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The Secret of China Keeping Leading the Export of Steel Trade Since 21 Century

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Abstract: The foundation was set by early industrialization, post-1949 emphasis on heavy industries, and post-1978 economic reforms.China emerged as a significant exporter of steel in the 21st century due to several factors that enhanced its competitiveness. These factors include the presence of abundant reserves of iron ore, a substantial labour force, and developments in technology. As a result, China successfully debunked the prevailing notion of relying solely on domestic resources and established itself as a prominent player in the global steel market. This paper examines China's global steel market dominance due to historical foundations, economic reforms, and competitive advantages. This study employs the H-O model and the supply and demand model, utilizing secondary data from various sources. The samples for this study include China's total population, China's GDP, Australia, and Europe and the United States. The type of data utilized in this research is secondary data, and it involves characteristics such as bar charts to observe the steel industry's development in China, Australia, and Europe and the United States. The data encompasses steel resource content, total steel import and export, total steel production, and the environmental policy stringency index. This paper proposes a novel avenue for future research, focusing on the integration of environmental factors into models explaining international steel trade dynamics. The investigation aims to shed light on the influence of environmental standards on trade patterns and, consequently, advance our comprehension of China's position within the global steel market.

Keywords: China Steel trade, Steel Export and Import, Steel Supply and Demand, environmental control standards

1. Introduction

The rise of China as a prominent player in the international steel industry is a complex story that may be attributed to a combination of historical, economic, and strategic factors. This study aims to analyze the complex array of factors that have contributed to the growth and development of China's steel sector, leading it to become a prominent global exporter of steel. Utilizing an extensive body of scholarly literature, we undertake an investigation into the central role assumed by government-led industrialization endeavours, the informative nature of economic reforms, the strategic importance of infrastructure investments, the catalyzing effect of technological progress, and the shrewd adaptation of China's steel industry to changing global market dynamics.

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The genesis of China's notable foray into the core of the steel industry may be attributed to the latter part of the 19th century and the early part of the 20th century. The initial endeavours in industrialization established the foundation for subsequent expansion and advancement [1]. Nonetheless, the significant formation of the People's Republic of China in 1949 served as a crucial juncture. The Chinese government demonstrated steadfast resolve in prioritizing the advancement of heavy industries, namely the steel sector, as a crucial element of its ambitious economic agenda. The industry's rapid rise was facilitated by a visionary approach, strategic governmental ownership, and significant expenditures in advanced infrastructure and technology [2-3].

The implementation of the informational economic reforms in 1978 marked the onset of a distinct period characterized by the adoption of market-oriented policies, a surge in foreign investments, and the pursuit of export-driven strategies [4]. The aforementioned changes played a crucial role in fundamentally altering the course of China's steel sector. Expanding upon this fundamental basis, China has undertaken substantial expenditures in infrastructure, hence bringing about a transformative impact on both domestic and international transportation networks pertaining to steel goods [5]. China's steel sector has achieved strategic alignment with global demand, bolstered by consistent government support, thereby solidifying its position as a significant participant in the world steel market [6].

China's dominant position in steel manufacturing can be ascribed to a multitude of critical variables that contribute to its competitive advantage. To begin with, the considerable reserves of iron ore within the country conferred a significant advantage, guaranteeing a consistent and dependable source of raw materials for the manufacturing of steel [7]. Furthermore, the substantial population of China has fostered a considerable and proficient workforce, hence enhancing cost-effectiveness and facilitating an unparalleled growth in manufacturing capacity [8]. Furthermore, the industry's competitive advantage was strengthened by the continuous progress in steel-making technologies and a steadfast dedication to research and development [9].

Nevertheless, it is crucial to debunk the prevailing fallacy that China's steel industry prospers exclusively due to its ample domestic steel supplies. China's dependence on significant imports of steel raw materials contradicts the prevailing belief that domestic resource availability is the sole driver of industrial development [10].

Remarkably, against these formidable obstacles, China persists in exerting unequalled dominance in the worldwide steel export industry in the contemporary era. This article aims to explore the complex interplay between historical legacies, economic policies, infrastructural investments, and global market tactics that have contributed to China's prominent position in the steel sector.

What factors have contributed to China's continued dominance in the global steel trade since the beginning of the 21st century? This inquiry prompts contemplation. This research utilizes the Heckscher-Ohlin (H-O) model and the supply and demand model, employing secondary data from multiple sources. The samples utilized in this study encompass the entirety of China's population, China's Gross Domestic Product (GDP), as well as the regions of Australia, Europe, and the United States. The research employs secondary data, namely utilizing bar charts to examine the progress of the steel sector in China, Australia, Europe, and the United States. The dataset includes information on the content of steel resources, the overall import and export of steel, the total output of steel, and the stringency index of environmental policies. Through the utilization of supply and demand modelling and the comparative analysis of data across various places, a more comprehensive comprehension of the progression of the steel sector may be attained. Although the H-O model was employed in this study, it did not provide a comprehensive analysis of the evolution of China's steel sector. Consequently, the utilization of the supply and demand model is employed to conduct a more comprehensive analysis of the factors contributing to China's substantial expansion in the steel industry.

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2. Theoretical Framework

The Heckscher-Ohlin (H-O) model, alternatively referred to as the Heckscher-Ohlin-Samuelson model, is a seminal theoretical framework in the field of international trade. It elucidates the trade patterns observed between nations by taking into account disparities in their respective factor endowments. The Heckscher-Ohlin model, initially formulated by economists Eli Heckscher and Bertil Ohlin, was further modified by Paul Samuelson. The H-O model rests on several key assumptions and concepts:

1) Factors of Production: The model considers two primary factors of production - labor and capital. These factors are essential inputs in the production of goods and services.

2) Factor Endowments: It assumes that countries differ in their factor endowments, meaning they have varying levels of labor and capital. Some countries are considered labor-abundant, while others are capital-abundant.

3) Production Techniques: Different goods require different combinations of labor and capital in their production. Some goods are labor-intensive, while others are capital-intensive.

4) Comparative Advantage: The H-O model posits that countries will specialize in the production of goods that make the most efficient use of their abundant factors. This specialization leads to comparative advantage.

5) Trade Patterns: According to the model, countries will export goods that are intensive in their abundant factors and import goods that are intensive in their scarce factors. This trade pattern is driven by the comparative advantage gained from exploiting factor endowments.

It is crucial to acknowledge that the H-O model serves as a fundamental framework for comprehending international trade and has remained unaltered in my utilization of it. When employing the H-O model, economists and academics generally stick to these key principles without modifying the core notions. Alternatively, individuals have the option to utilize the model for the purpose of examining certain trade situations, determining comparative advantage, or investigating the consequences of alterations in factor endowments or trade regulations. Although there may be variations in the implementation and analysis of the H-O model, its essential assumptions and principles remain consistent.

The Supply and Demand model is a key concept in the field of economics, playing a pivotal role in elucidating the mechanisms by which prices and quantities of products and services are established within a market-based economic system. This model is predicated upon the interplay between buyers, who represent demand, and sellers, who represent supply, inside a given market. It offers a straightforward, yet robust, framework for examining a diverse array of economic situations.

Key features of the Supply and Demand model include:

First, Demand: This represents the quantity of a good or service that consumers are willing and able to purchase at different price levels. Typically, there is an inverse relationship between price and quantity demanded – as prices decrease, quantity demanded increases, and vice versa.

Second, Supply: Supply represents the quantity of a good or service that producers are willing and able to offer for sale at various price levels. In general, there is a direct relationship between price and quantity supplied – as prices rise, quantity supplied increases, and as prices fall, quantity supplied decreases.

Third, Equilibrium: The equilibrium point in the model is where the supply and demand curves intersect. At this point, the quantity demanded equals the quantity supplied, determining both the market price and the quantity bought and sold.

Fourth, Shifts in Supply and Demand: Changes in factors such as consumer preferences, income, technology, or production costs can lead to shifts in the supply and demand curves.

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These fluctuations have the potential to induce alterations in both the price at which supply and demand are balanced, as well as the quantity of goods or services exchanged in the market. The Supply and Demand model is regarded for its inherent simplicity and remarkable versatility. This model is utilized by economists and analysts for the purpose of examining a diverse range of economic phenomena, encompassing price fluctuations in specific marketplaces, as well as the effects of governmental policies and external disturbances on entire industries and economies. The essential ideas and assumptions of the Supply and Demand model have not been amended by the author in its usage. In addition, the author has employed this foundational framework to examine particular market circumstances, evaluate the impacts of diverse elements on the forces of supply and demand, and comprehend the ways in which alterations in these factors can shape market results. The model exhibits a persistent adherence to its fundamental framework and functions as a helpful instrument for conducting economic analysis. Furthermore, the data included in this study has been sourced exclusively from reputable institutions such as the World Bank, World Steel, Statista, and the OECD.

3. Results and Analysis

3.1. H-O Model: Resources

3.1.1. Raw Materials: Iron and Coal

Table 1: Major exporters of steel 2021 (million tonnes) (Source: Word Steel).

Rank	Total exports	Mt
1	China	66.2
2	Japan	33.8
3	Russia	32.6
4	South Korea	26.8
5	European Union (27)’	26.0
6	Germany	23.9

Table 2: Major importers of steel 2021 (million tonnes) (Source: Word Steel).

Rank	Total imports	Mt
1	European Union (27)’	48.1
2	United States	29.7
3	China	27.8
4	Germany	23.3
5	Italy	20.8
6	Turkey	16.2

Now, it's time to proceed to conduct a comparative analysis of the data pertaining to China's reserves of iron ore in relation to those of Australia, the European Union, the United States, and several other countries.

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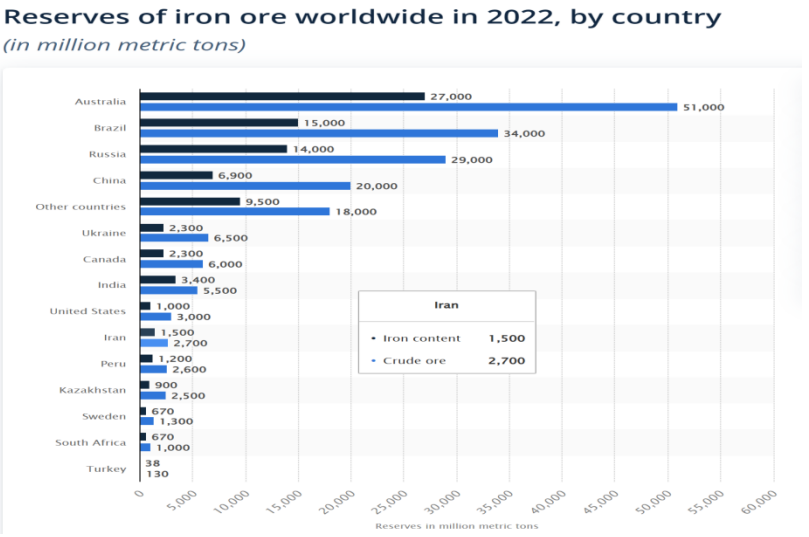

Figure 1: Reserves of iron ore worldwoide in 2022, by country (source: Statista).

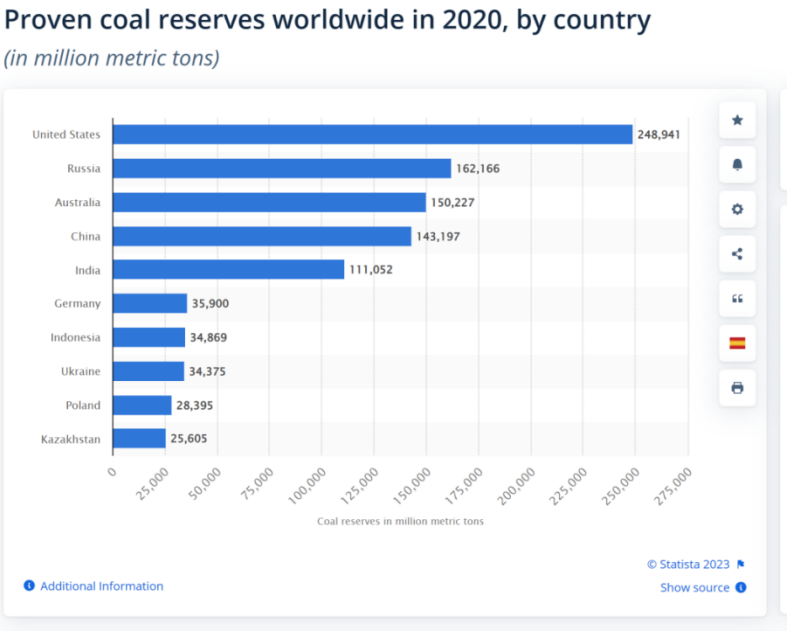

Figure 2: Proven coal reserves by country 2020 (Source: Statista).

China, as the foremost exporter, shown a significant achievement in its overall steel exports, amounting to 66.2 million metric tons (Mt). This figure greatly exceeded Japan's exports, which stood at a comparatively modest 33.8 Mt, as indicated in table 1.

In terms of imports, the European Union has emerged as the primary significant importer, with a total import volume of 48.1 Mt, as indicated in Table 2. It is noteworthy that China's import volume holds the third position, indicating its substantial involvement in the production and consumption of steel at the international level.

The available data indicates the significant presence of China's steel sector, although it is important to acknowledge that the country's competitive advantage is not exclusively dependent on its access to raw materials. In contrast to prevailing notions, it is noteworthy that China occupies the fourth position globally in terms of steel raw material resources, whereas Australia distinguishes itself with its substantial deposits of such resources. Moreover, it is noteworthy that the United States

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possesses significant coal deposits, which serve as a crucial primary resource for the manufacturing of steel (as depicted in figures 1 and 2).

In summary, China's prominent position within the global steel industry can be attributed to its substantial production capacity and strategic export capabilities, rather than a specific advantage in terms of steel raw material supplies.

The comparison with Australia is of special importance due to its possession of ample steel raw materials. This characteristic could lead one to expect that Australia would have the highest steel production and export volume, as predicted by the Heckscher-Ohlin (H-O) model. Nevertheless, the prevailing circumstances challenge this assumption, since China has emerged as the global frontrunner in both the production and exportation of steel, despite its need on imported raw materials.

3.1.2. Technology, Financial Capital, Labor, and Land

China's deficiencies in cash, technology, and land resources are apparent. Therefore, based on the H-O model, it can be inferred that the growth of China's steel sector is not predominantly influenced by the presence of ample resources.

The observed disparity implies that the H-O model, which posits trade patterns determined by factor endowments, may not be fully applicable in this particular instance. The multifaceted nature of international trade, encompassing factors such as trade policies, infrastructure, government assistance, production effectiveness, and market requirements, has exerted a more substantial influence on China's prominence in steel exports, beyond the forecasts of the Heckscher-Ohlin (H-O) model.

In summary, it is evident that China's steel exports hold significant magnitude, positioning the nation as the foremost global supplier of steel. The limitations of the H-O model in elucidating this phenomenon underscore the diverse array of circumstances that have contributed to China's exceptional position in the global steel market.

Considering the apparent inapplicability of the H-O model non this particular scenario, an alternate analytical technique, specifically the supply model, will be utilized.

Given the limitations of the H-O model in elucidating the intricate dynamics of China's steel industry and its notable global preeminence in steel exports, the supply model emerges as an appropriate selection for delving into the fundamental variables that have propelled China's substantial expansion and triumph in the steel sector.

Through the utilization of the supply model, an exploration of multiple facets can be undertaken, including production efficiency, governmental regulations, infrastructure expansion, technological progress, market demand, and competitive pricing. This model will provide a more extensive analysis of China's status as the primary exporter of steel worldwide and provide insights into the diverse factors that have influenced its exceptional expansion in the global steel industry.

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3.2. Supply and Demand

3.2.1. Supply of Steel

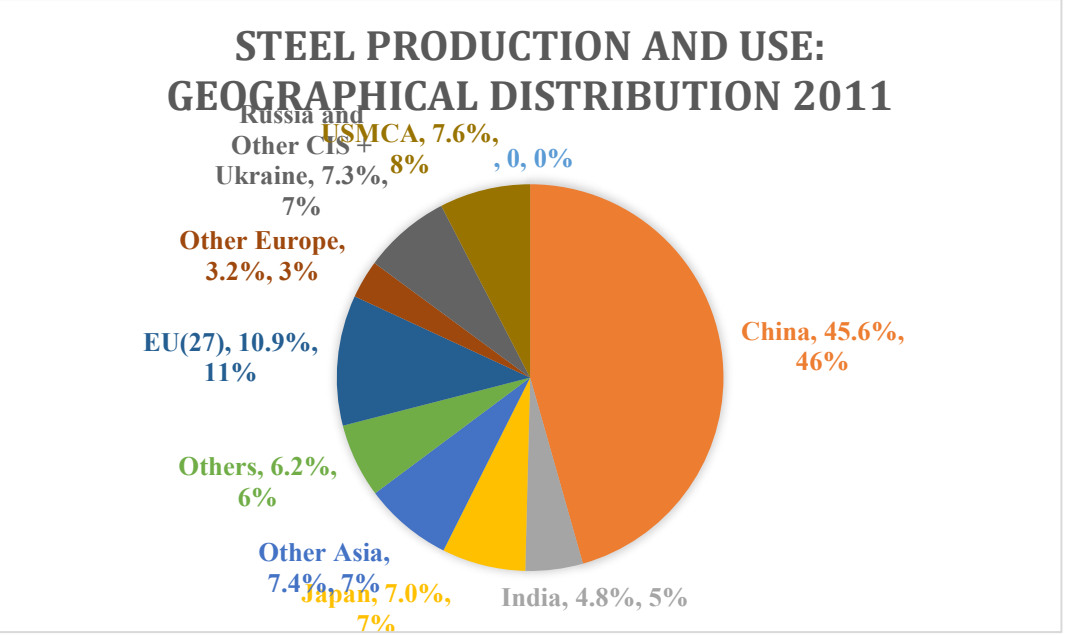

Figure 3: Steel production and use: Geographical distribution 2011 with crude steel production world total:1540 million tonnes (source: Word Steel).

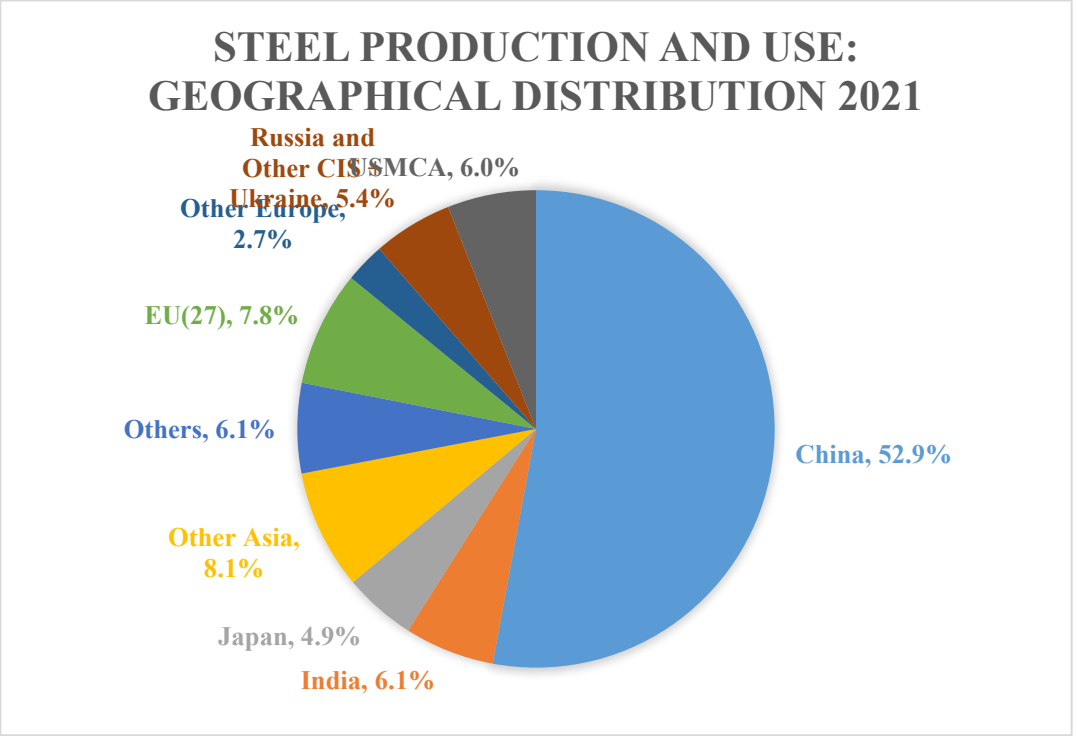

Figure 4: Steel production and use: Geographical distribution 2021 with crude steel production world total:1951 million tonnes (source: Word Steel).

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According to the data presented in figures 3 and 4, China's steel production in the year 2021 constituted a significant proportion of the global output, specifically amounting to 52.9 percent. This notable achievement further reinforces China's prevailing position within the international steel industry. China possesses a substantial steel manufacturing capacity, which acts as a strong basis for fulfilling the domestic demand in its steel market.

3.2.2. Demand of Steel

Figure 5: Imports of goods and services (% of GDP) - China (Source: Word Bank).

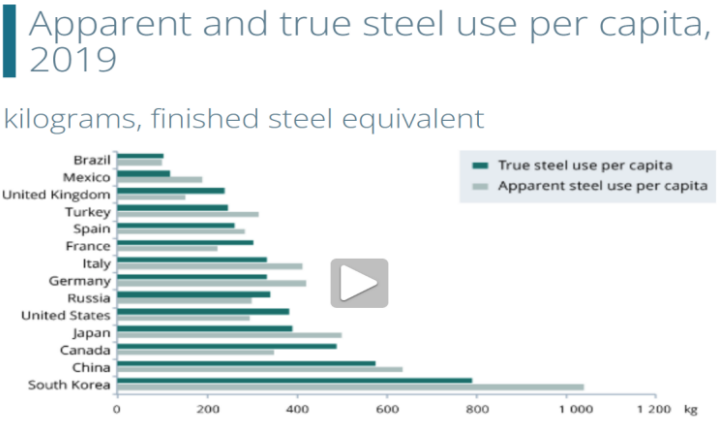

Figure 6: World Steel in Figures 2022 (source: Word Steel).

China's status as the second largest global economy is readily apparent. Upon analyzing the chart depicting per capita steel consumption, it becomes apparent that South Korea has the foremost place, while China ranks second. Nevertheless, it is imperative to take into account the contextual factors associated with China's vast population, as this gives rise to a significant aggregate requirement for steel within the nation (see to figures 5 and 6).

China's substantial economic size and magnitude contribute to the generation of a notable demand for steel within the country's society. The substantial demand in question functions as a potent catalyst for the advancement of China's steel sector. Consequently, China has progressively established itself as a prominent steel exporter, capitalizing on its resilient local demand and economic prowess to make substantial contributions to the worldwide steel industry. The interaction of these elements has significantly influenced the placement of China as a prominent participant in the global steel industry.

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3.3. Other Factors: Environmental Standards

Table 3: Environmental Policy Stringency Index (source: OECD).

country	Environmental Policy Stringency Index									
	1990	1995	2000	2003	2006	2009	2012	2014	2015	2020
1 France	1.44	1.39	1.75	2.08	3.08	3.69	3.92	4.22	4.03	4.89
3 Switzerland	1.50	2.33	2.25	2.25	2.28	3.36	3.64	4.06	4.03	4.5
4 Italy	1.61	1.42	1.78	1.92	3.14	3.28	3.58	4.00	4.06	3.72
6 United Kingdom	1.11	1.00	1.33	2.14	2.42	2.67	2.89	3.75	3.86	3.61
7 Norway	0.47	1.53	1.64	2.25	2.47	3.67	3.67	3.72	3.72	3.94
10 Canada	0.67	0.72	0.72	1.89	2.47	3.19	3.443	3.19	2.53	3.03
.....										
22 China	0.00	0.06	0.22	0.36	0.69	0.97	2.47	2.75	2.89	3.14

*The ranking is based on 2014 Envieonmental Policy Stringency Index

(Note: During the period of rapid development of China's steel industry from 2010 to 2016, selecting the 2014 Environmental Index for ranking purposes offers a more accurate reflection of the environmental factors' impact on the industry's growth.)

The exponential growth of China's steel sector can be ascribed to various critical elements. In the early stages of its development, China's environmental regulations were comparatively less stringent than those observed in Western nations, so enabling industries to operate with comparatively lower levels of compliance obligations. This conferred a competitive edge in relation to both manufacturing expenses and capability.

Furthermore, the policies implemented by the Chinese government have played a pivotal role in providing support and creating incentives for the development of the steel industry. The government aided the expansion of the sector by providing financial aid, infrastructure support, and favourable regulatory conditions, thereby minimizing substantial constraints.

On the contrary, European and American nations exhibit a high level of scientific and technological advancement, together with significant financial resources; nonetheless, they had difficulties in establishing their own steel sectors.One of the main impediments to progress in Western countries, namely in the realm of steel industry advancement, is the implementation of rigorous environmental regulations. An exemplar instance of this phenomenon can be derived from the environmental governance rankings in the year 2014. Upon analyzing the data presented in the table, it becomes apparent that Italy had already enacted environmental restrictions of a pretty high standard in the year 1990. Furthermore, Western nations such as France and the United Kingdom had approved notably stringent environmental rules during the same period. By the year 2009, a significant number of nations had reached a state of convergence in terms of their environmental control measures, with an average level of roughly 3.5. The implementation of rigorous environmental standards had a significant and far-reaching influence on the steel sector inside Western nations. The need for greater investments arose in order to adhere to cleaner and more environmentally sustainable technologies, leading to a decrease in production capabilities and a rise in production prices. Consequently, the steel sector in these locations faced substantial obstacles that hindered its competitiveness and growth. Upon closer examination of the tabular data pertaining to China, a conspicuous pattern becomes apparent. In the year 1990, it may be argued that China possessed a limited level of consciousness towards environmental regulations. China's environmental control level did not get a rating of 0.97 until the year 2009. The adoption of a permissive stance towards environmental regulations created a favourable context for the growth and expansion of China's steel sector. As a result, the steel sector in China experienced significant growth due to its comparatively lower costs of environmental compliance and less rigorous regulations in comparison

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to its Western counterparts. The significant divergence in environmental control regulations has played a crucial role in the advancement and expansion of China's steel sector, surpassing that of its Western counterparts.

Furthermore, it is worth noting that the pace and extent of domestic steel demand in Western countries may not have matched that of China, resulting in a comparatively lower sense of urgency to build their steel factories to a similar magnitude. In certain instances, these nations depended on imports from foreign countries, such as China, to fulfill their steel demands.

Moreover, there has been a heightened focus on sustainability and eco-friendly methods in Western countries due to increased environmental concerns and public knowledge regarding the environmental impact of industrial activities. Although the dedication to environmental preservation is praiseworthy, it might provide obstacles for the growth of enterprises with high levels of resource consumption, such as steel production.

In brief, the notable expansion of China's steel sector can be ascribed to a confluence of lenient environmental regulations during its initial phases, complemented by favorable governmental measures. However, the growth of steel industries in European and American nations has been constrained by stringent environmental restrictions, the requirement for more environmentally friendly technology, and fluctuating levels of domestic steel demand. The decision was made to engage in the importation of steel. Choosing to meet the country's steel demands while simultaneously safeguarding the environment is a mutually beneficial decision.

4. Discussion

Table 4: Summary of factors for the development of steel industry in different countries.

Summary			
Country	Supply + Demand: High domestic Demand Matters	H-O Model low applicability: Raw material, capital and Other resources don’t matter much	New Factor: Envieonmental Policy Stringency Index
China	High Supply + High Demand	Rich in land and capital (increasing tech)	Low and Increasing
US	High Supply + High Demand	Rich in technology and capital	
Australia	Low Supply + Low Demand	Rich in raw material,land,captial and tech	
Europe	Low Supply + High Demand	Rich in technology and capital	High and Increasing

China's rapid steel industry development can be attributed to a combination of factors, including high supply and demand in the steel market and comparatively lenient environmental control standards, enabling unhindered growth (shown in table 4). However, it is worth noting that the steel market in the United States exhibits a substantial level of supply and demand, alongside an abundance of capital and scientific and technological capabilities. Nevertheless, the growth of the country's steel industry has been constrained due to the imposition of stringent environmental control regulations. Likewise, the member nations of the European Union exhibit substantial demand and supply, bolstered by their possession of sophisticated scientific, technological, and capital resources. However, these countries encounter challenges in expanding their steel sectors as a result of severe regulations pertaining to environmental management. On the other hand, the steel sector in Australia exhibits a state of underdevelopment mostly attributable to its limited domestic demand for steel, resulting in a restricted supply within the market. In brief, the disparities in the development of the steel industry

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across China, the United States, the European Union, and Australia can be ascribed to a confluence of factors, encompassing the intricate dynamics of supply and demand, the availability of capital and technological resources, and the rigor of environmental regulations. The growth paths of their respective steel sectors have been influenced by these considerations. The environment is a significant factor that exerts influence on the growth of the steel sector in all nations.

5. Conclusion

The objective of this study is to examine the factors contributing to China's ongoing dominance in the global steel trade export market in the 21st century. The primary conclusions indicate that China's success in the global steel trade may be attributed to two major factors: substantial domestic demand, characterized by both per capita consumption and overall population size, and relatively lenient environmental rules.

Nevertheless, the paper acknowledges specific constraints. One notable constraint is to the disparity in data availability, whereby there exists a greater abundance of information pertaining to China, while other countries have comparatively less data accessible. Consequently, the study presented may not give a thorough elucidation of the complex dynamics involved in the steel trade between China and several nations.

Additionally, due to the scarcity of data for other countries, the paper faces challenges in conducting a specific analysis of the reasons behind the development of their respective steel industries. As a direction for future research, it would be intriguing to develop a model that takes environmental protection factors into account when explaining international steel trade. This consideration could potentially shed light on how environmental standards influence trade patterns and may lead to a more nuanced understanding of China's leadership in the global steel market.

In conclusion, while the paper provides valuable insights into the key factors driving China's steel trade exports, it acknowledges its limitations and emphasizes the importance of further research to develop more comprehensive and inclusive models to explore the complexities of the international steel trade landscape.

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