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Industrial Policy in the Development of the Iron and Steel Industry in Several Countries

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Abstract

Iron and steel making is one of the most important industrial sectors for economic development since they have high forward and backward linkages. Iron and steel production provides inputs and creates jobs in many other industries. Particularly, steel plays a prominent role in our daily lives. Experiences of many countries reveal that industrial policy plays a key role to achieve the best results for economic development. Because industrial policy can be used to prioritize the use of a country's limited resources to facilitate industrial upgrading. This study addresses the question of whether industrial policy is the main driver for economic development by focusing on the iron and steel industry. In this context, the leading countries in the iron and steel industry are examined from a historical perspective. It is emphasized that China and Japan, which are prominent countries in the iron and steel industry today, have achieved their status as global powers through selective industrial policy.

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1. Introduction

Steel is deeply engrained in our society since it is an indispensable material in modern life (IEA, 2020). When viewed in general, iron and steel (hereafter I&S) production appears to be one of the sectors that has a much greater impact on the development of national economies than commonly believed (Mousa et al., 2016). This is because, it is a strategic industry for economic development since I&S industry provides inputs for many sectors, such as automotive, consumer durables, railways, and aircraft construction. Also, the products of the I&S industry are crucial in buildings and infrastructure. Therefore, the development of the I&S industry means the development of other industries.

The I&S industry has long played a crucial role in economic development since it is one of the most essential materials supporting industrialization. In other words, the development of the I&S industry means the development of other industries.

Throughout history, the leading countries in I&S production have continuously changed. It appears that this change is very much related to the application of industrial policy (IP) in the related countries. As Chang (2003: 26) documented, several countries such as Sweden, Germany, and Japan actively used non-tariff measures to promote their I&S industries during the late 19th and early 20th centuries. In this article, we will follow the traces of IPs in the I&S industry.

In line with this perspective, the first section of the article examines the historical changes in iron and steel production and the current state of the industry. Subsequently, emphasis is placed on the significance of the iron and steel industry for national economies. Finally, the discussion revolves around the critical role that industrial policy plays in achieving rapid economic development through structural changes.

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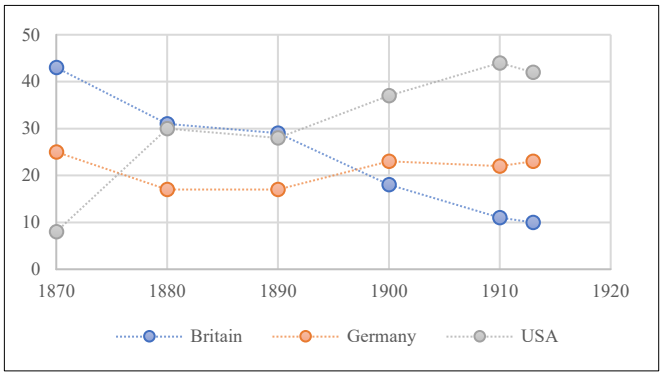
2. Historical Overview of the Iron and Steel Industry

In the 1700s, Sweden was a leader in world steel production. Between 1800 and 1900, there were two prominent countries in the I&S industry in the world. These were the UK and the United States (US), respectively. At the beginning of the 20th century, the Soviets began to carry out considerable production. Meanwhile, England left the leadership to the US. China and Japan did not have a significant share in the I&S industry at that time. After the Second World War, while Russia, Japan, and China gradually increased their production, the percentage of steel production of the US and the UK decreased. Today, China is the clear leader in the I&S industry (Pei et al., 2020: 3).

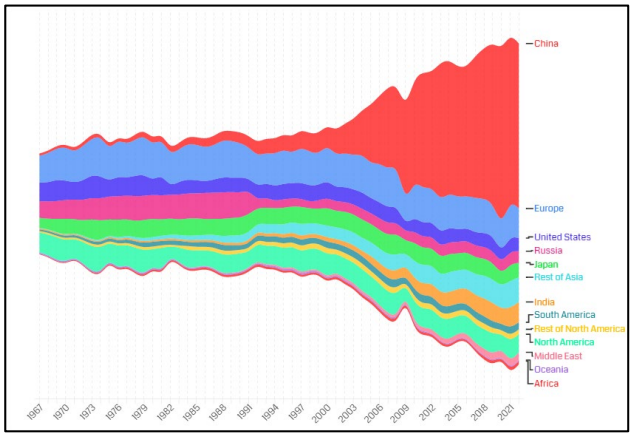
Figure 1. Steel Production in the USA, Germany and Britain, 1870-1913.



Source: Own construction based on James (2013: 93).

The end of the 19th century and the beginning of the 20th century are remarkable times of change for the world I&S industry. During that period, the leading countries of the I&S industry were Britain, Germany, and the US. In the 1870s, 43% of the world's steel had been produced in Britain. However, Britain's leadership of I&S production gradually declined and the US became the leader at the beginning of the 20th century.

Figure 2. Historical World Steel Production (1)



Source: Own construction based on WSA Steel Statistical Yearbooks (2022).

At the beginning of the second half of the 20th century, the world's largest steel producers were the USA, Russia (USSR until the 1990s), and Japan, respectively. The European region, on the other hand, produced 165 million metric tons, achieving considerable production levels in the relevant period. However, in the period from 1967 to the present, there have been considerable changes in steel production throughout the world. Especially Asian countries, which produced approximately 85 million metric tons in 1967, have reached the level of approximately 1.3 billion metric tons today. 1 billion metric tons of this belongs to China alone, making it the world leader in steel production by far. China had produced only 14 million metric tons in 1967. Likewise, India increased its annual production from 6 million metric tons to 125 million metric tons in the same period. While the steel production level remained almost stable in the European region, the US production decreased from 115 million metric tons to 80 million metric tons during the same period.

Table 1. Major Steel-Producing Countries (2020 and 2021)

Country	2021		2020	
	Rank	Tonnage	Rank	Tonnage
China	1	1 032.8	1	1 064.7
India	2	118.2	2	100.3
Japan	3	96.3	3	83.2
United States	4	85.8	4	72.7
Russia	5	75.6	5	71.6
South Korea	6	70.4	6	67.1
Türkiye	7	40.4	7	35.8
Germany	8	40.1	8	35.7
Brazil	9	36.2	9	31.4
Iran[(e)]	10	28.5	10	29.0
Italy	11	24.4	13	20.4
Taiwan, China	12	23.2	11	21.0
Vietnam	13	23.0	14	19.9
Ukraine	14	21.4	12	20.6
Mexico	15	18.5	15	16.8
Indonesia	16	14.3	16	12.9
Spain	17	14.2	18	11.0
France	18	13.9	17	11.6
Canada	19	13.0	19	11.0
Egypt	20	10.3	20	8.2

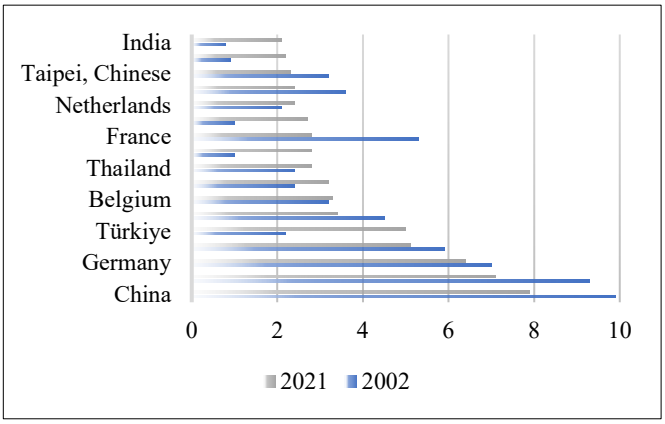
Saudi Arabia	21	8.7	22	7.8
Poland	22	8.5	21	7.9
Austria	23	7.9	24	6.8
United Kingdom	24	7.2	23	7.1
Belgium	25	6.9	26	6.1
Malaysia[(e)]	26	6.9	25	6.6
Netherlands	27	6.6	27	6.1
Australia	28	5.8	29	5.5
Bangladesh[(e)]	29	5.5	28	5.5
Thailand	30	5.5	30	4.5
Pakistan	31	5.3	35	3.8
South Africa[(e)]	32	5.0	34	3.9
Argentina	33	4.9	36	3.7
Slovakia	34	4.9	38	3.4
Czechia	35	4.8	31	4.5
Sweden	36	4.7	32	4.4
Kazakhstan[(e)]	37	4.4	33	3.9
Finland	38	4.3	37	3.5
Algeria	39	3.5	39	3.0
Romania	40	3.4	40	2.8
United Arab Emirates	41	3.0	41	2.7
Belarus[(e)]	42	2.4	42	2.5
Luxembourg	43	2.1	45	1.9
Oman[(e)]	44	2.0	44	2.0
Portugal	45	2.0	43	2.2
Serbia	46	1.7	47	1.5
Greece	47	1.5	48	1.4
Colombia	48	1.3	54	1.1
Chile	49	1.3	53	1.2
Kuwait[(e)]	50	1.3	49	1.3
Others		17.7		16.2
World		**1 951.2**		**1 879.4**
[(e)] = estimate				

Source: (World Steel Association, 2022).

According to World Steel Association data, steel production is increasing in the world. However, some countries stood out in the steel industry. The world's top 10 steel-producing countries are China, India, Japan, America, Russia, South Korea, Turkey, Germany, Brazil, and Iran, respectively. China, the world's largest steel producer, supplies approximately 53% of the steel produced worldwide, with over 1 billion tonnes as of 2021. East Asia has the world's largest I&S production, consumption, and exports and, thus, has a significant impact on the global I&S industry (Yang, 2021: 30).

The steel industry has been playing a very important role in the development of the Chinese economy for a long time. In recent decades, China's steel industry has grown rapidly, overtaking Japan, and becoming the world's largest steel producer in 1996 (Guo and Fu, 2010: 4356).

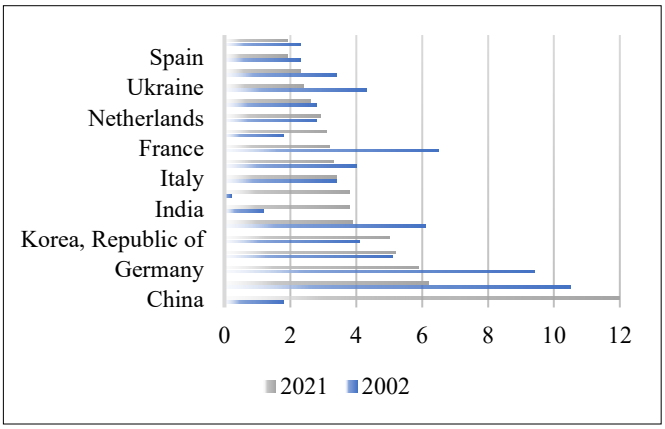
Figure 3. Share in value in world's I&S imports by countries, 2002 and 2021 (%)



Source: Own construction based on International Trade Centre (2022) data.

Figure 3 shows the percentage share of the world's largest I&S importing countries. According to the International Trade Center data, the world's largest I&S importing country is China with a rate of 7.9%. However, compared to 2002, China's share in the world I&S imports has decreased by about 2 percentage points. The same is true for the US. However, the share of imports in some countries such as Türkiye, Mexico, Indonesia, and India increased. The most striking increase was in Türkiye with a share of about 2.8%.

Figure 4. Share in value of world's iron & steel exports by countries, 2002 and 2021 (%)



Source: Own construction based on International Trade Centre (2022) data.

Figure 4 shows the percentage share of the world's largest I&S exporting countries. In 2021, China became the largest iron and steel exporter in the world, and Japan in 2002. According to the International Trade Center data, there is no significant change in most of the selected countries in 2002. But the change in China is quite striking. China's I&S exports increased by about 10 points in 9 years. It is understood that China gets its share of exports worldwide, especially from Japan and Germany.

3. The Importance of the Iron and Steel Industry for Economic Development

According to Hirschman (1958), sectors with strong backward linkages that purchase inputs from many other sectors are able to increase aggregate output by stimulating demand for the relevant sectors. On the other hand, sectors with forward connections can increase supply by selling their output to other sectors, thereby increasing overall consumption. Since the I&S industry provides inputs for many sectors, the development of the I&S industry means the development of other sectors. Probably, this is best understood by the successful economies of East Asia, namely Japan, Republic of Korea, and China. The development of the I&S industry has always been a priority for the governments of these economies.

Researchers conduct scientific research to identify the importance of the I&S steel industry for economic and social issues. The research commissioned by the World Steel Association to Oxford Economics in 2019 shows the importance of the I&S industry. The report revealed the global economic and social impacts of the I&S industry based on 2017 data. The data used in the report's summary are shown in Table 2. The Impacts of the I&S industry are impressive especially when we think that Hirschman's (1958) ideas about forward and backward linkages.

Table 2. Social and Economic Impact of the Global Steel Industry

	Indirect impact on the supply chain	**Direct impact on steel industry**	**Impact on customer sectors**	**Overall Impact**
Economic	For every $1 of value added within the steel industry itself, an additional $2.50 of value is generated as a result of purchases of equipment, raw materials, services, and energy. Thus, this contributes a total of $1.2 trillion in value added to the supply chain.	In 2017, the steel industry generated a total of $500 billion in value added by selling $2.5 trillion worth of products.	The steel industry generates a value-added output of US$1.2 trillion by providing services or selling products to other sectors.	The steel industry contributes a total value added of US$2.9 trillion, accounting for 3.8% of the global GDP.
Social	For every 2 jobs in the steel industry, 13 additional jobs are supported throughout its supply chain, and within the global supply chain of the steel sector, there are 40.5 million people employed.	The steel industry employs 6.1 million people.	The steel industry supports 49.3 million jobs in customer sectors worldwide.	The steel industry globally supports approximately a total of 96 million jobs.

Source: Own construction based on Oxford Economics Report (2019).

Industries are linked when a company acquires goods or services from another company to facilitate the manufacturing of its products. This interconnection extends across various industries, forming a continuous cycle of transactions. Additionally, the economic impact is amplified by the spending of earnings by workers employed in all industries. Consequently, similar to other sectors, I&S production

generates output and employment opportunities in a multitude of industries.

4. Industrial Policy Traces Behind the Success

Industrial policy (IP) has been the subject of one of the most heated debates in economics from the start, although the term IP did not come into general use until World War II. Central to the IP is the assumption that free markets do not produce the best results. The theoretical basis of IP lies in the assumption that to achieve rapid economic development, selective state intervention is necessary. In particular, a frequent manifestation of IP is the concern to increase productivity, industrial competitiveness and expected synergies through industrial clusters (Haar, 2014: 221).

Economic development requires the transformation of the economic structure of a country. This includes diversification into new sectors; reassign resources to more productive enterprises; and, critically, to improve the quality of goods produced (Khandelwal, 2010). It is unlikely that an unguided market economy can do this. Therefore, IP and public sector investment are necessary for economic development. Well designed and prioritized public sector investment may ensure not only technological progress and efficient use of resources but also contribute to the development of indigenous manufacturing capabilities via building up skills and knowledge.

As Chang (2008, 15) points out, "practically all of today's developed countries, including Britain and the US, the supposed homes of the free market and free trade, have become rich on the basis of policy recipes that go against the orthodoxy of neo-liberal economics." Similarly, Rodrik (2007) states, "nearly each country that could materialize fast growth and industrialization has applied some kind of industrial policy." According to Rodrik, the question to be discussed is not if an industrial policy is required but how it should be.

Akyüz, (2022: 38) suggests that IP is the main driver for the economic development of the countries. A country could have a chance to possess a strong position in a competitive world market since it has a developed industry and a high level of manufacturing ability. Otherwise, countries will likely to face with exploitation by the stronger ones. As Barnes, Kaplinsky, and Morriss (2003: 20) indicate, selective IP can have considerable success even in the countries with weak bureaucratic capacity like South Africa.

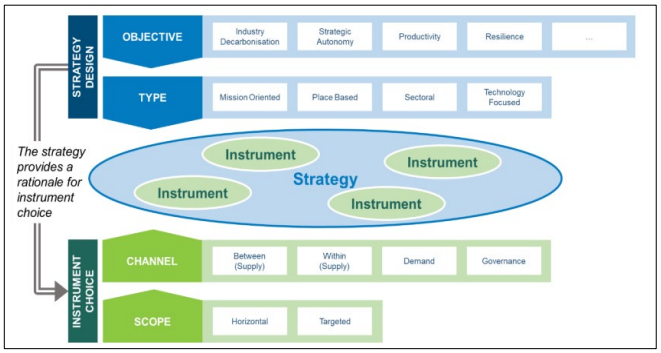
In the period after 1950, IP was discussed in detail in most developed and developing countries. Developing countries saw IP as the key to social development and independence in the post-colonial era. For the other group of countries, including Europe in particular, IP was the way to rebuild their economies' productivity and social structure (Andreoni and Chang, 2019: 136).

After the Second World War, many developing countries adopted "industrial policies" to protect traditional local activities and promote emerging industries to compete with advanced countries. However, by the 1980s, industrial policies had lost their credibility due to their tendency to hinder competition and allow governments to selectively choose winners and losers based on their preferences. This disrepute arose primarily from the perception that IPs increased the influence of vested interests within governments. Despite the emergence of powerful entities such as the European Union, which represented a new perspective on IP, the creation of the European Single Market raised questions about the sectoral and geographical implications, as well as the need for incentives to foster cooperation. These developments prompted a reevaluation of IP (Cohen, 2006: 89).

The growth of Europe after the Second World War can be attributed to the implementation of comprehensive IPs. The objective was to establish advanced production capabilities in key manufacturing sectors such as steel, chemicals, and automobiles, which were representative of the "Fordist" manufacturing model in the 1950s. Additionally, in the 1970s, Europe aimed to achieve dominance in emerging fields such as aerospace, biotechnology, and electronics. IPs played a critical role in providing the essential infrastructure for developed economies, including transportation and telecommunications networks. Furthermore, these policies contributed to ensuring a stable energy supply for economies with limited energy resources. Overall, IPs played a significant role in facilitating the development of Europe's manufacturing base and supporting its economic growth (Pianta, 2014: 277-278).

Over the past three decades, influenced by Western countries and international organizations such as the World Bank, neoliberal policies have been adopted and market-based economic models have gained prominence (Wade, 2012: 224). Sense of mainstream neo-liberal economy is based on market fundamentalism carrying the claim that state should play secondary role in economy.

Figure 5. The Formulation of Industrial Policy



Source: (Criscuolo et al., 2022: 6).

Some OECD countries are drawing attention to the policies pursued by rapidly growing economies, notably China. The need for industrial policies in developing countries generally predates financial and economic crises (Warwick, 2013: 10).

Table 3. Evolution of Theory and Practice of Industrial Policy

Phase	Key ideas	Representative contributors
1940s to late 1960s	- Industrialization is necessary for countries to achieve development. - IPs, including infant industry protection, state coordination, and ownership, are of critical importance for fostering development. - Market failures are particularly pervasive in developing countries and hinder the process of development.	Rosenstein-Rodan (1943) Hirschman (1958) Prebisch (1959) Myrdal (1957)
1970s to 1990s	-Significant barriers to IP are considered. IP encourages rent-seeking and promotes waste. -The era of the Washington Consensus. -Government failure is worse than market failure. Privatization and attracting foreign direct investment, trade liberalization, minimal government intervention, and economic stability are necessary for industrialization and growth.	Baldwin (1969) Krueger (1974;1990) Pack (1993; 2000)
2000s to present day	-Both government and market failures are present. -The "how" question of industrial policy is more important than the "why" question. -While institutional setting matters, the design is quite challenging. -National innovation systems should be promoted in the context of IP. -Flexibility in IP is noteworthy, with a fundamental focus on technological progress and innovation.	Amsden (1989) Dosi (2009) Rodrik (2004; 2007) Chang (2002; 2003; 2009) Lall (2004) Lin (2009) Nelson (1993) Robinson (2009).

Source: (Criscuolo et al., 2022: 6).

Source: (Naudé, 2010: 10).

The development of the I&S industry has always been a priority for the governments of the Republic of Korea, Japan, and China. Because these countries saw East Asia's I&S industry as a productive area and adopted the policy leadership objective from an institutional point of view. (Yang, 2021: 14).

While the average tariff rate remained relatively low in the late 19th and early 20th centuries, Germany provided strong tariff protection for the strategically important I&S industry. While Sweden has generally followed low tariff policies, it has provided very similar protection for the steel and engineering industries. Countries such as Sweden, Germany, and Japan have adopted a policy of non-tariff measures for purposes such as state aid to ventures that seem risky, subsidies for research and development, the establishment of some institutions to stimulate public-private cooperation, and the development of state "model factories" (Chang, 2003: 26).

4.1 Japan

For quite some time, the Japanese government has made the development of the I&S industry a primary goal. Indeed, Japan's leadership and intervention in the I&S sector is extremely consistent and highly productive. The Ministry of Economy, Trade, and Industry is the most authoritative institution for the I&S sector in Japan, with specific competent institutions including the Manufacturing Industry Bureau and the Trade Policy Bureau. The Manufacturing Industry Bureau is responsible for overseeing the particular affairs of the I&S sector. At the same time, the Trade Policy Bureau is a global institution that handles macroeconomic regulation, control, and policy formulation in various sectors, particularly in terms of development environment, restructuring, and enterprise reform. Additionally, the Japan Iron and Steel Federation plays a significant role in the management of the I&S industry in Japan. During the period of industrial restructuring, the government's control over the I&S industry in Japan primarily focused on the following areas:

(1) Regularly providing guidance outputs for the I&S sector, monitoring their implementation, and ensuring compliance. Encouraging businesses to collaborate and coordinate price adjustments as necessary. Coordinating steel exports and regulating the actions of steel companies concerning pricing and quantity.

(2) Intervening and adjusting the production of specific steel grades or controlling the trade of certain steel product grades based on market changes, when deemed necessary.

(3) Adjusting prices of raw materials and energy sources such as scrap and electricity and implementing trade control measures concerning the amount of imported scrap.

(4) Monitoring new investments and developments in the I&S industry and implementing measures, such as the "Interim

Measures to Stabilize Specific Depressed Industries," to address excess capacity in the sector.

(5) Providing financial support to businesses for capacity reduction or transfer and promoting participation in coordination consortia. Introducing preferential measures, particularly regarding the Employment Adjustment Assistance Funds.

(6) Collaborating with intermediary organizations that coordinate the I&S industry and its downstream sectors to develop and implement quality systems for steel products, in line with the plant certification system. Establishing standards and norms for related products.

(7) Encouraging the concentration of production capacity in large companies by compressing surplus assets.

(8) Providing tax incentives along with accelerated depreciation opportunities to companies that prioritize and invest in environmental protection equipment. Encouraging strong financial support from banks for cutting-edge technologies and fundamental research in the I&S industry. Providing government grants for major projects (Li, 2020: 8).

4.2 China

China's crude steel production reached 31.78 million tons in 1978 and increased to 128.5 million tons by the year 2000. This indicates a 4.04-fold increase in production over approximately twenty years. The corresponding compound annual growth rate is approximately 6.56%. Furthermore, in 1996, China surpassed the milestone of 100 million tons of crude steel output, making it the world's largest steel producer. Under the patronage of the government, the construction of Baosteel, China's first modern I&S production base, mobilized the nation's nearly all resources and power (Li, 2020: 7).

Strong domestic demand, primarily driven by the manufacturing, construction, and automotive sectors, has accelerated the growth of the I&S industry. One of the policies implemented by the government in 2002 was a 40% reduction in resource tax for companies engaged in mining and metallurgical processing. This policy aimed to promote integrated activities in the I&S sector, balance the tax burden, and enhance competition (Kabak et al., 2016: 532).

The policies implemented in the 1990s for the I&S industry are quite remarkable. The closure, transformation, and reconstruction of inefficient production units in line with the 8th and 9th Five-Year Plans contributed to the technological optimization of the I&S industry. These policies not only improved efficiency but also enhanced product quality. Additionally, the domestic market share of steel products from various sectors, including automobile panels, petroleum pipes, and heavy rails, has steadily increased (Li, 2020: 8).

5. Conclusion

Economic development requires the transformation of a country's economic structure and selective state intervention is instrumental to achieve structural transformation. Historical experiences make it clear that IP is the main driver for the economic development of the countries. Although industrial policy gained significant attention after World War II, it generally took a backseat between the years 1970 and 1990. In the 21st century, the idea that IP should support innovation has become predominant again.

IP is essential to prioritize the use of a country's limited resources. Industries are linked to one another when one firm buys goods or services from another to produce its own products. What we know is that countries like Sweden, Germany, and Japan systematically applied IP to strategic industries such as I&S. I&S production generates high forward and backward linkages that purchase inputs from many other sectors are able to increase aggregate output by stimulating demand for the relevant sectors. This sector also leads to creation of jobs in hundreds of industries.

Research conducted based on examples from China and Japan demonstrates that IP is the underlying factor behind these countries' prominence in the economically crucial I&S sector. Due to the pursued policies, China currently holds the top position in the I&S sector, while Japan ranks third. This highlights the critical importance of the I&S sector, particularly for developing countries in terms of their development. Furthermore, it indicates that the realization of the I&S industry through IP is feasible.

One limitation of this study is the inability of the authors to extend the historical perspective in terms of data. Specifically, creating a global dataset dating back to the period before 1967 would strengthen the testing of hypotheses.

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