportunities through radical innovations.

Furthermore, the presence of superstar firms in technology-intensive sectors, such as artificial intelligence, has profound implications for the structure of the labour market and income distribution. On the one hand, these firms generate high-quality jobs, but they can also contribute to growing inequality, as access to the skills needed to thrive in an AI-driven environment may be limited to a narrow portion of the population.

Finally, it is crucial to consider that the dominance of superstar firms and their influence on the AI ecosystem pose significant challenges in terms of regulation and public policy. Policymakers must strike a balance between fostering innovation and ensuring that the benefits of economic growth are distributed more equitably. This includes considering strategies that promote effective competition and regulations that mitigate the risk of market power becoming even more concentrated in the hands of a few entities.

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## Appendix A

**Table A1.** Relationship between countries and superstar firms.

Rank	Country	Superstar Firms
1	U.S.	60
2	China	9
3	UK	5
4	France	4
5	Germany	3
6	India	3
7	Switzerland	3
8	Australia	2
9	Hong Kong	2
10	Belgium	1
11	Canada	1
12	Denmark	1
13	Ireland	1
14	Netherlands	1
15	Saudi Arabia	1
16	South Korea	1
17	Taiwan	1
18	UAE	1

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