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目　次

特集「北東アジアにおけるSDGs実現のための国際協力の可能性」

■研究報告

特集「北東アジアにおけるSDGs実現のための国際協力の可能性」

Efforts of Russian enterprises to fulfill Sustainable Development Goals

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Abstract

The paper analyzes the policies and efforts of Russian companies to implement Sustainable Development Goals (SDGs) in their operations. In the 2010s big Russian companies included the SDGs in corporate strategic and reporting documents, transferred responsibility in this area to a higher level of management, improved their products and services in accordance with SD requirements, and funded various projects in the field of environmental and social impact of the company.

Russian companies often use term ‘ESG’ (environmental, social and corporate governance) when they describe their approach and strategy to implement sustainable development agenda in their operations. It reflects the major priorities that they have, i.e. care for the environment, responsible attitude towards employees and clients, transparent work of the company and participation in charities. It can be noticed that in the early 2020s the Russian businesses are seeking to pay more attention to the social component of ESG - support for personnel, their training, labor protection, development of regions of presence - rather than environmental and corporate governance.

There are numerous cases illustrating efforts of the Russian companies to fulfill the SDGs. State-owned companies reflect government policies while specific priorities highly depend on the industry of each company. The paper presents examples of good practices of the Russian companies to fulfill SDGs based on the country’s first ‘Voluntary National Review of the progress made in the implementation of the 2030 Agenda for Sustainable Development’.

Keywords: SDGs, Russian companies, ESG, sustainable development, corporate responsibility.
JEL classification codes: D220, D250, L100.

The comprehensive nature of the Sustainable Development Goals (SDGs) set out in the 2030 Agenda requires close collaboration between the governments and businesses in all countries. Private and state-owned enterprises are important in contributing to the implementation of the SDGs and raising awareness of the 2030 Agenda among society at large. Tools employed by the businesses may vary from the inclusion of specific SDG indicators in the strategic agenda of companies, the allocation of regular funding for their achievement and increasing the social responsibility of business to solving specific problems through the implementation of local projects.

Massive introduction of sustainable development ideas into the development strategies of large Russian businesses began in 2004-2007. The first companies that included the SDGs into their strategies were large exporters - oil and gas companies, petrochemical enterprises and energy companies. At the first stage, the driver for creating SD reports was the fact of working with foreign markets and presence on foreign exchanges. The first SD reports were a logical continuation of the social responsibility and environmental reports that had been published by major companies since the early 2000s. Factors of SD importance for the Russian companies were both commercial (increased competitiveness in the domestic and global markets: brand trust, consumer loyalty and investment attractiveness etc.) and non-commercial (implementation of the government’s guidelines, contribution to improving the well-being of the society etc.).

According to the opinion poll of Russian companies on SDGs implementation conducted in 2018 by Global Compact Network Russia, Russian business had made significant progress in understanding their involvement in sustainable development processes (Global Compact Network Russia, 2018). The progress was emphasized in three major spheres: thematic (articulating priorities and motivation in the implementation of the SDGs, managing expectations, etc.), structural (transformation of management systems responsible for sustainable development, transferring responsibility in this area to higher level of management, etc.), financial and investment-related (awareness that involvement in the global agenda is not only a cost reduction factor due to the occurrence of risks, but also a factor of investment attractiveness, financial preferences etc.). At that time Russian companies were more focused on 'economic' SDGs (such as promoting sustainable economic growth, creating infrastructure, ensuring industrialization, introducing innovations, rational consumption and production models, sustainability of cities and communities, access to affordable clean energy sources, etc.) than socio-economic ones. Thus, among the most effective measures of business participation in the achievement of SDGs the companies specified introduction of advanced innovative and technological solutions at all levels of the company's activity, inclusion of SDGs in corporate strategic and reporting documents, improvement of products/ services in accordance with SDG requirements, funding of projects in the field of environmental and social impact of the company, development of cooperation with government authorities and other interested parties.

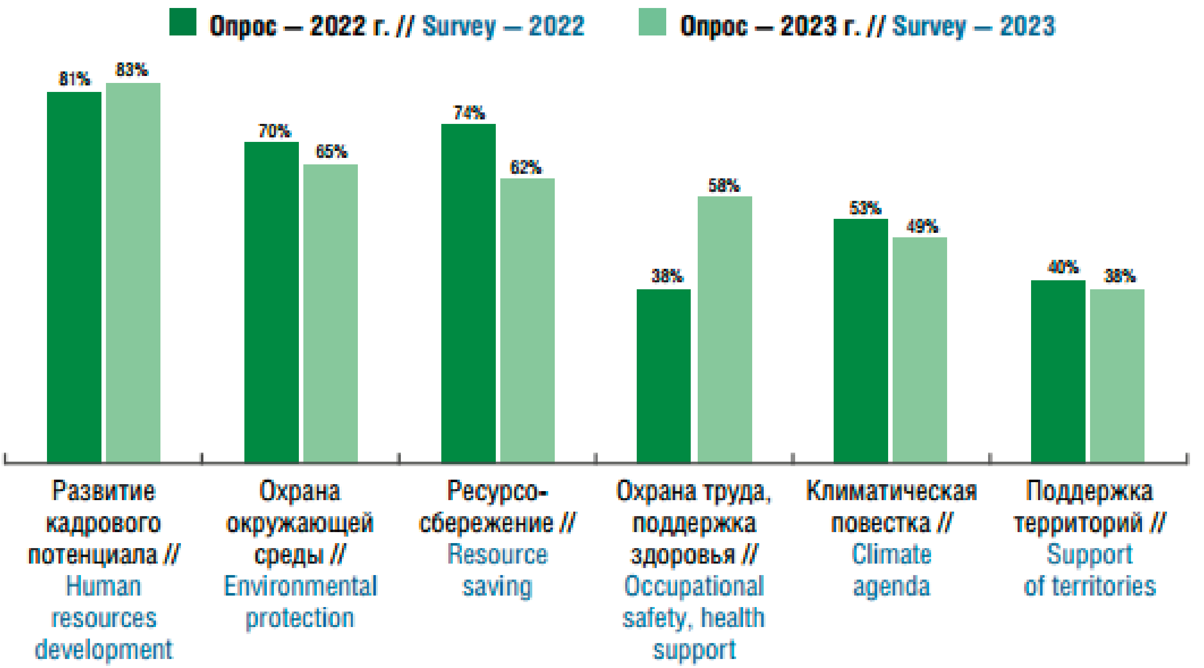
In general, companies in Russia place primary responsibility for achieving the SDGs on federal authorities. According to opinion polls, most of them consider the role of federal authorities in achieving the SDGs to be more significant than the role of business and business associations. Therefore, the government had to take the lead in mobilizing the society by improving the legislature, providing preferences and creating stimulus for businesses to implement the SDGs. The Ministry of Economic Development of the Russian Federation is responsible for the dialog on the SDGs between the government and businesses. In December 2020 the Ministry established an Expert Council for Sustainable Development. Its major task is to promote professional and expert discussions on methods and tools for achieving the UN SDGs. Currently, the Expert Council includes 89 organizations from the banking sector and retail trade, public catering, construction, chemical, food, tobacco and forestry industries, metallurgy, energy and transport, from the sphere of technology and telecommunications. Council members regularly exchange experiences and effective practices in implementing projects to achieve SDGs and promote responsible business standards among companies. They discuss key risks and opportunities for business associated with the global trend towards sustainable development (Ministry of Economic Development of Russian Federation, n.d.).

In the context of the ongoing structural transformation of the Russian economy, attention is growing to the importance of the sustainable development agenda at both the state and corporate levels, and the introduction of financial and non-financial sustainable development principles into the activities of companies. Russian companies often use term 'ESG' (environmental, social and corporate governance) when they describe their approach and strategy to implement sustainable development agenda in their operations. It reflects the major priorities that they have, i.e. care for the environment, responsible attitude towards employees and clients, transparent work of the company and participation in charities. A company's commitment to ESG principles gives it certain advantages, such as government subsidies, special lending conditions, customer loyalty, attractiveness for employees, and the opportunity to pay less taxes. Compliance with the criteria is monitored through company reports and ESG ratings from independent agencies (Sberbank, 2024).

According to the recent opinion polls, Russian business believes that the relevance of sustainable development programs remains despite volatile geopolitical and macroeconomic conditions. The key changes that can be noticed in the approach of the Russian companies include a shift in focus to national priorities, abandonment of some ESG goals, and changes in the timeframes for achieving strategic goals. Experts also note that businesses are seeking to pay more attention to the social component of ESG - support for personnel, their training, labor protection, development of regions of presence - rather than environmental and corporate governance (see Figure 1 below). Of the environmental aspects, only the importance of greenhouse gas emissions audits increased in 2023 (B1 Group, 2024). Experts attribute the emphasis on the social component of SD to a significant shortage of personnel in almost all sectors of the Russian economy. According to opinion polls, 84% of employers in the mechanical engineering sector, 69% of IT companies, 66% of construction organizations, and 64% of employers in the financial sector intended to expand their staff and hire personnel in 2024. At the same time, unemployment in Russia is only 2.9% (Vedomosti, 2024). Therefore, the companies have to compete for the high-skilled workforce by improving social welfare packages.

Sustainable development goals are generally included in a company's business strategy or overall development strategy. For example, in December 2021, Rosneft included not only production and financial targets, but also a set of quantitative and qualitative ESG goals in its development strategy until 2030. Rosneft became the first Russian oil and gas company to announce its intention to achieve carbon neutrality by 2050 in its strategy. Some companies have formulated ESG goals in a separate document. For example, PhosAgro, a big producer of

Figure 1 - Priorities of the ESG agenda of Russian companies in 2022–2023



Source: (Russian Union of Industrialists and Entrepreneurs, 2023, p.7).

fertilizers, separately adopted climate and water strategies in 2020.

There are numerous cases illustrating efforts of the Russian companies to fulfill SDGs. State-owned companies reflect government policies while specific priorities highly depend on the industry of each company. Based on the information reported by the companies to the Russian Union of Industrialists and Entrepreneurs in 2021-2022, it can be concluded that more than 50% of companies mark 11 goals of UN-2030 SDGs as priority, which are also correlated with Russia's national development goals. They include SDG 3 "Good health and well-being", SDG 4 "Quality education", SDG 6 "Clean water and sanitation", SDG 7 "Affordable and clean energy", SDG 8 "Decent work and Economic growth", SDG 9 "Industrialization, innovation and infrastructure", SDG 11 "Sustainable cities and Human settlements", SDG 12 "Responsible consumption and production", SDG 13 "Combating climate change", SDG 15 "Preserving the terrestrial ecosystem", SDG 17 "Partnership for Sustainable Development" (Russian Union of Industrialists and Entrepreneurs, 2023).

Usually enterprises choose several goals as focus areas and concentrate their efforts on implementing projects that contribute to the achievement of these SDGs. The examples of such good practices are presented in Table 1.

To sum up, it can be concluded that Russian companies have been making considerable efforts to fulfill SDGs at their corporate level. Enterprises that are big, state-owned or affiliated with foreign markets have been more active in this process. The Russian government and business associations have been working on the institutional framework, expert discussions and best practices sharing to stimulate businesses to play leading role in the country's sustainable development. Without reducing the harmful impact on nature, improving the quality of corporate governance, investing in social programs within the company and in the territories of presence, businesses risk facing significant challenges in the future. Therefore, more and more Russian companies decide to include the ESG agenda as a platform for implementing sustainable development goals in their risk management policies and their development plans.

Table 1 - Good practices of the Russian companies' contribution into the SDGs implementation

SDG	Company name(s) (specialization)	Description of a good practice/project to implement the SDG
SDG-2 (zero hunger)	PhosAgro (production of fertilizers)	actions to promote sustainable agriculture (in December 2018, PhosAgro became the first Russian company to sign an agreement with FAO for the implementation of the project for promotion of new technologies and knowledge in the area of sustainable land management and agriculture)

SDG-6 (clean water and sanitation)	United Chemical Company Uralchem (production of fertilizers)	investment in the development of sustainable water use (water purification system based on membrane technology was installed at their fertilizer plant)
SDG-7 (energy)	En+Group (energy)	implementing the "New Energy" programme: modernization of Siberian hydro electric power stations to reduce greenhouse gas emissions by coal fired power plants
SDG-8 (decent work and economic growth)	Lukoil (energy)	financing of the International Labor Organization's project which aims to raise the efficiency of youth employment policy and programmes in Azerbaijan, Kazakhstan, Russia, and Uzbekistan.
SDG-9 (Industrialization, innovation and infrastructure)	Severstal PJSC (metallurgy)	initiatives that contribute to the development of Cherepovets, which has the status of a single-industry city (ex., support SMEs in the region)
	MTS PJSC, Vimpel-Communications PJSC, MegaFon PJSC, Rostelecom PJSC (telecom)	projects aimed at reduction of the digital gap, provision of digital services to hard-to-reach areas via construction of new fiber optic networks and the development of satellite communication channels
SDG-10 (reduce inequality)	Vnesheconombank (finance)	projects to provide comprehensive support to elderly people living in nursing homes
SDG-11 (sustainable cities)	Rosatom (nuclear energy)	"Lean Smart City" project (technology solutions for more efficient urban management) implementation in the city of Sarov ranks among the best practices of sustainable development according to the UN Human Settlements Programme
	Moscow Refinery Plant of Gazprom Neft (energy)	contribution of private sector to reduction of the negative environmental impact of cities (The Moscow Refinery Plant of Gazprom Neft reduced river water consumption by 3 times by introducing innovative biological treatment facilities)
	Metalloinvest (metallurgy)	implements programmes for development of local economic mainstays in single-industry cities where it has branches
SDG-12 (responsible consumption and production)	Magnit, X5 Retail Group (retail)	chain stores implement initiatives to encourage consumers to consume responsibly. They install reverse vending machines (automatic machines for collecting plastic containers and aluminum cans for their further shipment for recycling)
	Severstal PJSC (metallurgy)	implements a programme to increase the share of secondary energy use. As of 2019, the Cherepovets Steel Mill, the company's largest plant, met its electricity demand by 27.9 % via secondary fuel. By 2025, the company plans to increase the share of secondary gases in electricity generation to 33.9 %.
	Segezha Timber Holding (timber)	In 2018, Segezha Timber Holding put into operation a modern multi-fuel boiler which allows using wood waste and sewage sludge as fuel, thus significantly reducing emissions into the atmosphere and localizing the impact on the environment.
SDG-13 (combating climate change)	SIBUR Holding (energy)	provides oil producing companies with an environmentally and economically efficient solution for utilization of associated petroleum gas (APG), i.e. its processing at gas processing plants.
SDG-14	Sakhalin Energy Investment Company Ltd. (energy)	implements a programme to protect the population of marine mammals, primarily gray whales, in the area of its operations (shift of the route of marine pipelines, prevention of water pollution, establishment of navigation corridors, limiting the speed of ships and the height of helicopter flights, determination and control of safe distances between ships and marine mammals)
	Rosneft Oil Company PJSC (energy)	has been carrying out comprehensive research expeditions at the licensed plots of the company in the Arctic. The research is carried out in 5 seas of the Arctic, with special attention paid to the study of ice conditions. Environmental atlases are prepared based on the results of studies conducted by the company.

SDG 15 (terrestrial ecosystems)	RusHydro Group (energy)	implements measures aimed at protection of ecosystems and natural habitats of animals, preservation of rare and endangered species of animals and birds, as well as works to care for the environment among citizens. Besides, the company conducts scientific research and supports the material and technical base of specially protected natural areas.
	En+ Group (energy)	implements a long-term comprehensive programme for the preservation of the unique natural complex of Lake Baikal, which includes environmental monitoring, aimed at identifying and further studying threats to the lake's ecosystem, including its biodiversity. Local citizens are actively involved in these activities. They are engaged in garbage collection, improvement and promotion of ecotourism infrastructure in the coastal zone of Lake Baikal, as well as educational activities that propagate care for the environment and biodiversity conservation.
SDG 15 (peace and justice)	Sakhalin Energy Investment Company Ltd. (energy)	Since its establishment Sakhalin Energy Investment Company Ltd. has been cooperating with the low-numbered indigenous peoples of the North of the Sakhalin region.

Source: compiled by the author based on (Analytical Center for the Government of the Russian Federation, 2020).

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持続可能な開発目標を達成するためのロシア企業の取り組み（要旨）

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本稿では、持続可能な開発目標（SDGs）を事業活動に導入するロシア企業の政策と取り組みを分析した。2010年代には、ロシアの大企業は、SDGsを企業戦略や報告書類に盛り込み、この分野の責任を経営陣のより高いレベルに移行し、SDGsの要件に従って製品やサービスを改善し、環境や社会への自社のインパクトの観点からさまざまプロジェクトに資金提供を行っている。

ロシア企業は、持続可能な開発アジェンダを業務に導入するためのアプローチや戦略を説明する際に、「ESG」（環境、社会、企業統治）という用語をよく使用する。これは、環境への配慮、従業員や顧客に対する責任ある姿勢、企業の透明性のある業務、慈善活動への参加など、彼らが重視する主要な優先事項を反映している。2020年代初頭には、ロシア企業はESGの社会的側面、すなわち、従業員への支援、従業員の研修、労働保護、事業展開地域の開発に、より重点的に取り組もうとしていることが分かる。

ロシア企業がSDGs達成に向けた取り組みを行っていることを示す事例は数多くある。国営企業は政府の方針を反映しているが、各企業の優先事項は業界によって大きく異なる。本稿では、ロシア初の「持続可能な開発のための2030アジェンダ実施状況に関する自発的国別レビュー」に基づき、SDGs達成に向けたロシア企業の優れた取り組み事例を紹介する。

The Role of Companies for Fostering the Implementation of SDGs in Northeast Asia

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Abstract

This paper explores how to create a space for companies to actively participate in order to revitalize cooperation for the implementation of the SDGs in Northeast Asia.

Recent trends in SDGs implementation are grim. *The Sustainable Development Goals Report 2024*, published in June 2024, warns that the SDGs will be difficult to achieve without massive investment and scaled-up action. In addition, a look at the national implementation performance of countries in Northeast Asia suggests the need for a coordinated response at the regional level, focusing on SDG 13(climate action), SDG 14(marine ecosystems), and SDG 15(terrestrial ecosystems).

This report emphasizes the need for cooperation among companies in Northeast Asia to respond to especially climate change, and suggests four ways to promote this. First, it is necessary to conduct a joint study by a group of experts as a preparatory work to promote corporate solidarity and cooperation for climate response at the Northeast Asian regional level. Second, it is necessary to establish partnerships for cooperation among Northeast Asian companies. Third, it is necessary to seek appropriate policy support from the governments of those area. Fourth, it is necessary to confirm the possibility and confidence that collaborative efforts can pay off by succeeding in relatively small-scale pilot projects.

Keywords: SDGs, International business, International Policy Coordination and Transmission, International Institutional Arrangements, Environment
JEL Classification codes: F550 O320 O330 O380 O530

1. Introduction

The research work to explore cooperation ways on the SDGs in Northeast Asia and the role of business in such cooperation is meaningful in the following three aspects.

First, efficient cooperation at the regional level is crucial for more effective implementation of the SDGs, which are being promoted by all countries as an important national task.[1] However, when relations between neighboring countries are uncomfortable, cooperation among countries in the implementation of the SDGs becomes difficult. Therefore, efforts to revitalize regional cooperation to promote the implementation of the SDGs in Northeast Asia, which is the center of the so-called neo-Cold War system, are expected to contribute to mitigating conflicts and confrontations and creating an atmosphere of peace and mutual cooperation.

Second, the implementation of SDGs presupposes that all countries around the world participate to solve global challenges, and this requires the participation of various stakeholders. In particular, since the implementation of SDGs reflects the trend of the times, companies that must meet the needs and interests of consumers need to make active efforts to include SDGs implementation issues in their management strategies. It is also worth noting that the implementation of the SDGs can also affect the investment flow of international capital because it requires companies to develop new technologies and creates new markets in the global economy.

Third, because the planning and implementation of the SDGs is strictly nationalized, there are large differences in problem perceptions and approaches among countries, even for the same goals. Therefore, despite the great need for cooperation among regional countries, it is difficult to materialize cooperation. This

[1] North Korea (Democratic People's Republic of Korea), which shows the most closed trend among countries in Northeast Asia, is also actively participating in the implementation of SDGs led by the UN, and in 2021, it released a voluntary national review report (VNR), which is an interim report.

is especially true when the work is done at the national level. Therefore, the most feasible way forward in the current situation is to first explore the possibility of cooperation for SDGs implementation in the region at the researcher and expert level, and then gradually involve government agencies after securing the possibility of corporate participation.

In this paper, as one of the strategic approaches to revitalizing cooperation for the implementation of SDGs in Northeast Asia, we seek to secure a space where companies can actively participate.

In order to do so, it is necessary to first evaluate companies' understanding and perception of SDGs and whether they are reflected in management strategies, and this paper will focus on Korean companies. Also, we will summarize the reasons and background of why the UN's SDGs require the active participation of companies.

Finally, in order to find out how to foster cooperation among companies in Northeast Asia, we will identify the seriousness of the climate change problem and the current status of companies' responses, and explore specific ways to cooperate. Since climate change is now recognized as one of the most important issues in the world, it is relatively easy to attract the cooperation of companies in Northeast Asia to implement the SDGs.

2. Korean companies' understanding of SDGs and establishing reflected management strategies

Shortly before the COVID-19 outbreak, a survey of Korea's top 100 companies on the status of SDGs implementation was published,[2] showing an overview of how and to what extent major Korean companies understand and incorporate the SDGs into their operations.

This survey was conducted on the top 100 KOSPI companies,[3] and the survey respondents were found to belong to the team (department) of "social contribution" (40%), "strategic planning" (29%), "promotion" (11%), and "shared growth" (11%), reflecting that SDGs-related matters are handled by various teams (departments) that differ from company to company.

In addition, the surveyed companies belong to the following industries (multiple responses were allowed): 'manufacturing' (36.8%), 'finance, insurance, and real estate' (15.8%), 'construction and infrastructure' (7.9%), 'ICT' (7.9%), 'gas, oil, and mining' (5.3%), 'healthcare, pharmaceuticals, and cosmetics' (5.3%), 'transportation and logistics' (5.2%), 'chemicals' (5.2%), 'distribution' (2.6%), 'trade' (2,6%), and others (5.3%). In other words, 'manufacturing' and 'finance, insurance, and real estate' together account for the majority of respondents.

Q1. Basic understanding of the SDGs

To the question, “Do you believe that businesses are key players in achieving the SDGs?”, the responses are 'agree' (65.8%), 'strongly agree' (23.7%), and 'neutral'(7.9%). This shows that the vast majority of respondents (90%) recognize that businesses have a key role to play in the implementation of the SDGs.

When asked, “Do you believe that implementing the SDGs is essential to your business?”, 55.3% of respondents said 'Agree', 26.3% said 'Strongly Agree', and 15.8% said 'Neutral'. This suggests that most companies (82%) perceive SDGs implementation as an essential element of their business.

When asked, “Do you believe that implementing the SDGs has a positive impact on non-financial as well as financial factors?”, 60.5% of respondents answered 'yes', 'very much so' (23.7%), and 'moderately so' (15.8%). The vast majority (84%) of responding companies recognize that implementing the SDGs not only improves their image, but also helps increase profits.

When asked, “How do you think implementing the SDGs will benefit your company?”, respondents answered: “Strengthening corporate sustainability” (89.5%), “Preventing environmental and social risks” (71.1%), “Creating a common communication vehicle for corporate sustainability” (65.8%), “Identifying

Table 1 - Basic understanding of the SDGs by companies

Questions	strongly Agree	Agree	Neutral
Do you think businesses are key actors in achieving the SDGs?	23.7	65.8	7.9
Do you think the implementation of the SDGs is essential for business management?	26.3	55.3	15.8
Do you believe that implementing the SDGs has a positive impact on non-financial as well as financial factors?	23.7	60.5	15.8

2 Global Compact Network Korea,「A Survey Analysis of SDGs Implementation Status of Top 100 KOSPI Companies」, October 29, 2019. http://unglobalcompact.kr/ (Date of Search: 24.9.10)

3 The KOSPI (Korea Composite Stock Price Index) is an index that compares the base and comparison of the market capitalization, which is the sum of the shares of companies listed on the Korea Exchange's stock market.

future business opportunities" (50%), and "Strengthening alignment with national policies" (21.1%). This shows that most respondents believe that implementing the SDGs will help them become more sustainable.

When asked, "What are the challenges you face in implementing SDGs-related work?", respondents answered, "Low public awareness" (55.3%), "Lack of cooperation within the company" (52.6%), "Lack of resources such as budget and manpower" (50%), "Lack of evaluation methodology" (47.4%), "Lack of laws, systems, and policies" (39.5%), and "Lack of interest and will from top management" (31.6%). This shows that lack of awareness of the SDGs from the general public and other departments within the company is the biggest challenge. In addition, a lack of policy support from the government and a lack of commitment from top management[4] are also cited as barriers to SDGs implementation in companies.

Q2: Setting goals and prioritizing SDG implementation

☐ Setting Goals for SDGs implementation

Setting specific and measurable SDGs targets at the corporate level is likely to have a positive impact on performance of the organization. The following questions reveal some of the characteristics of this approach.

When asked, "Are you managing SDGs targets as key performance indicators (KPIs)?", only 44.7% of respondents said 'yes', indicating that companies are tepid about setting clear and specific targets for SDGs implementation. In addition, only 39.5% of respondents said that they have set timeframes for achieving KPIs, suggesting that corporate-level management and oversight of goal achievement is not adequate.

In response to the question, "How often do you evaluate the progress of the SDGs?", the majority of respondents answered "not at all" (31.6%) or "once a year" (44.7%), while "quarterly" (2.6%) and "semi-annually" (5.3%) were less than 10%.

☐ Prioritizing SDGs implementation

If companies take a strategic approach for SDGs implementation, they will prioritize among the SDGs. To do this, companies can consider the impact of their decisions in the value chain (supply chain).

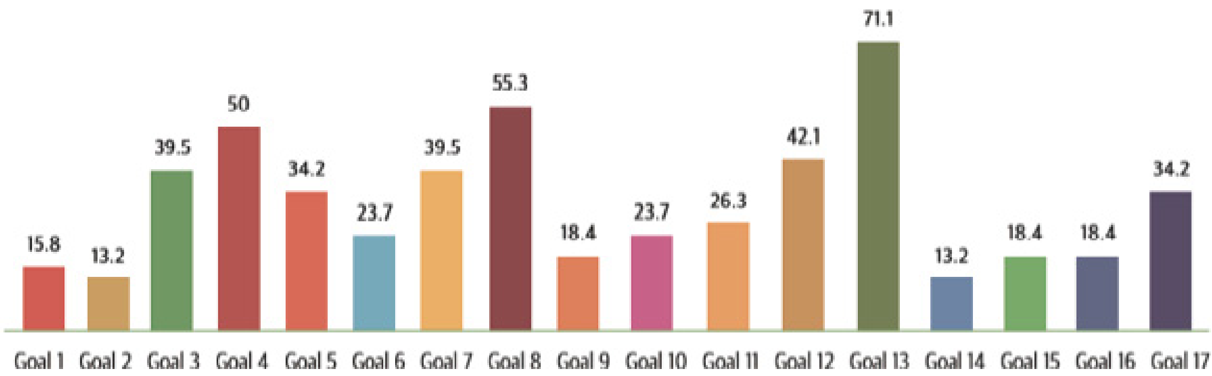
When asked, "Are you evaluating and prioritizing the impacts on the value chain (e.g., procurement, production, operations, distribution, and disposal) to implement the SDGs?", slightly more than half (55%) answers positively: saying 'yes' (31.6%) and 'very much so' (23.7%), while 'disagree' (23.7%) and 'strongly disagree' (2.6%). This suggests that companies are seriously looking at the social and environmental impact of their actions to implement SDGs.

When asked, "What are your current priorities as you look to implement the SDGs?", 'SDG 13' (climate change) is the top priority at 71.1%, followed by 'SDG 8' (sustainable growth and decent work) at 55.3%, 'SDG 4' (quality education) at 50%, and 'SDG 12' (sustainable consumption and production) at 42.1%. The fact that 'Climate change' accounts for the largest portion seems to reflect that companies also recognize that the issue of climate change will have a significant impact on corporate sustainability.

Q3: Building partnerships for SDGs implementation and integrating them into business strategies

For the implementation of the SDGs by companies to be effective and efficient, the goals of the SDGs and how they will be implemented should be appropriately reflected in their business strategies.

<Figure 1> Priorities selected by companies in implementing the SDGs (multiple responses allowed) (%)



4 When asked separately about top management's awareness of the SDGs, the responses were "very much so" (27%), "yes" (43.3%), "fairly so" (24.3), and "not so much" (5.4%), indicating a fairly high proportion of positive responses (70%). So, excluding 27% of the respondents who answered 'very much so', it is considered more reasonable to interpret this results as not very active.

When asked, "Are the SDGs goals reflected in your organization's vision and business strategy?", only 44.7% of respondents said 'yes', while 55.3% said 'no'.

When asked, "Are the SDGs embedded in the various functions of your organization?" only 18% of respondents answered "yes" (13.1%) and "very much so" (5.3%).

In addition, when asked "What needs to be improved in order to internalize the SDGs?" (multiple responses were allowed), the most responses were: "Raising awareness within the organization" (89.5%), "Securing human and budgetary resources" (73.7%), "Implementing SDG-related projects" (60.5%), "Incorporating the SDGs into the corporate vision and strategy" (36.8%), "Strengthening partnerships with external organizations" (36.8%), and "Linking to key performance indicators (KPIs)" (15.8%). To internalize the implementation of SDGs in the company's work, it seems necessary to strengthen the human and material foundation by improving the awareness of internal employees and securing related resources.

Interestingly, while awareness of the need for partnerships with external organizations to implement SDGs is relatively low, 97% of respondents appear to participate in at least one partnership to achieve this. When asked, "What types of partnerships are you engaged in to achieve the SDGs?" (multiple responses were allowed), the top three responses were "issue-specific initiatives" (57.9%), "industry-specific initiatives" (47.4%), and "multilateral partnerships" (39.5%).

When asked who their most influential stakeholders are in the implementation of the SDGs, the top three responses were "shareholders/investors," "national/local governments," and "customers/partners. It seems that they are relatively sensitive to the influence of shareholders (investors) and governments.

3. Corporate roles and business opportunities in implementing the SDGs

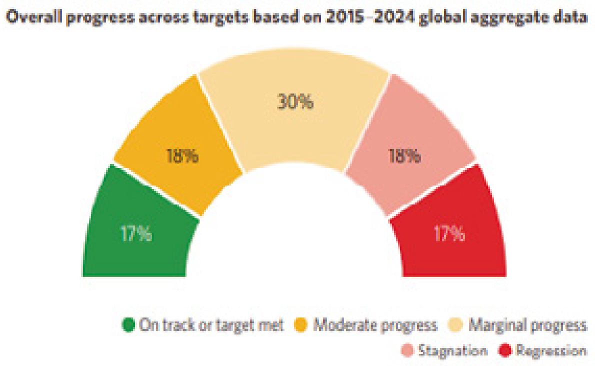
A. Recent slack in SDGs performance

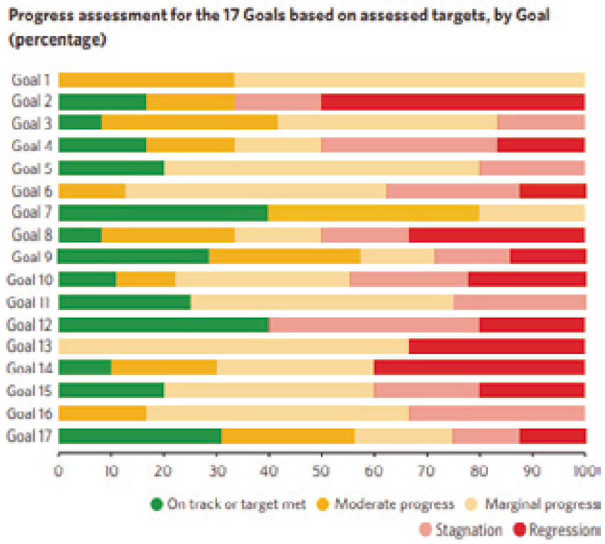
Recent performances in SDGs implementation are grim. *The Sustainable Development Goals Report 2024*, released on June 28, 2024, warns that the SDGs will be difficult to achieve without significant investment and scaled-up action. According to the report, only 17% of the SDGs are currently on track, nearly half are making minimal or moderate progress, and more than one-third are stagnating or regressing. Specifically, SDGs 1 (No Poverty), 6 (Clean Water and Sanitation), 13 (Climate Action), and 16 (Peace, Justice and Strong Institutions) are underperforming.[5]

B. 2024 performances of SDGs in Northeast Asian countries

According to the *Sustainable Development Report 2024: The SDGs and the UN Summit of the Future*, which presents detailed country-by-country progress,[6] at the global level, progress on the SDGs has been assessed as stagnant since 2020. Based on the progress made on the SDGs since 2015, there is concern that none of the 17 SDGs will be achieved by 2030. In addition,

<Figure 2> Progress Assessment for the 17 Goals (by 2024)





Source: UN, *The Sustainable Development Goals Report 2024*, p. 4.

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[5] Of these, SDG 13 (Climate Action) appears to be the most underperforming.

[6] Jeffrey D. Sachs, Guillaume Lafortune and Grayson Fuller, *Sustainable Development Report 2024: The SDGs and the UN Summit of the Future, Sustainable Development Solutions Network*, (Dublin University Press: Dublin, Ireland), 2024.

<Figure 3> 2024 SDG dashboards for Northeast Asia (levels and trends)

Source: Jeffrey D. Sachs, Guillaume Lafortune and Grayson Fuller, *Sustainable Development Report 2024*, pp. 24-26.

disparities in SDGs performance between countries remain large, with SDG 2 (Zero Hunger), SDG 11 (Sustainable Cities and Communities), SDG 14 (Marine Ecosystems), SDG 15 (Terrestrial Ecosystems), and SDG 16 (Peace, Justice and Strong Institutions) in particular showing no or very limited progress since 2015.[7]

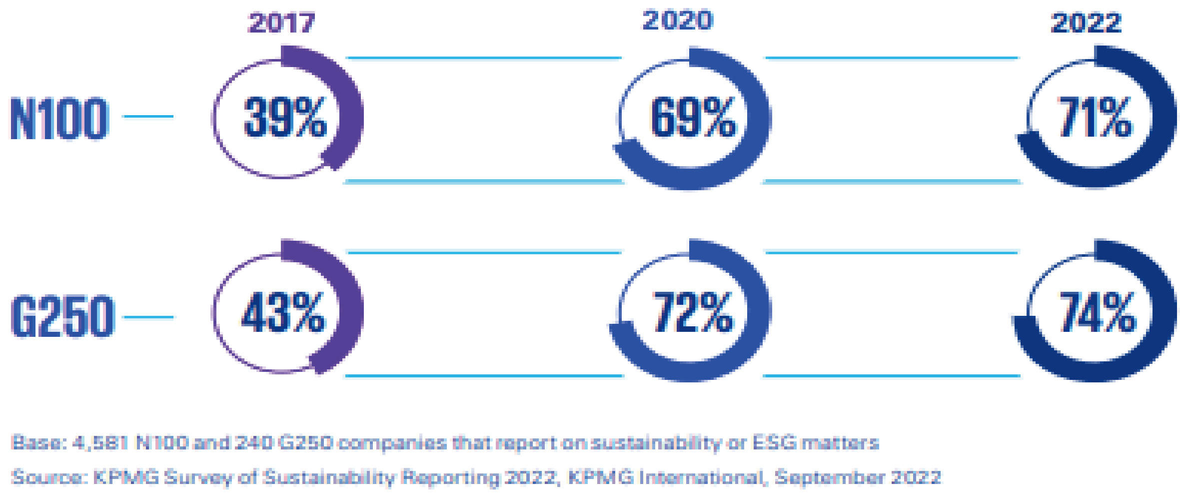
Looking at country-level performance, Northeast Asian countries are underperforming on SDG 2 (Zero Hunger), SDG 13 (Climate Action), SDG 14 (Marine Ecosystems), and SDG 15 (Terrestrial Ecosystems) by 2024. Of these, SDG 13, SDG 14, and SDG 15 have the highest need for collective action in Northeast Asia (Figure 3).

C. How companies can actively engage to improve SDGs performance

Since the SDGs were adopted by the United Nations in 2015, there have been ongoing efforts at both the national and private levels to implement them, but why has overall progress been slow and the gap between countries widened in recent years?

Recent surveys show that most major corporations recognize their responsibility to the SDGs implementations. A survey of the world's 250 largest companies (G250) found that 96% of them publish sustainability reports, and the number of the world's 250 largest companies (G250) that report on their progress for SDGs has slowed slightly at 74% in 2022 after a sharp increase from 43% in 2017 to 72% in 2020.8

<Figure 4> Global SDG reporting rates (2017-2022)



Source: KPMG International, *Big shifts, small steps : Survey of Sustainability Reporting 2022*, Oct. 2022. p. 57.

[7] Ibid., p. 15.

[8] KPMG International, *Big shifts, small steps: Survey of Sustainability Reporting 2022*, Oct. 2022. p. 57.

Furthermore, among the 4,581 nationally largest (N100) companies in 58 countries, the portion of companies that have published SDGs reports has increased from 39% in 2017 to 69% in 2020 and 71% in 2022.

Why is it that despite this growing corporate engagement, overall SDGs performance is still lagging? Of course, it can be argued that corporate engagement alone is not enough to dramatically improve the performance of SDGs, but it is possible to raise the question of whether the high percentage of companies actively engaging with the SDGs is different with the ground real situation. In this regard, it is worth noting that companies tend to actively promote positive impacts while ignoring or denying negative impacts.

For a study that analyzes how companies' integrated reporting (IR) reflects their performance on the SDGs,[9] it notes that companies are increasingly incorporating the SDGs into their performance reporting and using them as a tool to enhance their reputation and create a favorable business environment.

In this regard, some groups of experts have raised questions about whether the activities of companies participating in SDGs have substantially and effectively contributed to the implementation of SDGs. Various studies have been conducted to address these concerns.[10] There is also a research suggesting that 'SDG washing' cases exist among major corporations. However, some researchers argue that ‘SDG washing’ has different characteristics from ‘green washing’[11]: rather than intentional deception, managers are more likely to face challenges in implementing their corporate strategies for the SDGs, leading to underperformance. These studies suggest that companies need to work with other sectors of society (e.g., public, private, and civil society) to limit negative impacts and optimize positive impacts, particularly by encouraging collective action and partnerships.[12]

4. How companies in Northeast Asia are working together on the SDGs: focusing on climate action

A. Reports on the severity of climate change

According to the AR6 Synthesis Report: Climate Change 2023, which published by the IPCC in 2023[13], recent climate change is evaluated as very fast and threatening. As a result, there have been widespread and rapid changes in the atmosphere, cryosphere and biosphere, and human-induced climate change is causing climate extremes around the world, with widespread adverse impacts on nature and people, and associated losses and damages.[14]

The IPCC report (2023) proposes several policy options. Among these, the most relevant messages for us are: first, under the governance and policy aspect, it states that clear policy objectives, cross-sectoral policy coordination and inclusive governance promote effective climate action, and that regulatory and economic instruments can have a significant impact if applied broadly.[15] Second, with respect to finance, technology, and international cooperation, which are key enablers for climate action, the report recommends expanding the financing needed to achieve climate goals, revitalizing the technology innovation system, and strengthening international cooperation through various channels.[16]

B. Perceptions of companies on climate action

In 2019, Deloitte surveyed 1,168 European chief financial officers (CFOs) about their organizations' responses to climate change. The results showed that corporate actions are inconsistent, primarily focused on short-term cost savings, with the following implications:[17] First, there is increasing pressure to act from a wide range of stakeholders. Second, corporate climate action is largely focused on short-term cost savings. Third, few

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[9] see Manes-Rossi, F., Nicolo`, G., Tiron Tudor, A. and Zanellato, G. (2021), “Drivers of integrated reporting by state-owned enterprises in Europe: a longitudinal analysis”, *Meditari Accountancy Research*, vol. 29(3), pp. 586-616.

[10] Manes-Rossi, F. and Nicolo`, G. (2021), “Exploring sustainable development goals reporting practices: From symbolic to substantive approaches—Evidence from the energy sector”, *Corporate Social Responsibility and Environmental Management*, John Wiley & Sons, vol. 29(5), pp. 1799-1815.; Jan Anton van Zanten and Rob van Tulder. (2021), "Improving companies' impacts on sustainable development: A nexus approach to the SDGS," *Business Strategy and the Environment*, Wiley Blackwell, vol. 30(8), pp. 3703-3720.; Iñaki Heras-Saizarbitoria, Laida Urbieta and Olivier Boiral. (2022), "Organizations' engagement with sustainable development goals: From cherry-picking to SDG-washing?," *Corporate Social Responsibility and Environmental Management*, John Wiley & Sons, vol. 29(2), pp. 316-328.; Rob Van Tulder & Suzana B. Rodrigues & Hafiz Mirza & Kathleen Sexsmith. (2021), "The UN's Sustainable Development Goals: Can multinational enterprises lead the Decade of Action?," *Journal of International Business Policy*, Palgrave Macmillan, vol. 4(1), pp. 1-21.

[11] Which often is interpreted as normatively flawed motivations for real action.

[12] Jan Anton van Zanten and Rob van Tulder. (2021), "Improving companies' impacts on sustainable development: A nexus approach to the SDGS," *Business Strategy and the Environment*, Wiley Blackwell, vol. 30(8), p. 3704.

[13] https://www.ipcc.ch/report/ar6/syr/

[14] With respect to climate change impacts and climate-related risks, we analyze that climate-related risks under projected future warming levels are higher than those assessed in last year's report, and that long-term impacts are likely to be up to several times stronger than currently observed

[15] IPCC, *CLIMATE CHANGE 2023*; Synthesis Report, 2023, p. 32.

[16] Ibid., p. 33

[17] Michela Coppola et al., “Climate change and corporate response: Stakeholder pressures driving companies to act”, *Deloitte Insights: Climate & Sustainability Special Issue*, Deloitte (Seoul), 2020, pp. 38-48. (https://www2.deloitte.com/content/dam/Deloitte/kr/Documents/insights/deloitte-korea-review/SP/kr_insights_ESG-04.pdf)

<Figure 5> Key Findings from *Deloitte 2024 CxO Sustainability Report*

Source: Deloitte, *Deloitte 2024 CxO Sustainability Report : Signs of a shift in business climate action*, September 2024.(https://www.deloitte.com/mt/en/issues/climate/cxo-sustainability-report.html)

companies fully understand their climate risks; and fourth, few have established governance and coordination mechanisms to develop and implement comprehensive climate strategies.

Deloitte recently surveyed 2,100 C-suite executives in 27 countries about their positions and strategies on sustainability and climate change and published the results.[18] Significant changes and observations from the report include: 85% of respondents increased their sustainability investments in 2024 (compared to 75% in 2023), 70% of respondents expect climate change to have a significant impact on their business strategy over the next three years, and half of respondents have begun implementing technology solutions to help them meet their climate-related goals.

The survey identifies five “harder-to-implement, needle-moving actions”: 'Developing new climate-friendly products or services' (48%); 'Requiring suppliers and business partners to meet specific sustainability criteria' (47%); 'Reconfiguring operations, infrastructure, and/or supply chain to be more climate-resilient' (46%); 'Lobbying for or making political donations in support of climate initiatives' (44%), 'Tying senior leaders’ compensation to environmental sustainability performance' (43%). In summary, companies want to develop climate-friendly products and technologies, need business partners to help them address climate change, and recognize the importance of lobbying politicians for effective policies.

C. How companies in our area cooperate to respond to climate change

□ Proposal of the Cooperation Ways for Climate Response

First, it is necessary to conduct a joint study by a group of experts as a preparatory work to promote corporate solidarity and cooperation in climate response at the Northeast Asian region. In the joint study, it is necessary to identify the actual situation of how enterprises in Northeast Asia are responding to climate change, compare and analyze the main features of each government's climate response policies, and explore the possibility of cooperation among enterprises in climate response. The outputs of this joint research can be closely shared among government and business officials, and can serve as a catalyst for building consensus on the need for Northeast Asia-wide cooperation.

Second, it is necessary to establish partnerships for cooperation among companies in Northeast Asia. To this end, various partnerships for cooperation can be organized by climate change issues, industries, or sectors. In addition, the task of organizing such partnerships can begin by exchanging

[18] Deloitte, Deloitte 2024 CxO Sustainability Report : Signs of a shift in business climate action, September 2024. (https://www.deloitte.com/global/en/issues/climate/cxo-sustainability-report.html)

concerns and views (in the form of a forum). Once a consensus has been reached through discussion of a range of interests, it can be expected that opportunities to implement concrete ways of working together will be identified. Of course, the discussion places for companies could also include sharing the results of the joint research proposed above, as well as the opportunity to hear the views of relevant goverment officials.

Third, it is necessary to find appropriate ways to induce policy support from governments in Northeast Asia. As we have seen in the previous section, businesses are sensitive to government policy stances, so the degree of government support for business-to-business cooperation on climate change in Northeast Asia will be a critical factor in the success of business-to-business cooperation. For this, we will provide a logical basis for convincing governments of the need for policy support. The work to provide such a logical foundation could be prioritized in the joint research mentioned above.

Fourth, it is important to create success stories through pilot projects. While the cause of climate action is a good one, the business conditions and characteristics of each country in Northeast Asia are different, and for collaboration to be fruitful, it is necessary to confirm at the earliest possible stage the possibility and confidence that joint efforts can pay off through the success of relatively small-scale pilot projects. In this case, it would be desirable to prioritize areas where it is easy to build partnerships between companies and where policy support from the central government is available; identifying these areas could be an important topic for joint research.

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北東アジアにおけるSDGsの実施を促進するための企業の役割（要旨）

韓国・SDコリアフォーラム常任理事
林崗澤

本稿は、北東アジアにおけるSDGs実施に向けた協力を活性化させるために、企業が積極的に参加できる場をどのように創出するかについて検討する。

SDGs実施の最近の動向は厳しい。2024年6月に発表された『持続可能な開発目標報告書2024』では、大規模な投資と行動の拡大なしにはSDGsの達成は困難であると警告している。また、北東アジア諸国の国内実施状況をみると、SDG13（気候変動対策）、SDG14（海洋生態系）、SDG15（陸域生態系）に焦点を当てた地域レベルでの協調的な対応が必要であることが示唆される。

本稿では、特に気候変動への対応に向けた北東アジアの企業間連携の必要性を強調し、その推進方策として4つの方法を提案する。

第一に、北東アジア地域レベルでの気候対応に向けた企業の連帯と協力を促進するための準備作業として、専門家グループによる共同研究を行う必要がある。

第二に、北東アジアの企業間の協力のためのパートナーシップを構築する必要がある。

第三に、当該地域の政府から適切な政策支援を求める必要がある。

第四に、比較的小規模なパイロットプロジェクトを成功させることで、協調的取り組みが成果を上げることができるということが確信されるようにしていく必要がある。

International Cooperation on SDGs in Northeast Asia: China's Practice and Exploration

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Abstract

SDGs refers to the 17 Sustainable Development Goals (SDGs) adopted by the United Nations in 2015, aiming to promote global sustainable development in three dimensions: economic, social, and environmental. As a major power in Northeast Asia, China has actively participated in the global sustainable development cause, achieved remarkable results in promoting sustainable development strategies at home, and played a crucial role in the international cooperation on SDGs in Northeast Asia. In view of the current geopolitical conflicts and other difficulties faced by Northeast Asia's sustainable development cooperation, an in-depth study of China's practical path in Northeast Asia's SDGs international cooperation will not only help China leverage its advantages in regional cooperation, fulfill its responsibilities, and achieve mutual benefits and win-win results, but also offer new ideas for solving the problems of Northeast Asia's sustainable development, promote cooperation among countries in the region, and facilitate the implementation of the 2030 Agenda for Sustainable Development in Northeast Asia.

Keywords: Northeast Asia, SDGs Cooperation, Chinese Practice, Path Exploration
JEL classification codes:F53 F63 F64 F66 F68

1. Introduction

In September 2015, the United Nations Summit on Sustainable Development adopted the 2030 Agenda for Sustainable Development, which encompasses 17 Sustainable Development Goals (SDGs). These goals provide a comprehensive and challenging blueprint for the world to achieve coordinated social, economic, and environmental development from 2015 to 2030. They are designed to address a wide array of global issues, including poverty eradication, climate change, economic growth, and social equity. The goals are interconnected and emphasize the significance of global cooperation, encouraging all stakeholders, such as governments, the private sector, and civil society, to collaborate.

The countries in Northeast Asia hold an important position in the global economic and geopolitical arenas. This region includes China, Japan, the Republic of Korea, the Democratic People's Republic of Korea, Mongolia, and the Russian Far East. It is one of the most economically dynamic regions globally, with large economies and abundant natural and human resources. [1] However, the countries in Northeast Asia face both unique opportunities and serious challenges in the pursuit of sustainable development goals.

In the economic domain, despite the disparities in the levels of economic development and industrial structures among the countries in the Northeast Asian region, they are highly complementary, offering broad prospects for extensive economic cooperation. China's manufacturing strengths, Japan and South Korea's advanced technologies and high-end manufacturing industries, and Russia's energy resources have the potential to realize the optimal allocation of resources and the synergistic development of industries through cooperation. Nevertheless, issues like trade protectionism, trade barriers, and unbalanced economic development within the region impede the process of regional economic integration and affect the achievement of the Sustainable Development Goals' objective of promoting economic growth and employment.

At the social level, the Northeast Asian countries have made certain accomplishments in areas such as education and healthcare. However, there are also problems like an aging population, wealth gaps, and uneven social welfare. For instance, in Japan, the severity of its aging population has exerted

[1] 吴昊．东北亚区域经济合作研究[M]．社会科学文献出版社．2020.10

tremendous pressure on its social security system. Meanwhile, some developing countries still need to improve the distribution of educational resources and the accessibility of healthcare services, which goes against the SDGs' objectives of ensuring health for all, providing high-quality education, and reducing inequality.

On the environmental front, the countries in Northeast Asia face multiple challenges, such as climate change, environmental pollution, and resource scarcity. Industrial activities, energy consumption, and rapid urbanization in the region have led to increasing air, water, and soil pollution. Simultaneously, due to their geographical locations and climatic conditions, the countries in Northeast Asia are vulnerable to climate change, and the frequent occurrence of extreme weather events poses a threat to ecosystems and human life, which is contrary to the requirements of the Sustainable Development Goals regarding addressing climate change, protecting ecosystems, and promoting the sustainable use of resources.

As a major power in Northeast Asia, China plays an indispensable role in promoting sustainable development in the region. China has actively participated in the global sustainable development process and vigorously promoted sustainable development strategies at home, achieving remarkable results, particularly in poverty alleviation, renewable energy development, and ecological environmental protection. It has also accumulated rich experience. In regional cooperation in Northeast Asia, China has carried out extensive cooperation with neighboring countries in fields like economy and trade, energy, environmental protection, and cultural exchanges, and has made positive contributions to promoting sustainable development in the region. However, currently, the sustainable development cooperation among Northeast Asian countries still faces numerous difficulties, such as geopolitical conflicts, historical legacy issues, and imperfect cooperation mechanisms, which hinder the realization of regional sustainable development goals.

Against this backdrop, it is of great practical significance to study China's practical path in international cooperation on SDGs in Northeast Asia. On the one hand, it will help China better leverage its own advantages, assume greater responsibility in Northeast Asian regional cooperation, promote the process of regional sustainable development, and achieve mutual benefits, win-win results, and common development with neighboring countries. On the other hand, by exploring effective practical cooperation paths, it can offer new ideas and methods for resolving the problems faced by the Northeast Asian countries in their sustainable development, promote cooperation among regional countries within the framework of the SDGs, jointly address global challenges, and facilitate the smooth implementation of the 2030 Agenda for Sustainable Development in Northeast Asia.

2. Theoretical Foundations

2.1 Theory of Sustainable Development

This theory serves as a crucial cornerstone for international cooperation on the Sustainable Development Goals (SDGs). It originated in the mid-20th century and gradually took shape as global environmental problems became increasingly prominent and people began to reflect on the traditional development model. [2]

In 1987, the World Commission on Environment and Development (WCED) defined sustainable development in its report “Our Common Future” as “development that meets the needs of the present generation without jeopardizing the ability of future generations to meet their own needs.” This definition emphasizes the harmonious coexistence and coordinated progress among the three dimensions of the economy, society, and environment, thereby providing a fundamental framework for the establishment of sustainable development goals.

In Northeast Asia, the theory of sustainable development guides countries to attach importance to environmental protection and social equity while striving for economic growth. For instance, during its economic development process in Northeast Asia, China has actively promoted industrial upgrading and transformation, phased out high-energy-consuming and high-polluting industries, vigorously developed a green and circular economy, and strengthened ecological environment protection and restoration. All these efforts are precisely the concrete manifestations of the theory of sustainable development in regional development.

2.2 Global Governance Theory

This theory offers a framework and mechanism for international cooperation on the Sustainable Development Goals (SDGs). Global governance entails resolving global issues through binding international rules to maintain a normal international political and economic order.[3] Under the

[2] Mebratu D. Sustainability and sustainable development: historical and conceptual review. Environmental Impact assessment Review, 1998, 18(6): 493-520.

[3] Lawrence Finkelstein. “What is Global Governance?”, *Global Governance*, Vol.1, No.3, 1995. Thomas Weiss, Rorden Wilkinson. “Global Governance to the Rescue: Saving International Relations?”, *Global Governance*, Vol.20, No.1, 2014. **薛澜，关婷．多元国家治理模式下的全球治理——理想与现实[J]．政治学研究．** 2021 (03): 65-77+161-162.

framework of global governance, governments, international organizations, non-governmental organizations, and the private sector participate in formulating and implementing global rules and decisions through consultation and cooperation. With regard to international cooperation on SDGs, the theory of global governance emphasizes that countries should reinforce international cooperation and coordination in the pursuit of achieving the SDGs and jointly address global challenges.

In the Northeast Asian region, when dealing with climate change and transboundary environmental pollution, countries need to enhance communication and coordination among governments and establish effective regional cooperation mechanisms based on the theory of global governance. Meanwhile, they should encourage the active participation of enterprises, social organizations, and other non-governmental entities to form a multi-dimensional and collaborative governance scenario. The Northeast Asian Subregional Environmental Cooperation Programme (NEASPEC), with the involvement of the countries in Northeast Asia, serves as an environmental cooperation initiative under the guidance of the global governance concept. Its aim is to address regional environmental problems like air pollution via technical assistance and data sharing.[4]

2.3 International Interdependence Theory

This theory provides motivation for international cooperation on SDGs from the perspective of interstate relations. According to this theory, along with economic globalization and scientific and technological progress, the degree of interconnection and interdependence among countries in terms of economy, politics, and culture has been deepening.[5] Under this interdependence, the interests of all countries are closely intertwined, making it difficult for any single country to handle global problems independently. Hence, it is essential to achieve common interests through international cooperation.

In Northeast Asia, there is a high degree of economic complementarity among countries. Japan and South Korea possess advanced technology and capital, China has a huge market and a manufacturing base, and Russia has energy resources, among other aspects. This economic interdependence has driven countries to cooperate in the field of sustainable development to realize the optimal allocation of resources and common development. Meanwhile, when addressing global challenges like climate change and the prevention and control of infectious diseases, the countries in Northeast Asia are aware of their interdependence. Only through strengthened cooperation can they effectively respond to these challenges and safeguard the common interests of the countries in the region.

3. Current Status of Cooperation

3.1 Participation of SDGs in Northeast Asian Countries

According to the UN Sustainable Development Goals Report

[4] NEASPEC. https://neaspec.org/
[5] Robert O. Keohane and Joseph S. Nye Jr., “Globalization: What's New? What's Not? (And So What?)”, Foreign Policy, No.118 (Spring,2000), pp. 104-119.
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[7] SDG Gateway Asia Pacific. https://data.unescap.org/data-analysis/country-sdg-profiles

Table1 *SDG data availability in 2024（Availability levels, since 2015）*

Country	Sufficient Indicators	Insufficient Indicators	No Data & Not applicable	SDG Goal Top 5
Mongolia	145(63%)	38（16%）	49（22%）	7-8-10-6-17
Republic of Korea	142（61%）	32（14%）	58（25%）	7-6-12-8-9
China*	134（58%）	31（13%）	67（29%）	7-6-17-15-10
Russian Federation	140（60%）	24（10%）	68（29%）	7-8-10-6-17
Japan	140（60%）	22（9%）	70（30%）	12-7-8-9-17
DPR Korea	84（36%）	22（9%）	126（53%）	7-15-2-6-3

Note: Data in parentheses are rates for a total of 232 indicators. * China's data excludes the data from Hong Kong, Macao and Taiwan.
Source: UN ESCAP Data Analysis

2024, merely 17% of the SDGs tracking indicators are currently on track, while over one-third are stagnant or even showing regression.[6] The persistent impacts of the COVID-19 pandemic, escalating conflicts, geopolitical tensions, and the growing concerns regarding climate change are seriously impeding progress towards these goals.

Table 1 presents an analysis of the available indicators for the SDGs in Northeast Asia and the top five goals on which Northeast Asian countries are focusing, based on the data analysis by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). The results indicate that all countries in Northeast Asia have more than 70% of the available indicators, with the exception of the Democratic People's Republic of Korea, which has 50% of the available indicators. Among them, Mongolia has the highest number of indicators, trailed by the Republic of Korea, China, Russia, Japan, and the Democratic People's Republic of Korea.

Simultaneously, Northeast Asian countries have placed emphasis on Goal 7. However, the focus on other goals varies among different countries. Japan and the Republic of Korea have focused more on Goals 12, 8, and 9. China, Mongolia, and Russia have concentrated more on Goals 6, 8, 17, and 10. The Democratic People's Republic of Korea has focused more on Goals 15, 2, 6, and 3.

3.2 Existing Cooperation Mechanisms and Platforms

In the process of promoting international cooperation regarding the Sustainable Development Goals (SDGs), Northeast Asian countries have gradually established a series of cooperation mechanisms and platforms, which offer crucial support for exchanges and collaboration among countries within the region.

Relevant United Nations (UN) forums play a leading role in the international cooperation on SDGs in Northeast Asia. For instance, the UN Multi-Party Forum on SDGs in Northeast Asia, regularly organized by the UN Economic and Social Commission for Asia and the Pacific (ESCAP) Subregional Office for East and Northeast Asia (ESCAP-ENEA), creates opportunities for exchanges among stakeholders from governments, academia, the international community, and civil society in East and Northeast Asia.[8] At this forum, all parties share their experiences and deliberate on key challenges and opportunities concerning specific SDGs of the UN 2030 Agenda for Sustainable Development. It also provides subregionally relevant information resources and perspectives for regional and global forums, thereby making significant contributions to the understanding and practice of the SDGs in Northeast Asian countries.

Moreover, several specialized cooperation mechanisms play a pivotal role in specific areas. The Northeast Asian Subregional Programme for Environmental Cooperation (NEASPEC), which is committed to environmental protection and sustainable development in Northeast Asia, has launched a number of collaborative projects in areas such as air pollution reduction, technology demonstration for clean coal-fired power plants, and air pollution data collection and standardized analysis.[9] Through this programme, countries in the region have enhanced technical exchanges and assistance in the environmental field and have jointly addressed environmental challenges like air pollution, thus providing practical experience for achieving the environmental goals of the SDGs.

These cooperation mechanisms and platforms have facilitated exchanges and cooperation among Northeast Asian countries within the framework of the SDGs at various levels and in different areas, thereby laying a solid foundation for sustainable development in the region.

3.3 Key Areas of Cooperation and Achievements

Northeast Asian countries have engaged in cooperation within several key areas under the international cooperation framework of the Sustainable Development Goals (SDGs), and have achieved a series of remarkable accomplishments.

Energy: Countries in the region are actively promoting energy cooperation initiatives to achieve sustainable energy supply and utilization. China and Russia have deepened their cooperation in the oil, natural gas, and other energy sectors. Since the northern section of the China-Russia Eastern Natural Gas Pipeline Project was put into operation and opened to the public in December 2019, the cumulative gas transmission volume of the China-Russia Eastern Line had exceeded 80 billion cubic meters by December 2024. This not only meets the energy demands of certain domestic regions in China but also provides a stable market for Russia's energy exports, thereby promoting the sustainable development of both sides in the energy field. It is estimated that the annual supply of natural gas resources along the China-Russia Eastern Route can reduce carbon dioxide emissions by 164 million tons and sulfur dioxide emissions by 1.82 million tons.[10] Meanwhile, China has cooperated with Japan and the Republic of Korea in the

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8 ESCAP. https://www.unescap.org/
9 NEASPEC. https://neaspec.org/
10 中国国家能源局 (NEA) https://www.nea.gov.cn/2024-12/06/c_1310787439.htm
11 世界资源研究所 (WRI) https://wri.org.cn/news/Promoting-Renewable-Energy-International-Development-Cooperation%2C-China-Has-Great-Potential

research and development (R&D) and application of renewable energy technologies, jointly exploring the efficient utilization of new energy sources such as solar energy and wind energy, and facilitating the optimization and upgrading of the energy structure.[11]

Environment: The outcomes of cooperation in this area are also remarkable. The Northeast Asian Subregional Environmental Cooperation Programme (NEASPEC) has achieved notable results in alleviating air pollution. Through technical assistance, NEASPEC has assisted countries in the region to upgrade their air pollution monitoring and control technologies, and the air quality has witnessed significant improvement in air pollution control projects carried out in some key cities.[12] In 2024, the Northeast Institute of Geography and Agroecology of the Chinese Academy of Sciences (NIEGAS) signed a Letter of Intent to collaborate with the UNESCO Regional Office for East Asia and also signed a Memorandum of Understanding (MoU) on cooperation with the Institute of Geography of the Russian Academy of Sciences, Siberia Branch, and the Sochava Institute of Geography.[13] These agreements were aimed at addressing the problems faced by Northeast Asia regarding the development and utilization of resources, the environment, and sustainable development.

Moreover, in the area of marine environmental protection, the countries have strengthened joint monitoring and control of marine pollution, jointly protected marine ecosystems, and preserved marine biodiversity. In Northeast Asia, apart from the Northeast Asian Subregional Cooperation Programme (NEASPEC), China, Japan, and the Republic of Korea participate in the Northwest Pacific Action Plan (NOWPAP)[14] and the China-Japan-Republic of Korea Environment Ministers' Meeting (TEEM)[15]. The Northwest Pacific Action Plan (NOWPAP) focuses on marine environmental governance, while the Northeast Asian Subregional Cooperation Programme (NEASPEC) and the China-Japan-Republic of Korea Environment Ministers' Meeting (TEEM) are also partly concerned with marine environmental governance. Overall, these three cooperation mechanisms are interconnected, forming a multilateral cooperation mechanism for the marine environment in Northeast Asia.

Education: Northeast Asian countries have promoted the sharing and complementarity of educational resources through student exchanges and academic cooperation. Student exchange programs between China and Japan, South Korea as well as Russia have become increasingly frequent, with a large number of students traveling to each other's countries every year for further studies. Meanwhile, academic cooperation among universities has been enhanced, with joint research projects and academic symposiums being conducted, and a series of research outcomes have been achieved in areas such as artificial intelligence and environmental science.

The achievements of such cooperation have not only driven the development of Northeast Asian countries in related fields but also made a positive contribution to the realization of sustainable development goals. Through energy cooperation, energy security has been ensured and energy transformation has been promoted; environmental cooperation has improved the regional ecological environment and facilitated sustainable development; and educational cooperation has enhanced the quality of human resources in the region and provided intellectual support for scientific and technological innovation and social development.

3.4 Challenges and Problems of Cooperation

Although Northeast Asian countries have achieved certain accomplishments in international cooperation regarding the Sustainable Development Goals (SDGs), they still encounter numerous challenges and problems during the cooperation process.

Firstly, the lack of mutual political trust constitutes a significant factor that restricts the in-depth development of cooperation. Northeast Asian countries have complex geopolitical relations and historical legacy issues. Some countries have differences in territorial disputes and historical perspectives, which undermine mutual political trust among them and render it challenging to reach a consensus on certain cooperation projects.

Secondly, the shortage of funds presents a major predicament for cooperation. Many sustainable development projects, such as those in environmental protection and infrastructure construction, demand substantial capital investment. However, the limited economic strength of some developing countries in Northeast Asia makes it arduous for them to shoulder the high costs of these projects. Meanwhile, the restricted channels for international financial assistance and the uneven distribution of funds have impeded the successful implementation of some projects that are in urgent need of financial support.

Finally, difficulties in coordinating interests also impede the further deepening of cooperation. Northeast Asian countries vary in terms of economic development level, industrial structure,

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[12] NEASPEC. https://neaspec.org/
[13] 中国科学院(CAS) https://www.cas.cn/cm/202407/t20240723_5026779.shtml
[14] NOWPAP. https://www.unep.org/nowpap/zh-hans
[15] 中华人民共和国生态环境部(MEE) https://www.mee.gov.cn/ywdt/hjywnews/202409/t20240930_1087260.shtml

and resource endowment. During the cooperation process, each country has its own distinct interests, making it difficult to establish a unified mechanism for coordinating interests. In regional economic cooperation, conflicts of interest arise among countries regarding issues like trade rules and market access, resulting in difficulties in reaching and implementing cooperation agreements. For instance, during the formulation of regional trade agreements, negotiations have frequently reached a stalemate due to the different requirements of countries regarding the degree of market openness for agricultural and manufacturing products, thereby affecting the progress of regional economic cooperation.

These challenges and problems have severely constrained the in-depth development of international cooperation on SDGs among Northeast Asian countries and demand joint efforts to identify effective solutions.

4. China's practice

4.1 Cooperative positions

In the international cooperation on the Sustainable Development Goals (SDGs) in Northeast Asia, China has adopted a positive, open, and cooperative stance, as illustrated below:

First, China adheres to multilateralism and win-win cooperation. China advocates that countries in Northeast Asia should jointly promote the achievement of the SDGs through multilateral cooperation mechanisms within the framework of the United Nations 2030 Agenda for Sustainable Development. It also emphasizes that all countries should abandon the zero-sum mentality,[16] seek common interests, and attain mutual benefits and win-win results.

Secondly, China advocates openness, inclusiveness, and equal participation. In the cooperation on the SDGs in Northeast Asia, China advocates openness and inclusiveness and welcomes the participation of all countries in the region as well as relevant international organizations, regardless of their size, strength, or economic status. All participants are expected to enjoy equal status and have a say in the cooperation and be involved in the planning, implementation, and supervision of cooperation projects.

Thirdly, China emphasizes green development and innovation. China has integrated the concept of green development into the cooperation on the SDGs in Northeast Asia, stressing the coordination and coexistence of economic development and environmental protection. It promotes cooperation among countries in areas such as clean energy, energy conservation and emission reduction, and ecological protection. Meanwhile, China also focuses on innovation-driven cooperation, encouraging countries to strengthen exchanges and cooperation in fields like the digital economy and scientific and technological innovation, with the aim of promoting the achievement of the SDGs through innovative means.

Fourthly, China emphasizes the priority of development and a livelihood-oriented approach. China holds that the core of the SDGs is development. In its cooperation in Northeast Asia, it has always given high priority to promoting the economic and social development of all countries and has been committed to facilitating infrastructure construction, trade and investment facilitation, etc., so as to drive the resolution of livelihood issues, such as employment and poverty reduction, with the intention of enabling more people to benefit from the fruits of cooperation.

4.2 Key issues

In the process of China's promotion of international cooperation on the Sustainable Development Goals (SDGs) in Northeast Asia, it faces a number of key issues,[17] which are summarized as follows:

Environment: Against the backdrop of global climate change, the issue of carbon emissions has become one of the main focuses of attention. Meanwhile, China is also facing several more complex and urgent ecological challenges. Water pollution, soil degradation, and loss of biodiversity are all intertwined, posing serious threats to China's ecological balance and sustainable development. To address these complex ecological problems, it is necessary to formulate and implement effective measures in a comprehensive and multi-dimensional manner and strive to realize the harmonious coexistence of human activities and the natural environment, thereby ensuring the stability of the ecosystem and the steady progress of the goal of sustainable development.

Social dimension: With the continuous urbanization process, the aging of the population and the profound transformation of the employment structure, China's social infrastructure is at a critical stage of transition. This trend has had a decisive impact on the country's core social issues. In this process, issues such as social security, pension services and employment quality have gradually come to the forefront and become the focus of great attention from all sectors of society.

Moreover, the disparities among different social groups in

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16 中国社会科学网 (CSSN) https://www.cssn.cn/skgz/bwyc/202410/t20241029_5797214.shtml

17 廖天舒，吴淳，朱晖，刘冰冰．中国可持续发展实践之路：助力商业向善及更高水平开放 [R]. 2023.03 https://web-assets.bcg.com/3f/9d/6cf9743740fdb45d9131c752aa30/bcg-china-pathway-to-a-sustainable-future-chn-mar-2023.pdf

terms of income levels, educational attainment and access to public services have created an urgent need for policy support and effective interventions to safeguard social equity and ensure social stability and harmony, which are essential foundations for the sustainable development of society as a whole.

Governance: China has a large number of state-owned enterprises (SOEs) covering a wide range of areas, and its capital market is still relatively underdeveloped, which places higher demands on the comprehensiveness and effectiveness of domestic governance. As an important pillar of the national economy, SOEs play a pivotal role in economic development. Hence, they need to be guided by a sound and scientific governance mechanism to continuously strive to improve management efficiency, optimize the industrial layout, and enhance the innovation capacity.

On the other hand, the healthy development of the capital market is of great significance for optimizing the allocation of resources and promoting the growth of the real economy. Therefore, strengthening the construction of the capital market and further improving its regulatory system have become the key measures to cope with the challenges of economic governance and ensure the smooth and healthy operation of the entire economic system.

4.3 Path exploration

The Global Development Initiative (GDI) is an important concept and action strategy put forward by China to promote the cause of global development. Adhering to the people-centered principle as well as the concepts of inclusive and balanced development and harmonious coexistence between human beings and nature, the GDI focuses on eight areas, namely poverty alleviation, food security, anti-epidemic and vaccine, financing for development, climate change and green development, industrialization, digital economy, and interconnectivity, with the goal of promoting stronger, greener and healthier global development. Figure 1 is a road map of China's Global Development Initiative for realizing the 2030 Agenda for Sustainable Development.

Against the backdrop of global development initiatives, the exploration of an effective path for international cooperation on the Sustainable Development Goals (SDGs) in Northeast Asia needs to focus on five key elements: strengthening policy communication and coordination, deepening cooperation in the economic field, enhancing cooperation in science, technology and innovation, promoting cooperation in the social and humanistic fields, and constructing an enterprise-led participation and cooperation model.

I. Enhancing Policy Communication and Coordination

-Establishing a Regular High-Level Dialogue Mechanism

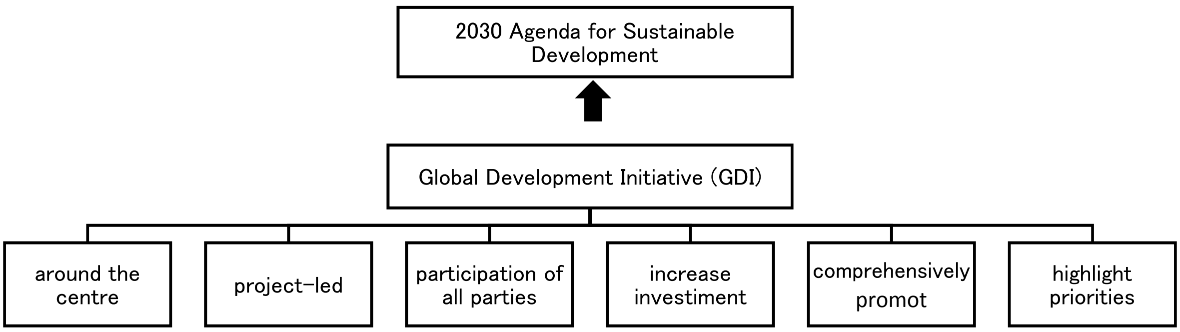
Northeast Asian governments need to set up a regular high-level meeting mechanism. This mechanism should mainly focus on issues related to the cooperation on the Sustainable Development Goals (SDGs). Through it, in-depth communication and coordination can be carried out regarding strategic planning, policy formulation, and the implementation of major sustainable development projects in the region.

For example, when it comes to climate change policies, these governments can jointly discuss and establish regional carbon emission targets and energy transition timetables. Such collaboration helps build a unified policy framework. By taking these steps, the synergy of policy orientations among different countries can be ensured, and obstacles to cooperation caused by policy differences can be effectively avoided.

-Improving the Policy Connection and Mutual Recognition Mechanism

It's crucial to conduct a systematic review of existing SDGs-

Figure 1 *Pathway map for the implementation of global development initiatives*



Source: China International Development Knowledge Center, National Development Initiative Implementation Progress Report 2023. [18]

[18] 中国国际发展知识中心 (CIKD). 全球发展倡议落实进展报告 [R]. https://www.mfa.gov.cn/web/wjb_673085/zzjg_673183/gjjjs_674249/xgxw_674251/202306/P020230620670372006993.pdf

[13] 中国科学院 (CAS) https://www.cas.cn/cm/202407/t20240723_5026779.shtml

[14] NOWPAP. https://www.unep.org/nowpap/zh-hans

[15] 中华人民共和国生态环境部 (MEE) https://www.mee.gov.cn/ywdt/hjywnews/202409/t20240930_1087260.shtml

related policies and regulations in each country. Then, active efforts should be made to promote the docking and mutual recognition of policies in core areas like trade, investment, environmental protection, and social welfare.

Take the construction of a green product certification mutual recognition system as an example. Under this system, products meeting the green standards of one country can enter the markets of other Northeast Asian countries without hindrance. This reduces enterprises' trade costs and stimulates the development of green industries, contributing significantly to achieving the goals of Sustainable Consumption and Production (SDG12).

II. Deepening Economic Field Cooperation

-Expansion of Green Trade, Green Supply Chain Building, and Trade Barrier Removal

Deepening economic cooperation calls for focusing on expanding green trade, constructing green supply chains, and eliminating trade barriers. The building of a green supply chain integrating raw material supply, production, logistics, and sales terminals should rely on each country's industrial strengths in the region.

For example, using Russia's rich timber resources as a starting point, green processing and manufacturing can be done in China. Then, leveraging Japan and South Korea's efficient logistics networks helps introduce green furniture and related products to the market. This realizes green and sustainable development across the supply chain and fosters a positive interaction between regional economic growth and ecological protection.

Through bilateral or multilateral negotiations, efforts should be made to gradually cut and even remove tariff and non-tariff barriers for green products and sustainable services. Simplifying customs clearance and enhancing trade facilitation are also vital. These steps will boost the scale of green trade in the region and drive the regional economy towards a sustainable model.

-Strengthening Cross-Border Investment, Guiding Green Investment, and Establishing an Investment Guarantee

Governments are key to strengthening cross-border investment cooperation. They should introduce preferential policies to guide domestic and foreign enterprises to invest in regional sustainable sectors like renewable energy, environmental protection, and the recycling economy.

Encouraging Japanese and South Korean enterprises to invest in China for new energy auto parts production bases is significant. By leveraging China's market and industrial support advantages, the competitiveness of the region's new energy auto industry can be jointly enhanced, contributing to achieving goals like clean energy (SDG7) and industrial innovation (SDG9).

Moreover, building a comprehensive cross-border investment protection mechanism, including agreements and dispute settlement, is essential. It safeguards investors' rights, boosts enterprises' confidence in cross-border investment, and attracts more funds for sustainable projects in Northeast Asian countries.

III. Reinforcing Cooperation in Science, Technology, and Innovation

-Implementation of Joint Scientific Research Projects

Conducting joint scientific research projects is crucial for strengthening cooperation in science, technology, and innovation. Focusing on key SDGs-related scientific issues like marine ecological protection, resource sustainable utilization, and climate change responses, we should organize scientific research institutions, universities, and enterprises from various countries to jointly carry out such projects.

Establishing a joint research fund for financial support is necessary. Also, a rational mechanism for sharing intellectual property rights and transforming research achievements should be formulated. This ensures prompt application of research outcomes to sustainable development work, enhancing the regional collaborative innovation capacity in science and technology.

-Construction of a Platform for Scientific and Technological Exchanges

The establishment of a scientific and technological exchange platform is significant for promoting cooperation. We should organize international seminars and academic conferences, and build an online cooperation platform.

Regularly arranging Northeast Asian sustainable development-related seminars and forums, and inviting experts and representatives from different countries to participate is essential. Through sharing the latest findings, advancements, and experiences, it facilitates information exchange, stimulates innovative thinking, and promotes interdisciplinary and cross-regional cooperation.

With the Internet's help, the online platform enables research entities from different countries to release requirements, seek cooperation, and conduct exchanges. It breaks time and space limitations, creates a continuous cooperation atmosphere, and accelerates the popularization and application of achievements in the region.

IV. Facilitating Cooperation in the Social and Humanistic Spheres

-Strengthening Educational and Cultural Exchanges

To boost cooperation in social and humanistic aspects, intensifying educational and cultural exchanges is vital. This includes implementing student exchange programs, joint training, and arranging diverse cultural activities.

Specifically, expanding student exchanges among Northeast Asian universities is needed, along with increasing quotas for majors related to sustainable development. Also, actively promoting joint postgraduate cultivation is key, which involves formulating plans together, integrating educational strengths of each country, and cultivating professionals with an international vision and understanding of regional sustainable development. Through these, human resources can be reserved for future cooperation.

Moreover, organizing cultural festivals, art exhibitions, etc., showcases unique cultural charm, deepens mutual understanding, and promotes sustainable concepts in traditional cultures, thus stabilizing the cultural foundation for sustainable development.

-Promoting Cooperation between Civil Organizations and Volunteers

Fostering cooperation between civil organizations and volunteers is another crucial part. It means supporting cooperation among civil environmental protection groups and setting up a volunteer service exchange platform.

Encouraging such organizations from different countries to enhance cooperation and conduct activities like environmental protection publicity is important. For example, jointly launching bird migration route protection activities and organizing volunteers for monitoring. This gathers civil society strength to protect the ecological environment and increases people's participation and recognition of the SDGs.

The Northeast Asia volunteer service exchange platform allows volunteers from various countries to join sustainable development projects abroad, facilitating learning from different experiences and promoting exchanges and cooperation at the civil society level.

V. Business-Led Engagement and Cooperation

-Establishing a Clear Direction for Development

Enterprises in sustainable development must set a clear growth direction by precisely defining visions, strategies, and road maps. This helps them identify the path for sustainable growth, enabling pursuit with clear goals and plans, and steady, orderly progress along the set route.

-Reshaping Business Processes

Enterprises should focus on building a strong supply chain and comprehensively apply sustainable concepts to reshape core processes like procurement, production, and manufacturing. Thus, they can achieve core business transformation, ensuring strict compliance with sustainable principles and laying a solid foundation at the process level.

-Innovating in Investment and Financing Management

Enterprises are to proactively manage sustainable investment and financing, explore innovative business and operation paths, and develop new segments in related fields. This proactive stance brings diverse opportunities, promotes overall sustainable development, and enhances market competitiveness and sustainable achievement ability.

-Strengthening Multi-Party Collaboration and Information Management

Enterprises need to intensify sustainable data analysis and disclosure for timely, accurate, and transparent presentation. Also, vigorously promote multi-party cooperation, establish extensive relationships, and adjust the talent mechanism timely to have a suitable talent team.

Implementing these initiatives empowers enterprises' all-round sustainable transformation, helping them adapt to changes and realize sustainable growth.

5. Conclusion

In the current context of deepening globalization, with the world confronting unprecedented global challenges, the traditional model relying solely on economic growth to drive development is obsolete. Nowadays, the concept of sustainable development has swiftly emerged and is globally recognized as a core development trend. Its importance is evident as it closely ties to human society's ability to attain long-term well-being and stable, healthy progress in the future.

International cooperation has always been crucial in realizing the Sustainable Development Goals (SDGs). It serves as a solid bridge connecting different countries and regions, offering a vital platform and mechanism for resource pooling and concerted action. Notably, highlighting the irreplaceable significance of further strengthening international cooperation on the SDGs in Northeast Asia is essential for more efficient and comprehensive global development. The Northeast Asian region hosts numerous countries with distinct economic, cultural, and technological features. Deep and extensive cooperation among them would surely create a potent development synergy, significantly impacting the global sustainable development pattern.

From the perspective of the practical implementation of the SDGs and related methodology, proactively learning from countries' past experiences and meticulously exploring cooperation potential in sustainable development is of great practical value. It injects a stronger and more enduring impetus into economic and social transformation. This helps participants avoid risks and detours when facing complex global challenges and accelerates global sustainable development, enabling mankind to reach a more ideal and balanced state in resource utilization, environmental protection, and social equity, thus laying a solid foundation for humanity's long-term future.

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北東アジアにおけるSDGsの国際協力：中国の実践と模索（要旨）

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2015年に国連で採択された17の目標を指す「持続可能な開発目標（SDGs）」は、経済、社会、環境の３つの側面から、地球規模の持続可能な開発を推進することを目的としている。北東アジアの重要な大国として、中国は世界の持続可能な開発に積極的に参加し、自国内で持続可能な開発戦略を推進する上で目覚ましい成果を達成しており、北東アジアにおけるSDGsに関する国際協力において重要な役割を果たしてきた。現在、北東アジアの持続可能な開発協力が直面している地政学的対立やその他の困難に鑑みれば、北東アジアのSDGs国際協力における中国の実践的な道筋を深く研究することは、中国が地域協力において自国の優位性を十分に活用し、責任を果たし、相互利益とウィンウィンの結果を達成するのに役立つだけでなく、北東アジアの持続可能な開発に関する問題の解決に向けた新たな視点を提供し、北東アジア地域における各国間の協力を促進し、北東アジアにおける「持続可能な開発のための2030アジェンダ」の実施を促進することが可能となる。

Analysis on the Development of New Energy Vehicle Industry in China under the Double Carbon Targets

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Abstract

With the increasingly serious problem of global climate change, countries are transitioning to a low-carbon economy. As the world's largest emitter, China has proposed the "dual carbon" goals of carbon peaking by 2030 and carbon neutrality by 2060. In this context, the transformation and upgrading of fuel vehicles is imperative. The new energy vehicle industry has gained unprecedented momentums, but at the same time, it is also facing many challenges. This article aims to systematize the development history, current situation, challenges and potential opportunities of China's new energy automobile industry under the background of "double carbon". The study will first discuss the core role of new energy vehicles in promoting the transformation of a low-carbon economy, and the impact of politics, market demand and technological innovation on the industry. Based on this, this article will continue to discuss a series of challenges faced by the former industry, such as technological bottlenecks, insufficient infrastructure, and international competition. Finally, this paper will combine the trend of China's new energy vehicle industry and put forward target policy recommendations to provide theoretical support for promoting the industry. Through comprehensive, this paper seeks to provide valuable insights for policymakers and industry participants to drive greater progress in China's NEV industry in achieving the "dual carbon" goals.

Keywords: double carbon goals, new energy vehicles, development status, challenges, opportunities
JFL classification codes:F63 F64 L62 L92 Q56

To address global climamte challlenges, the UN adopted the 2030 Agenda for Sustainable Development, wherein the Sustainable Development Goals (SDGs) explicitly mandate that all nations implement proactive strategues to reduce greenhouse gas emissions and accelerate the transtion to a green economy. As the world's largest greenhouse gas emitter, China has proposed the "dual carbon" goals, which serves as a catalyst for industrial restructing and technological innovation. With this policy framework, the new energy vehicle (NEV) sector, a pivotal component of the low-carbon economics systems, has emerged as a strategic priority in China's national green development agendasu.

1 Dual-carbon targets and the development context of China's new energy vehicle industry

1.1 Introduction and meaning of the dual-carbon goal

Since the reform and opening up, China's economic volume has been steadily increasing, alongside the continuous advancement of urbanization and industrialization. However, this industrialization process has come at a cost, leading to an increasingly serious with environmental pollution issues. In response to the current state of domestic development and the context of addressing global climate issues, President Xi announced at the 75th United Nations General Debate in September 2020 that China will aims to peak its carbon dioxide emissions by 2030, and achieve carbon neutrality by 2060 - this is referred to as a "dual-carbon" commitment. The "dual-carbon" goals represent a major strategic objective of the Chinese Government, To achieve it, China needs to vigorously develop green industries, promote the transformation of its energy structure and adopt a series of stringent measures to reduce emissions.

1.2 Development background of China's new energy vehicle industry

As a key component of China's advanced manufacturing industry, the automobile industry plays a central role in the transition from high-speed development economic growth to high-quality development, but in the process of industrial development, However, this sector faces challenges such as high energy consumption and industry overcapacity, As a result, transitioning to low-carbon and decarburization decarbonized solution is an effective strategy to actively promote energy conservation and emission reduction, thereby assisting in the achievement of the "dual carbon" goals.[1] New energy vehicles embody a fusion of innovative energy sources,, new materials, Internet, big data, artificial intelligence and other trans-formative technologies. They are facilitating the evolution of automobiles from pure transportation to mobile intelligent terminals, energy storage units and digital spaces. This transformation is driving the upgrading of energy, transportation and information and communication infrastructures. Promoting the popularization and development of new energy vehicles has become an important way for China to achieve the "dual-carbon" goal. Promoting the development and widespread adoption of new energy vehicles is crucial for building of a clean and beautiful world and fostering a coummunity with a future for mankind. Achieving the "dual carbon" goals has emerged as a significant pathway for China through the advancement of NEV.

In recent years, new energy vehicles have emerged as a key focus of global industrial transformation and development and an important engine to promote the sustainable growth of the world economy, the world's major automotive powers have strengthened planning and policy support, and multinational automotive enterprises have increased R & D investment and improved industrial layout.[2] Although China's new energy vehicle industry started late, its development has been remarkably swift. Following the initiation of new energy vehicle pilot in 2009, both national and local governments have implementedvarious subsidy policies to facilitate the widespread adoption of NEVs. These measures include subsidies for vehicle purchases, tax incentives, free licenses, charging facilities, etc., in order to remove obstacles to the full-scale promotion of new energy vehicles. In recent years, under the unremitting efforts of the government, new energy vehicles, like newborn babies, have gradually learned to walk and stepped into the fast lane, realizing the transformation and upgrading from traditional fuel vehicles to new energy vehicles.[3]

2 Analysis of the development history and current situation of China's new energy vehicle industry

2.1 Development history of China's new energy vehicle industry

The development of China's new energy vehicles can be traced back to the 1990s. After years of technical accumulation and policy support, China's new energy vehicle industry has gradually matured from scratch, from small to large.

In 1991, China initiated the "863 Program", designating electric vehicles as a key area for research and development. Since then, prestigious institutions like Tsinghua University, Shanghai Jiao Tong University and other institutions of higher learning and research institutions began to carry out research and development of electric vehicle technology. In 2001, the "Tenth Five-Year Plan" formally identified new energy vehicles as an important national development direction, with increasing financial and policy support. In 2009, the government launched the "Ten Cities, One Thousand Vehicles" program, aiming to vigorously promote new energy vehicles in ten cities, including Beijing and Shanghai. This program has greatly stimulated market demand and promoted the popularity of new energy vehicles. In 2012, the State issued the "Energy Saving and New Energy Vehicle Industry Development Plan (2012-2020)", which set an ambitious goal of reaching a cumulative production and sales target of 5 million new energy vehicles by 2020. To achieve this goal, the government has further increased its support for new energy vehicles, including measures such as providing subsidies for vehicle purchases, reducing or waiving the purchase tax, and accelerating the construction of charging infrastructure.

China's new energy vehicle industry has entered a new phase of development with the introduction of the 2020 "dual-carbon" target vision in 2020. In 2021, NEVs' sales in China reached a record high of 3.52 million units, capturing 53% of the global market share. The global NEVs market continued to e xpand rapidly in 2022 , with total sales reaching 10.55 million units - an increase of 3.8 million units from the previous year. China's new energy vehicle market sales maintained its climbing momentum, with sales climbing to 6.887 million units, representing 65.3% of the global market share and ranking first globally for the eighth consecutive year.[4] 2023 was marked the

[1] Yang Yanfeng,Ge Xinqi." Research on innovation and development of China's new energy automobile industry under the background of "double carbon"[J]. Energy Storage Science and Technology,2022,11(7):2406-2407.

[2] Ministry of Industry and Information Technology of the People's Republic of China. Development Plan for the New Energy Vehicle Industry (2021-2035)

[3] Yin Biao,Duan Pengfei." Countermeasures for the development of new energy automobile industry in China under the background of "double carbon"[J]. Shanghai Energy Conservation, 2023,(08):1048-1052.

[4] Beijing Institute of Technology. China New Energy Vehicle Big Data Research Report (2023), English version

first year that China's new energy vehicle industry operated without national subsidies for electric vehicle purchases. By this time, China's new energy vehicle ownership has exceeded 5 million units. The industry has now become a cornerstone of the global automotive electrification transition. A comprehensive industry chain has emerged in China, encompassing everthing from the upstream supply of battery materials to the downstream vehicle manufacturing. Each link has a large number of enterprises involved, and has shown strong competitiveness in the international market.

2.2 Analysis of the Current Situation of China's New Energy Vehicle Industry

2.2.1 Market size and development trends

In recent years, China's new energy vehicle market share has been steadily rising. In 2023, China's overall automobile sales exceeded 30 million units, and the growth momentum of new energy vehicles continued, gradually stepping into the era of ten million units. China's local new energy automobile enterprises are rapidly rising, BYD reported annual sales of 3.02 million units, in 2023, making it the world's top-selling company in the new energy passenger car sector. Among the top ten Chinese automobile enterprises, five positions are occupied by NEV manufactures accounting for a total of 43%. According to China Association of Automobile Manufacturers (CAAM), the global sales of new energy vehicles in 2023 were 14.653 million, with 9.495 million, 1.468 million and 2.948 million in China, the U.S. and Europe, respectively, and China's new energy vehicle exports increased by 37.9% year-on-year, with a market share of 31.6%, ranking first globally for the ninth consecutive year.In the first three quarters of 2024, the production and sales of new energy vehicles were completed respectively at 8,316,000 and 8,320,000, up 31.7% and 32.5% year-on-year.[5] the International Energy Agency released the "2024 Global Electric Vehicle Outlook" report is also expected to 2024 global new energy vehicle sales will reach 17 million, which than the 2023 increase of 3 million electric vehicle sales, most of them from China. Meanwhile, electric vehicle sales could account for about 45% of China's total vehicle sales in 2024.[6]

2.2.2 Technological Innovation and Industry Chain Construction

In addition to the rising market position of new energy automobile enterprises, the market position of China's new energy industry chain has also been further enhanced, positioning the country as an accelerating supply chain center for the global automobile industry. China has developedthe world's most comprehensive industrial chain, encompassing materials research and development, battery production, recycling to equipment support. The technological innovation of China's new energy vehicle industry primarliy focuses on breakthroughs in core technologies such as batteries, motors and electronic control systems. Notably, advancements in lithium battery technology have been crucial, the four major raw materials of positive electrode, negative electrode, electrolyte and diaphragm are basically dependent on imports. The localization rate of lithium battery equipment has reached more than 90%, and the localization rate of key process equipment has reached more than 80%, this provides an important support for the large-scale popularization of electric vehicles and renewable energy storage. With the continuous progress of technology, the energy density and safety of new energy batteries have been greatly improved, and the cost has gradually decreased.

2.2.3 Key players and market landscape

China's new energy vehicle market is showing a trend of diversification, intelligence and internationalization. China's major new energy vehicle companies not only occupy an important position in the domestic market, but also gradually emerge in the international market. Mainstream companies such as BYD, Weilai, Xiaopeng, etc. have formed a competitive landscape in different market segments.

BYD (BYD) is one of the leading companies in China's new energy vehicle market not only producing pure electric vehicles (EVs) but also occupying an important market share in the field of plug-in hybrid electric vehicles (PHEVs). Its battery technology and core component production capacity give it a competitive advantage in the market. Weilai Automobile focuses on high-end smart electric vehicles. It not only innovates in hardware, but also continues to increase in software, intelligence and autonomous driving technology. It has launched innovative services including "battery replacement" technology, focusing on the mid-to-high-end market. Xiaopeng Motors is an innovative company focusing on smart electric vehicles, especially in the fields of autonomous driving and smart cockpits, with strong

[5] Data source: China Association of Automobile Manufacturers (CAAM) .
[6] International Energy Agency. Global Electric Vehicle Outlook 2024

technology foundation, its flagship models, such as Xiaopeng P7 and G3, have gained a certain market share by virtue of intelligent driving systems, autonomous driving technology and designs that meet consumer needs. Cars mainly launch plug-in hybrid (PHEV) models, such as ONE, L9, etc. These models are favored by consumers for their large space, high performance and long cruising range, showing strong market competitiveness.

2.2.4 Policy support and market mechanisms

Since its initial pilot program in 2009, China has been actively promoting new energy vehicles. The relevant subsidy policy is also changing with the development of the industry, from the pilot demonstration and promotion stage to promote the application of the stage, and then to the stage of market-oriented adjustments. The geographic scope of the pilot cities has expanded from a national focus, and the subsidized models have evolved from being limited public vehicles to encompassing various types of new energy models. In October 2020, the State Council Standing Committee meeting adopted the "new energy automobile industry development plan (2021-2035)", "the new energy automobile industry development plan (2021-2035)". Development Plan (2021-2035)", the "plan" for the development of China's new energy automobile industry in the next few years for the deployment, put forward to 2025, China's new energy automobile market competitiveness increased significantly, power battery, drive motor, vehicle operating system and other key technologies to achieve a major breakthrough, the level of safety comprehensively improved. The average power consumption of new pure electric passenger cars has dropped to 12.0 kWh/100km, the sales volume of new energy vehicles has reached about 20% of the total sales volume of new automobiles, highly self-driving cars have realized the commercial application of limited areas and specific scenarios, and the convenience of the charging and switching services has been significantly improved.

Local policies have also encouraged the consumption of new energy vehicles. For example, in the "Shanghai Municipal Implementation Plan for Accelerating the New Energy Vehicle Industry (2021-2025)" in February 2021. This plan aims to position Shanghai as a national leader in the NEVs industry by 2025, focusing on achieving major breakthroughs in core technology research. The R&D and manufacturing of key components such as power batteries and management systems, fuel cells, drive motors and power electronics have reached the international leading level. In September 2021, Tianjin pointed out in the "14th Five-Year Plan for Tianjin's New Energy Industry" that it will focus on supporting new application projects for intelligent manufacturing of new energy vehicle power batteries. Heilongjiang Province's 2022 "Heilongjiang New Energy Vehicle Planning (2022-2025)" clearly stated that the province will build a new energy vehicle and parts industry, centered around Harbin and Daqing. Aiming to create a group of high-profile and prestigious new energy vehicles and parts brands.

3 Challenges and development opportunities for China's new energy vehicle industry

3.1 Challenges facing China's new energy vehicle industry

3.1.1 Technical bottlenecks and core competitiveness to be broken through

Battery technology is fundamental to the new energy vehicle industry, as keys aspects like the battery life and charging speed of power batteries directly affect the market acceptance of electric vehicles. Although China has made great progress in battery manufacturing, especially companies such as BYD and Ningde Times have certain advantages in the battery industry chain, they still face some bottlenecks. For example, although the energy density of the battery has been significantly improved, the battery life performance is still unstable in the case of long-distance driving, extreme cold or extreme hot weather, etc., and it is difficult for users to travel for long distances. main concern. The safety of batteries is still a potential hidden danger of electric vehicles, especially in extreme cases such as collisions, overcharging or overdischarging, safety issues such as spontaneous combustion may occur. Meanwhile, China's new energy automobile industry chain part of the link into the contraction period, mainly manifested in the battery enterprise into the production capacity release period and the chip investment into the contraction period, the tail end of the enterprise facing financing pressure. Compared with foreign countries, China's new energy vehicle chip development is relatively backward, the domestic chip self-sufficiency rate is only maintained at 10%.[7] According to the data from the Battery Alliance, China's power automobile production capacity of 1260GWh, by the end of 2022 and increased to 1,860GWh by the end of June 2023. However, the capacity utilization rate for batteries in China was 51.6% in 2022, which dropped to approximately 41% in 2023. There are more than 300 domestic automotive chip companies, the market share is rapidly to the

[7] Yin Biao, Duan Pengfei." Countermeasures for the development of new energy automobile industry in China under the background of "double carbon"[J]. Shanghai Energy Conservation, 2023, (08):1048-1052.

head of the enterprise concentration, in the investment and financing and mass production under the double pressure, the automotive chip industry will usher in the "elimination race".

In terms of autonomous driving technology for new energy vehicles, Chinese companies also face some challenges. While they have established a competitive edge in vehicle manufacturing, they still rely heavily on external suppliers for core components (such as battery management systems, electric drive systems, smart chips, etc.) still rely on external suppliers. Therefore, how to break the dependence on core technologies and achieve self-sufficiency has become an important challenge for Chinese new energy vehicle companies. Moreover, China's autonomous driving laws and regulations have not yet been perfected. How to promote the application of technology under the premise of ensuring safety has also become an important issue faced by enterprises.

3.1.2 Lagging infrastructure development

Although China has increased investment in charging infrastructure construction in recent years, overall, the charging piles for new energy vehicles are insufficient and unevenly distributed, showing the characteristics of dense coastal areas and relatively sparse northwest regions. The construction of new energy vehicles is still unable to grow rapidly. There are significant gaps between urban and rural areas, developed areas and underdeveloped areas. The number and charging speed of charging piles in first-tier cities and developed areas are relatively high, but in some second-and third-tier cities and rural areas, there is still a serious shortage of charging facilities, and the charging convenience and experience of users are poor. This restricts consumers' willingness to buy electric vehicles to a certain extent. Moreover, most charging piles still use relatively slow charging, and there are still bottlenecks in the construction of fast charging networks.

3.1.3 Impact of international competition and globalization strategies

The domestic market share of Chinese new energy vehicle companies is increasing year by year, but they still face strong competition from European, American and Japanese automakers. These multinational auto companies still occupy an important position in the high-end market by virtue of their strong brand influence, mature production technology and supply chain management capabilities. When Chinese new energy vehicle companies enter these overseas markets, they may face the following problems: First, the problems of brand recognition and trust. Second, the legal and policy barriers of different countries, especially the stricter safety and environmental protection of the European Union and the United States, put forward higher requirements for the product adaptability of Chinese enterprises. Third, the uncertainty of international trade policies, especially the trade between China and the United States, may also affect the internationalization process of Chinese new energy vehicle companies.

3.2 Future Development Opportunities for China's New Energy Vehicle Industry

3.2.1 Dual Carbon Targets and National Policy Facilitation

The future prospects of China's new energy automobile industry are exceptionally promising. As domestic and international trends evolve, the opportunities within the industry are becoming increasingly abundant and diverse. China's "double carbon" goal vision provides robust policy support for the new energy vehicle industry. To facilitate the achievement of this goal, a series of supportive policies such as car purchase subsidies, exemption from purchase tax, exemption from vehicle and ship tax, and construction of charging facilities have been implemented. Especially in terms of car purchase subsidies and tax incentives, it was pointed out that we should adhere to the main tone of "consolidating and expanding advantages", consolidate and further expand the advantages of new energy vehicles, and at the same time extend the vehicle purchase tax reduction and exemption policy for new energy vehicles until the end of 2027, which not only alleviates The burden on consumers to purchase cars has also greatly promoted the market penetration and popularization of new energy vehicles.

3.2.2 Growing Market Demand and Increasing Consumer Awareness

With the continuous improvement of public awareness of environmental protection, consumers' demand for low-carbon and green travel is increasing, and new energy vehicles have become the first choice of more and more consumers. Especially young people, they have higher requirements for environmental protection, intelligence and sense of technology. New energy vehicles are enthusiastically sought after by them because of their characteristics of environmental protection, low noise, and intelligence. At the same time, with the continuous improvement of the cruising range of electric vehicles and the improvement of charging convenience, consumers are gradually accepting new energy vehicles. These technological advances have significantly enhanced the comprehensive competitiveness of new energy vehicles and further promoted the growth of market demand.

3.2.3 Technological Innovation and Industrial Integration

With the urgency of global climate action, new energy is becoming an important bridge for communication and cooperation in the fields of economy, trade, technology and supply chain. New energy vehicles integrate green energy, artificial intelligence, the Internet, big data and other transformative technologies, positioning themselves as important platforms for the application of new technologies. In particular, breakthroughs in the field of solid-state batteries predict that future batteries will be safer, more durable and efficient. And with the low price of lithium carbonate, the decline in the cost of power batteries, the improvement in the cost of new energy vehicles, as well as geopolitical risks to international energy trade, rising oil prices accelerating the contraction of the fuel market, the sales of new energy vehicles in China to further enhance. Not only that, with the gradual development of China's new energy vehicle industry, the integration and optimization of the industrial chain has gradually become an important driving force for the industry. The cooperation among battery producers, vehicle manufacturers, charging facility enterprises, as well as the government and the capital market has formed a strong industrial synergy, which promotes the effective allocation of resources such as technology, capital and policies.

3.2.4 Internationalization and Global Market Expansion

As China's new energy vehicle market matures, many domestic companies have not only made remarkable achievements in the domestic market, but have also begun to actively layout the international market. Chinese new energy vehicle brands, such as BYD, Azure, and Xiaopeng, have gradually penetrated into developed markets such as Europe and North America by virtue of their lower production costs, mature supply chain systems, and excellent R&D capabilities. The internationalization process of Chinese companies serves not only to expand their market share, but also to further enhance their innovation capability and brand influence through technical collaboration with leading global automakers and technology firms. The rise of these Chinese brands not only boosts the global competitiveness of China's new energy vehicles, but also contibutes significantly to the electrification of the global automotive industry.

4 Policy recommendations for the future development of new energy vehicles in China

China's new energy vehicle industry is at a critical stage of booming development. With increasingly stringent environmental policies and growing market demand, new energy vehicles have become an important direction for future transportation development. In order to ensure that China's new energy vehicle industry can maintain its competitiveness and promote its sustainable development, it is necessary to carry out a comprehensive layout from the dimensions of technological innovation, market demand, policy support, industry chain synergy, etc., to promote the comprehensive upgrading and leapfrog development of the new energy vehicle industry.

4.1 Accelerate technological innovation and enhance industrial core competitiveness

Currently, the main technical bottlenecks faced by the new energy vehicle industry include power battery technology, charging facilities, autonomous driving technology, and hydrogen energy technology. Achieving breakthroughs in these areas can enhance product performance while also significantly reducing production costs, thereby facilitating the overall upgrade of the industry. On the one hand, it is necessary to strengthen the research and development of battery technology and the breakthrough and application of hydrogen energy technology. Enterprises and scientific research institutions can be encouraged to carry out R&D and innovation in battery materials, manufacturing processes and recycling technologies through special funds, tax exemptions, technology formulation and other means. At the same time, enterprises are encouraged to strengthen the R&D and demonstration application of hydrogen fuel cell technology. Supporting policies should facilitate the construction of hydrogen energy infrastructure and promote the gradual implementation of hydrogen energy vehicles in specific fields (such as logistics and public transportation). On the other hand, it is vital to continue to promoting intelligent network connection and autonomous driving technology. Enterprises should increase investment in intelligent network technology, autonomous driving algorithms, vehicle operating systems, etc., promote road testing and standardized management of smart vehicles, and gradually promote the commercialization of autonomous driving technology.

4.2 Improve infrastructure development and promote market penetration

The rapid development of new energy vehicles cannot be separated from perfect infrastructure support, especially the construction of charging facilities is crucial. At present, the number and distribution of charging piles have not yet fully met the growing market demand. In order to break through this problem, first of all, the government should strengthen the planning and construction of charging infrastructure and enrich the application scenarios of charging piles. Through rational layout and technological progress, promote the use of family charging piles by individuals, and focus on the reasonable planning and layout of public charging piles in the community according to the new energy vehicle ownership in the region.[8] At the same time, promote the intelligent construction of charging piles to realize interconnection and enhance user experience. Second, it is necessary to promote the integration of charging facilities with the smart grid. The large-scale popularization of new energy vehicles will significantly increase electricity demand, which poses a challenge to the load and scheduling of the power grid. The government should encourage the integration of charging piles with smart grids to promote the upgrading of grid infrastructure. Through the scheduling function of the smart grid, charging and intelligent control of charging time and power during periods of lighter power loads can avoid excessive pressure on the power grid from large-scale charging, while also realizing the energy storage function of charging piles, releasing the reserve power when the power is tight and further improving the efficiency of power usage.

4.3 Optimize policy support to stimulate market demand

In recent years, policies and measures such as car purchase subsidies and tax incentives have provided consumers and manufacturers with relatively generous incentives. However, as the market gradually matures, policies need to be further optimized and upgraded to promote the industry to become more independent and healthier. direction. Under the framework of the current new energy vehicle subsidy policy, we should gradually reduce reliance on purchase subsidies and shift to policies that pay more attention to technological innovation and market-oriented incentives, the "Technology Innovation Award" can be set up to reward the development of high-performance and high-safety new energy vehicles. By introducing low-carbon travel tax incentives, consumers are encouraged to buy green and environmentally friendly new energy implemented. To better balance the presence of new energy vehicles and fuel vehicles, implementing differentiated tax policies would be beneficial. For example, higher emission taxes or fuel surcharges are imposed on fuel vehicles, and the funds obtained are used for the new energy vehicle industry. This measure can not only effectively promote consumers' green travel choices, but also encourage car companies to accelerate the transformation of new energy vehicles through market mechanisms.

4.4 Promote internationalization strategy to enhance global competitiveness

With increasingly stringent global environmental regulations and increased demand for new energy products in the international market, the international market for new energy vehicles has become a new blue ocean for Chinese enterprises to expand. The technological advances, cost advantages and market scale of Chinese enterprises in the field of new energy vehicles have given them strong international competitiveness, and in order to further assist enterprises to go global, it is necessary for enterprises and the government to work together.

China's new energy automobile industry is a complex system engineering, involving technology, market, policy, internationalization and other aspects. Comprehensive policies should be implemented to create a complete industrial ecological chain, not only to encourage technological innovation and infrastructure construction, but also to promote the health of the industry by optimizing policy support and expanding the international market. The "dual-carbon" goals also put forward introduce richer and more diversified requirements for the production of China's new energy automobile enterprises. While traditional production methods still persist, it is essential for new energy automobile manufactures to adopt a green and low-carbon approach. This is not only in line with the requirements of China's "double carbon" goal, but also in line with the needs of the international market for low-carbon economy.[9] Enterprises should continue to strengthen the research and development of batteries, electric drive systems and intelligent technologies (such as autonomous driving and Telematics) to improve product performance and safety, and strive to occupy the right to speak in the global technical standards. Meanwhile, through precise market positioning and differentiation strategies, combined with localized operations and differentiated marketing, they should establish the image of a globally renowned brand and increase brand exposure through channels such as social media and automotive exhibitions. Enterprises also need to pay close attention to the policies and regulations of different countries and regions to ensure compliance and seek policy support, especially

[8] Zhao Zheng. Research on the status quo and challenges of new energy vehicle development in China under the dual-carbon goal[J]. Business Economy,2022, (08):46-47+52.

[9] Liu Zhuo." Analysis of the international competitiveness situation of new energy vehicles in China under the background of 'double carbon' target[J]. Modern Industrial Economy and Informatization,2024,14(06):34-37.

when it comes to environmental protection and certification requirements in markets such as Europe and the United States, where companies need to improve their level of compliance. In the process of internationalization, international cultivation of talents and cross-cultural management are equally important.

5 Conclusion

Under the guidance of the "dual carbon" goals, China's new energy vehicle industry is experiencing rapid development and has become an important driving force for the transformation of the global low-carbon economy. Despite challenges such as technical bottlenecks, insufficient infrastructure and international competition, the growth of market demand and policy support provides a solid foundation for the future of the industry. By accelerating technological innovation, improving infrastructure construction, and optimizing policy incentives, the new energy vehicle industry is expected to break through the current bottlenecks and achieve success.

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ダブルカーボン目標下における中国の新エネルギー自動車産業の発展に関する分析（要旨）

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深刻化する地球規模の気候変動問題を受け、各国は低炭素経済への移行を進めている。世界最大の二酸化炭素排出国である中国は、2030年までに二酸化炭素排出量をピークに達させ、2060年までに二酸化炭素排出量を実質ゼロにするという「ダブルカーボン」目標を掲げている。この状況下では、内燃機関車の転換とアップグレードが急務である。新エネルギー自動車産業はかつてないほどの好機を迎えているが、同時に多くの課題にも直面している。

本稿では、「ダブルカーボン」という背景の下、中国の新エネルギー自動車産業の歴史、現状、課題、潜在的な機会を体系的に整理することを目的とする。まず、低炭素経済への転換を促進する新エネルギー自動車の中核的な役割について論じ、政治、市場需要、技術革新が同産業に与える影響について考察する。これを踏まえた上で、本稿では、技術的ボトルネック、インフラの不備、国際競争といった、同産業が直面する一連の課題について引き続き論じる。

最後に、本稿では中国の新エネルギー自動車産業の動向を踏まえ、産業振興のための理論的裏付けとなる政策提案を行う。本稿は、包括的な分析を通じて、政策立案者や業界関係者が「ダブルカーボン」の目標達成に向けた中国の新エネルギー自動車産業のさらなる発展を推進するための示唆を提供することを目指している。

A Progress to Meet SDG 7 in the Russian Far East

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Abstract

The paper is devoted to the analysis of Russia's experience and progress in achieving SDG 7 in the Far Eastern region. The author provides basic SDG achievement indicators officially adopted by Russia and analyses the SDG statistics published by the Federal State Statistics Service of Russia. In addition to assessing official statistics, the author examines the latest empirical data related to the development of energy sector in the Russian Far East. As a result of a study of recent trends in RFE's energy sector and attempts of Russian government and private/state-owned enterprises to counter the energy deficit in the RFE, the author comes to the following conclusions. Firstly, the analysis of statistical data demonstrates that the basic SDG 7 indicators in the RFE are stable and largely are showing positive dynamics. However, the significantly increased energy consumption represents a serious challenge for the implementation of Russia's energy strategy. Secondly, in order to deal with power deficit, the Russian government has initiated a number of reforms aimed at increasing state support for business, encouraging investment in the development of energy infrastructure, while in the area of power grid management, Russia is pursuing a centralization policy. Thirdly, the clean energy agenda does not currently dominate Russia's energy policy. Rather, a special attention is drawn to nuclear energy, and it is assumed that first nuclear power plants in the RFE will be built in the 2030s to compensate for the energy deficit in the region.

Keywords: sustainable development, SDG 7, energy, Russian Far East, nuclear energy
JEL classification codes: O13, Q42, Q43, R58, H54

1. SDG 7 Progress Indicators as Adopted by Russia

In 2017, Russia began to provide official statistical information on SDG achievement indicators. The Federal State Statistics Service (Rosstat) was appointed as the body responsible for publishing the data and transferring it to international organizations.

Sustainable Development Goal No. 7 aims to ensure access to affordable, reliable, sustainable and modern energy for all. According to information, provided by Rosstat, Russia adopts the following indicators to demonstrate progress towards achieving SDG 7 (National set of…, 2024):

- By 2030, ensure universal access to affordable, reliable and modern energy services (measured as a) electricity consumption, billion kWh, b) electricity consumption per capita, kWh);

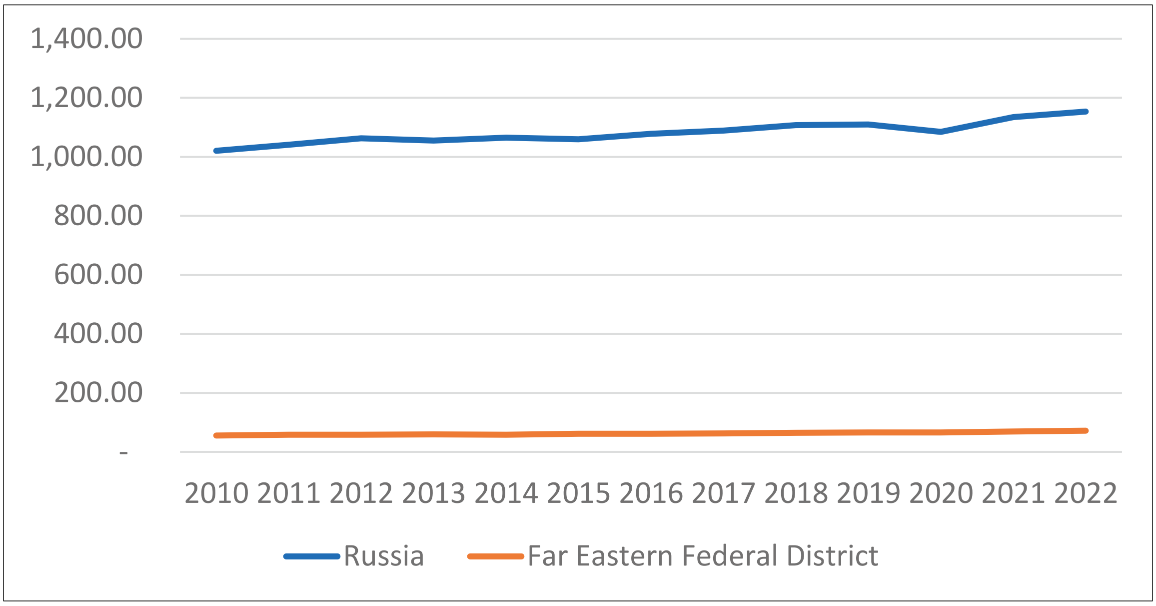
- By 2030, increase substantially the share of renewable energy in the global energy mix (measured as a) share of renewable energy in power generation mix, %, b) installed capacity of renewable power generation facilities (not including hydroelectric power plants with an installed capacity of over 25 MW), MW);

- By 2030, double the global rate of improvement in energy efficiency (measured as energy intensity of GNP for the year preceding the previous one, kg of conventional fuel per 10 thousand rubles in constant prices of 2016);

- By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology (measured as investments in solar, wind and geothermal power generation).

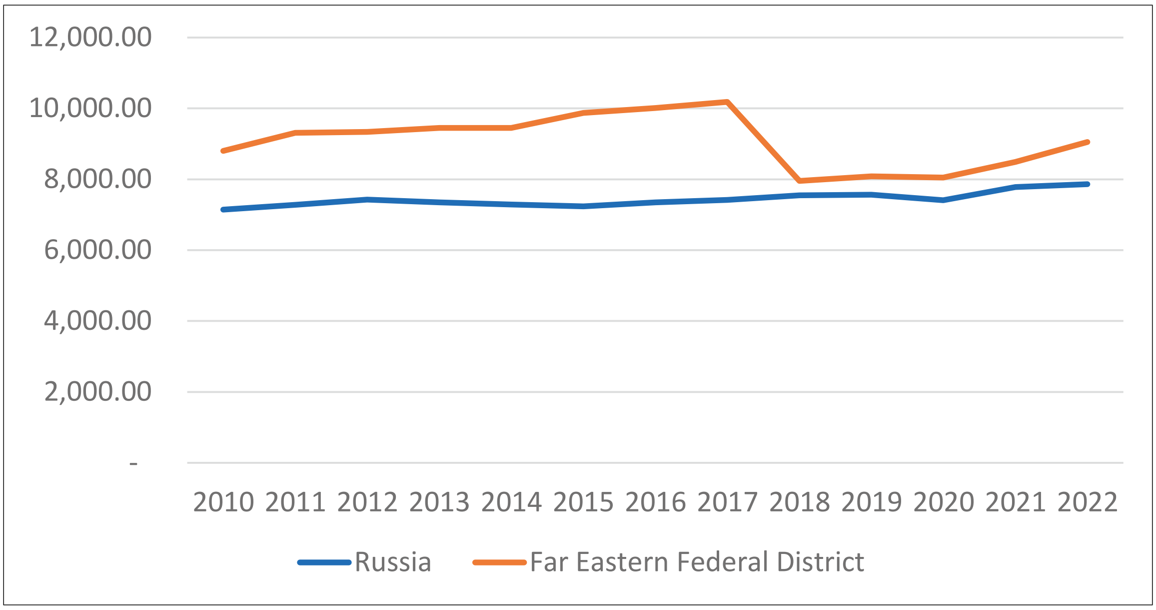
At the same time, no specific targets for achieving the designated indicators were officially proposed. Therefore, it is only possible to track the dynamics of progress in achieving a particular indicator. In addition, since 2022, many Russian

Figure 1: Electricity consumption in Russia and the RFE, 2010 – 2022, billion kWh



Source: Compiled from the Rosstat data (National set of…, 2024)

Figure 2: Electricity consumption per capita in Russia and the RFE, 2010 – 2022, billion kWh



Source: Compiled from the Rosstat data (National set of…, 2024)

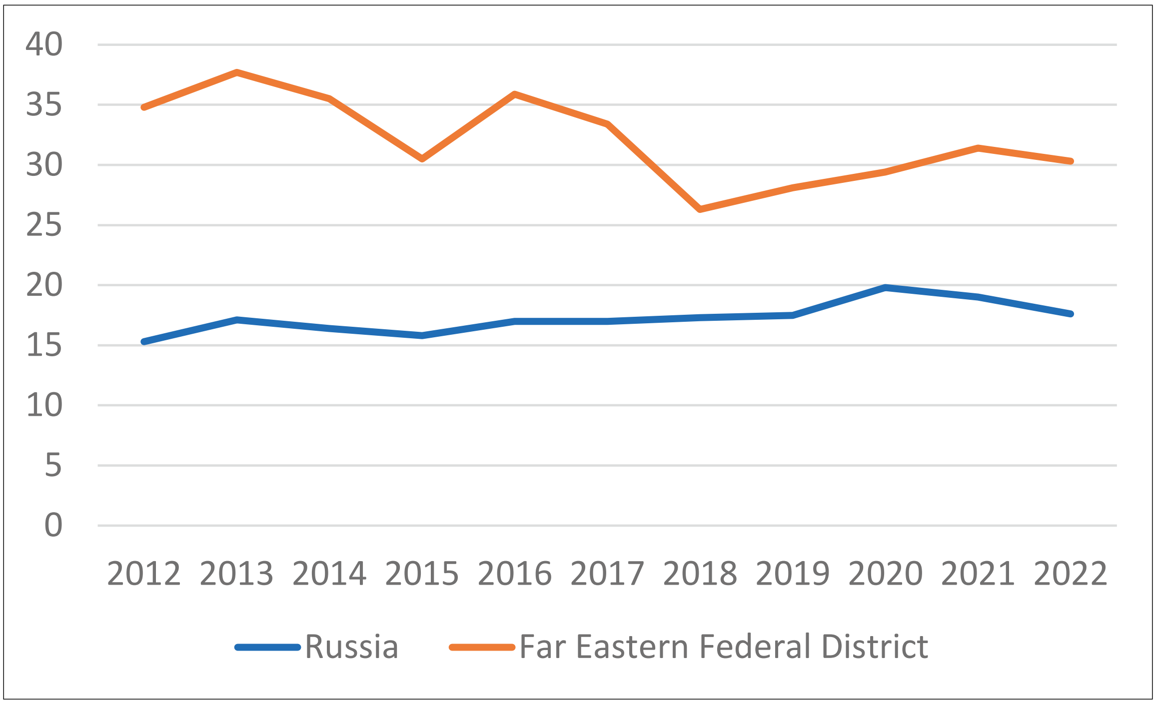
official agencies, including Rosstat, have stopped publishing statistics on a number of indicators. In this regard, Rosstat data related to statistics on energy consumption and other relevant indicators are also limited until 2022, which is a separate problem for analyzing the implementation of SDG 7.

Drawing on Rosstat data, the following observations can be made:

Electricity consumption in Russia has grown from 1026.6 billion kWh in 2010 to 1153.5 billion kWh in 2022, representing a 12.3% increase. In the Russian Far East, the growth rate is significantly higher – 29.6% from 2010 to 2022, when electricity consumption increased from 55.4 to 71.8 billion kWh.

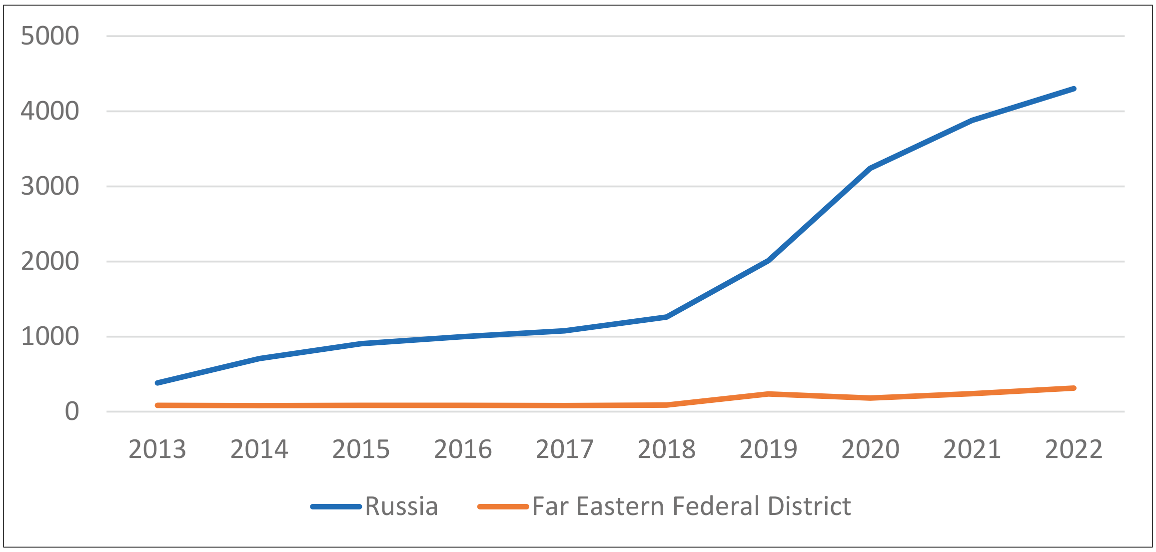
On average, electricity consumption per capita in Russia increased by 10.5%, from 7114.8 to 7862.9 kWh between 2010 and 2022. In the Russian Far East, the growth rate is 2.8%, from 8797.7 to 9052.4 over the same period. Rosstat statistics also record a drop between 2017 and 2018, likely related to the inclusion of the Republic of Buryatia and Zabaikalsky Krai into the Far Eastern Federal District in 2018. These two

Figure 3: Share of renewable energy in power generation mix in Russia and the RFE, 2012 – 2022, %



Source: Compiled from the Rosstat data (National set of…, 2024)

Figure 4: Installed capacity of renewable power generation facilities in Russia and the RFE, 2012 – 2022, MW



Source: Compiled from the Rosstat data (National set of…, 2024)

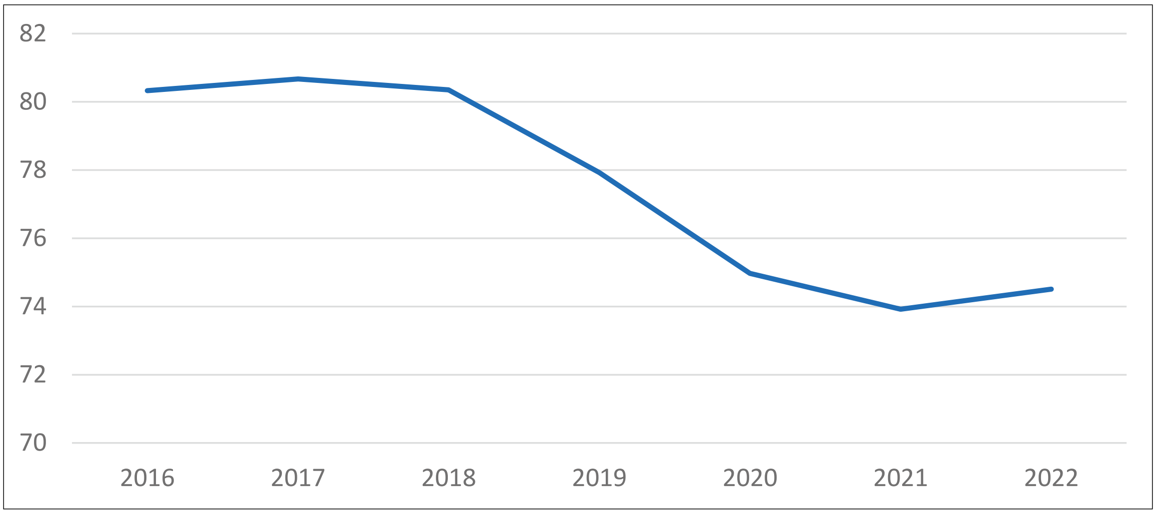
entities became a part of the RFE, but remain connected to the UPS Siberia (Unified Power System). Overall, the electricity consumption per capita rate is higher in the RFE compared to Russia as a whole.

The share of renewable energy sources in electricity generation mix in Russia increased from 15.3% in 2012 to 17.6% in 2022. In the Far East, this figure is higher, although its negative dynamics can be observed: from 34.8% in 2012 to 30.3% in 2022.

The installed capacity of renewable energy power generation facilities in Russia increased tenfold over the nine-year period from 2013 to 2022 – from 381 to 4,300 MW. In the RFE, growth rate is less impressive and amounts to only 284% – from 81.6 MW in 2013 to 313.2 MW in 2022.

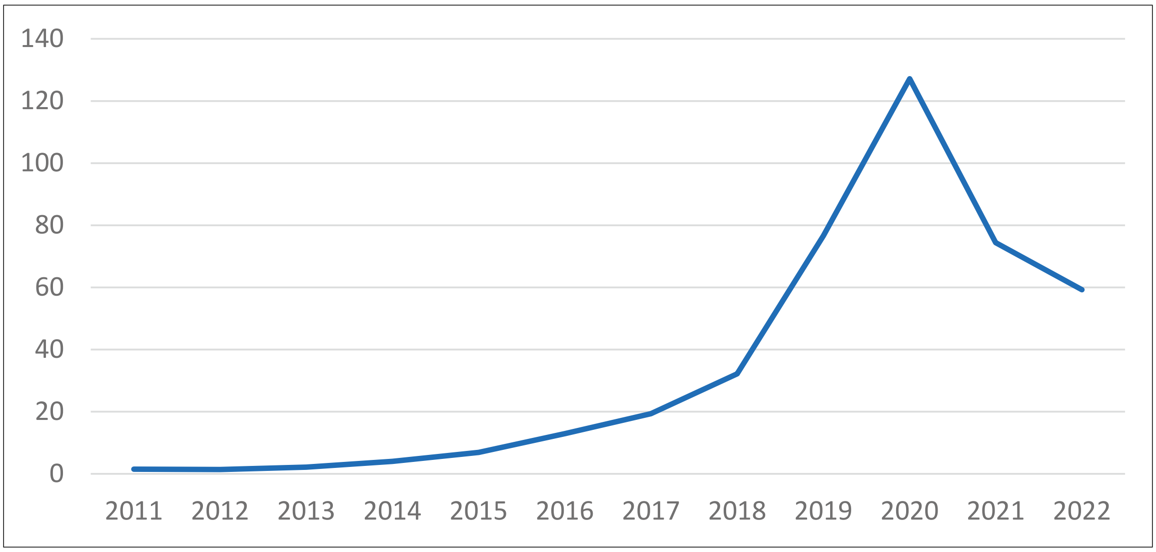
Energy intensity of GDP, expressed in kg of conventional fuel per 10 thousand rubles in constant prices of 2016, decreased in Russia – from 80.3 to 74.5 over 2016 – 2022 period, which represents a 7.24% decrease.

Figure 5: Energy intensity of GNP for the year preceding the previous one in Russia, kg of conventional fuel per 10 thousand rubles in constant prices of 2016



Source: Compiled from the data of Rosstat (National set of…, 2024)

Figure 6: Investments in solar, wind and geothermal power generation, RUB mln



Source: Compiled from the Rosstat data (National set of…, 2024)

The last indicator relates to investments in the development of power generation using three types of renewable sources – solar, wind and geothermal power. This indicator has a positive trend, the volume of investments has grown from 1.5 million rubles in 2011 to 59.2 million rubles in 2022.

2. Recent Trends in the RFE Energy Sector

Although recent statistics are not available, some conclusions about current trends in the development of the energy sector in the RFE can be drawn from statements made by Russian officials. Thus, statistics cited in the report by Russia's Minister of Energy Sergey Tsivilyov at the Eastern Economic Forum in Vladivostok in September 2024 indicate a significant increase in energy consumption in the Far Eastern Region (New energy for the Far East…, 2024).

Over the past two years, annual electricity consumption growth rate in the RFE stands at 3.9% which is much higher than Russia's average 1.5%. At the same time, there are growing problems with the maintenance and modernization of the aging energy infrastructure. Wear and tear of power generation facilities in the RFE stands at 13%, Russia's average – 9.5%. The degradation of the power grid assets is even more severe: wear and tear of power grids in RFE is up to 70%. As a result, there is a growing accident rate at both power generation facilities and power grids, poor power supply in certain areas. The electricity losses in the RFE energy system are estimated to stand at 10% (Russia's average is below 8%).

High energy consumption growth rate, coupled with the inadequate technical condition of power grids and generation facilities, have led to the fact that RFE is becoming an energy-deficient region. The reason for this is the high rate of economic growth in the region. According to S. Tsivilyov, "*in 2021, Russia surpassed the peak consumption of electricity of 1990 ... The Far East is developing at a much faster pace than Russia on average, and this is a good sign. The unified power system created in the USSR is no longer sufficient to implement Russia's economic development program. In energy-surplus areas, the energy infrastructure condition is a restraining factor for economic development*" (Sergey Tsivilyov…, 2024). His assessment is supported by Aysen Nikolayev, head of Sakha Republic (Yakutia), who claimed: "*the RFE energy sector no longer meets the pace of industrial growth today... after 2021, due to rapid industrial growth, consumption began to exceed electricity generation*" (New energy for the Far East…, 2024).

These circumstances also had an impact on electricity supplies to China, the main electricity export destinations for the RFE. Electricity exports from the RFE to China peaked in 2022 at 4.6 billion kWh, since then it has suffered a 32% decline to 3.1 billion kWh in 2023. Exports for the period January – June 2024 stand at 3.52 billion kWh (Korochkina, 2024). In august 2023, Russia reduced electricity exports to China via the Amur – Heihe power line from 600 MW to 100-200 MW due to low water levels in RFE areas, frequent emergency situations, growing electricity consumption in RFE energy system (Russia and China…, 2024). The Amur – Heihe power line is still operating in a limited mode, and in the context of energy shortage in the RFE and the poor technical condition of transborder power grids, the prospects for restoring exports on a large scale also remain limited. Another obstacle to increasing electricity exports appears to be the tariff issue. Although in October 2023, China agreed to buy Russian electricity at a 7% higher duty (Mingazov, 2023), the volume of electricity imported from Russia remained at a relatively low level.

3. Private/State-owned Enterprise Efforts to Counter Power Deficit in the RFE

UPS Vostok (RFE's energy system) consists of 59 power plants with total installed capacity of 14.3 GW. According to the projections, provided by Fyodor Opadchyi, head of SO UPS (System Operator of Russian Unified Power System), electricity deficit in the RFE will stand at 10.7 billion kWh by 2030. This would require the construction of additional power generation facilities with an installed capacity of 1.6 – 1.9 GW by that period (Fyodor Opadchyi…, 2024). This target is reflected in the *Scheme and Program for the Development of Electric Power Systems for 2024-2029*, adopted in November 2023 by Russia's Ministry of Energy: by 2029 the required volume of installed capacity of additional power generation facilities for UPS Vostok is indicated as 1.935 GW (Scheme and Program…, 2023).

However, attracting private capital to the construction of new power generation is a major problem. The unfavorable investment climate in many areas of the RFE and the high key interest rate in Russia (21% as of November 2024) hinder the attraction of private investment, and state support instruments are needed to solve this problem. According to the *Scheme and Program*, in order to build new power generation facilities in different regions of Russia, it's planned to conduct a *Competitive Selection of New Generating Facilities* (COM NGO) – a mechanism for attracting investment in energy sector, which allows for the construction of power generating facilities in energy-deficient territories, the list and description of which is established by a decision of the Government of Russia (Scheme and Program…, 2023). However, in the case of the RFE, the *Competitive Selection* may not take place at all due to the lack of competition and the unwillingness of generating companies to participate in unprofitable projects. According to Deputy Minister of Energy Evgeny Grabchak, the Ministry plans to decide in 2025 whether the *Competitive Selection* will be held or whether those responsible for commissioning new power generation capacities will be appointed by the government (The Ministry of Energy…, 2024).

Another instrument for stimulating private enterprises to modernize old and introduce new generation facilities is the *DPM program* (Capacity Provision Agreement) – a state support mechanism that provides for the obligation of generating companies appointed by the Russian government to commission new power generation capacities within a specified time period, subject to guaranteed payment. The implementation of the DPM-1 subsidy program (finished in the 2010s) made it possible to introduce about 30 GW of new generating capacity throughout Russia (Bystrov, 2020), and, according to the statement made by Aysen Nikolaev at the Eastern Economic Forum in Vladivostok in September 2024, the extension of the DMP-2 program until 2031 could help compensate power generation shortage in the RFE (New energy for the Far East…, 2024).

Probably one of the most realistic options to introduce new generation capacities in the RFE is the construction of nuclear power plants. According to the *draft General Scheme for the Electric Power Facilities Development until 2042*, Russia plans to introduce 28.5 GW of nuclear generation during this period (Draft General Scheme…, 2024). The construction of the nuclear power plants is expected to be carried out by state-owned Rosatom corporation. In the RFE, Rosatom plans to construct two nuclear power plants are expected in Khabarovsky and Primorsky Krai, each with an installed capacity of 1.2 GW, operating on medium-sized reactors (600 MW). At the moment, there are no nuclear power plants in the RFE, and their construction represent a certain challenge, requiring a significant restructuring of the labor market in the region. As Alexei Likhachev, Rosatom CEO notes, "*Ministry of Energy has already announced that it would like to launch one of these nuclear power plants [in the RFE] by 2032. We agree with this approach, although it will require a certain mobilization and public discussion... [the construction of a nuclear power plant] is a major boost to the development of the construction industry, the training of personnel in this region – we will need thousands of people to build and operate power plants*" (New energy for the Far East…, 2024). On December 30, 2024, Russian government has finally approved the *General Scheme for the Electric Power Facilities Development until 2042*. According to the final version of the document, in the RFE, it is planned to build five nuclear power plants: large ones in Primorsky Krai (near Fokino) and in Khabarovsky Krai (near Evron); small-capacity nuclear power plants in Yakutia and Chukotka, it is also planned to install a floating power unit close to Pevek, Chukotka. Thus, the construction of the nuclear power plant in Primorye will start in 2033 and by 2042, the plant will operate on two power units, each with a capacity of 1000 MW (General Scheme…б 2024).

Another problem in the energy sector of the RFE is related to the state of the power grid infrastructure. The experience of major blackouts in Primorsky Krai (2020; 2024) clearly demonstrated the wear and tear of power grid assets in the RFE. In this regard, the modernization and construction of new power grids is one of the most important priorities. Moreover, the construction of new power grids is also important because it represents another way to compensate for the power deficit, in addition to creating new power generation capacity. Thus, a key project for Primorsky Krai today is the construction of a new substation "*Varyag*" and the 500-kV transit transmission line "*Primorskaya Plant – Varyag*" with a length of 475 km, which will connect the northern and southern parts of Primorsky Krai. In conditions of power deficit, this line will provide power supply to certain areas of Vladivostok (currently experiencing a construction boom), as well as the future *Primorsky Steel Plant* – the expected supplier of products for the *Zvezda shipyard*, another major industrial facility in southern part of Primorsky Krai (Klimenko, 2024).

In the field of power grid management, the Russian government has initiated a reform aimed at power grid assets centralization. For more efficient power supply, consolidation of grid assets, development of abandoned power grids, and better funding transparency, amendments to the federal law "*On Electric Power Industry*" came into force on September 1, 2024, providing for the creation of *system-forming territorial grid organizations* (STSO). This reform involves the allocation of power grid assets from different companies and their transfer to a company appointed to the role of STSO. Starting from 2025, STSOs will operate in every region of Russia, and will become a kind of responsibility centers for power supply. As Evgeny Grabchak explained, "*the large number of local power grid companies and their disunity have complicated interaction in elimination of emergency situations and maintenance of power grids, including abandoned ones. Now the functioning of the energy infrastructure will be centralized*" (STSOs will be…, 2024).

In the RFE, the role of STSO will be assigned to the *Far Eastern Distribution Grid Company* (DRSK), a subsidiary of *RusHydro*, major power generation company in the RFE. In order to comply with the new requirements of the legislation on STSO, *RusHydro* will also redistribute part of its assets and transfer its power grids to the control of DRSK. Thus, in 2025, the grid assets of *RusHydro's YakutskEnergo* company (engaged in both power generation and power transmission activity) are planned to be transferred to DRSK (STSOs will be…, 2024).

4. Conclusions

An analysis of the dynamics of the indicators used to evaluate progress towards achieving SDG 7 in the RFE suggests that they are experiencing stable, although not outstanding, growth.

The share of renewable sources in the energy mix of the RFE is quite high and amounts to 30%, which is higher than the Russian average, and the installed capacity of power generation facilities operating on renewable sources also increased over the past few years. Another positive trend is the decreased energy intensity of GNP. At the same time, the share of renewable energy sources in the energy mix of the RFE has decreased in dynamics of recent years, while electricity consumption is growing at a significant rate. Against the backdrop of rapid economic and industrial growth, these circumstances have led to the emergence of a power deficit in the RFE, and this represents a challenge for the implementation of Russia's energy strategy.

In order to deal with power deficit, the Russian government has initiated a number of mechanisms and reforms aimed at increasing state support for business and encouraging investment in the development of energy infrastructure – for example, the DPM subsidy program, the extension of which until 2031 is proposed by local authorities in the RFE as possibly having a positive impact on attracting investment for the construction of new generation capacities. In the area of power grid management, the Russian government is pursuing a centralization policy aimed at transferring power grid assets to authorized companies selected to play the role of system-forming power grid companies (STSOs) in each region. In the RFE, the role of STSO will be transferred to DRSK, and in 2025 the redistribution of power grid assets of Far Eastern energy companies will begin.

The clean energy agenda does not currently dominate Russia's energy policy – moreover, sometimes it is presented in Russian official discourse as an obstacle to economic growth and even as a manifestation of Western neocolonialism towards developing countries (Sechin, 2024). The emphasis is mostly placed on developing coal, gas and hydropower generation (Sustainable Development Goals…, 2023). Special attention is drawn to nuclear energy, and it is assumed that first nuclear power plants in the RFE will be built in the 2030s to compensate for the energy deficit in the region.

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ロシア極東におけるSDG7達成に向けた進捗状況（要旨）

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バレンティン・I・ヴォロシャック

本稿では、ロシア極東地域におけるSDG7の達成に向けたロシアの経験と進捗状況の分析に焦点を当てる。筆者は、ロシアが公式に採択したSDG達成の基本指標を提示し、ロシア連邦国家統計局が発表したSDG統計を分析する。公式統計の評価に加え、筆者はロシア極東のエネルギーセクター開発に関する最新の経験的データを検証する。

ロシア極東のエネルギー部門における最近の傾向と、ロシア政府および民間・国営企業によるロシア極東のエネルギー不足への対策を調査した結果、筆者は以下の結論に達した。まず、統計データの分析から、ロシア極東におけるSDG7の基本指標は安定しており、概ね良好な動向を示していることが明らかになった。しかし、エネルギー消費の大幅な増加は、ロシアのエネルギー戦略の実施にとって深刻な課題である。

第二に、電力不足に対処するために、ロシア政府は、ビジネスへの国家支援の拡大、エネルギーインフラ開発への投資の奨励を目的とした数々の改革に着手している。一方、送電網管理の分野では、ロシアは集中化政策を推進している。

第三に、クリーンエネルギーの議題は、現在のところロシアのエネルギー政策を支配しているわけではない。むしろ、原子力エネルギーに特別な関心が寄せられており、2030年代にロシア極東初の原子力発電所が建設され、同地域のエネルギー不足を補うことが想定されている。

研 究 報 告

Is there a trade-off between Mining and Manufacturing? Empirical evidence from Mongolia

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Abstract

We argue that the extreme dependence on the natural resource sector has negatively affected a part of the Mongolian economy, thus causing the manufacturing sector to decline. The results support the argument. We found a long-run negative relationship between the growing resource sector and manufacturing: a 10% increase in the resource sector brings a 1-2% decrease in manufacturing in Mongolia. In addition, a structural break was found, indicating a change in the relationship from negative to positive, starting in 2010.

Keywords: Manufacturing, Natural resource abundance, Resource curse, Dutch disease, VECM, ARDL
JEL Classification: F14, F15, O13, O14, Q33

1 Introduction

The natural resource sector plays considerable role in Mongolian economy. In 2022, it accounts for 24 percent of the country's GDP and 95 percent of its exports. Although Mongolian economy enjoys high resource incomes, there are potential adverse effects of the booming resource sector on other sectors in the economy, in particular, manufacturing. In other words, there perhaps is a potential threat of de-industrialization in the economy. The negative effect, such as this, of the resource windfall on the economy is explained by the phenomenon so-called the Dutch disease.

The mechanism behind the Dutch disease is clear. A part of the resource revenues is spent on non-traded goods (services) which leads to a real appreciation, i.e., a rise in the relative price of non-traded goods in terms of traded goods. This in turn draws resources out of the non-resource traded sector (manufacturing) into the non-traded goods producing sector as Corden and Neary (1982) explained [1].

We conduct statistical analysis looking for evidence of Dutch disease in Mongolian economy. The vector error correction modeling (VECM) and Autoregressive distributed lag (ARDL) approaches are used. Findings suggest that a 10% increase in resource production is followed by 1-2% shrinkage in manufacturing.

In addition, we conducted a structural break test and found there is a breaking point in our data: March 2010 (henceforth 2010m3). We divided our sample into subsamples before 2010m3 and after 2010m3. Although the results are not statistically significant, we observed a shift in the long-run relationship between mineral resource production and manufacturing from negative to positive. This may be due to the development stages of the mining sector in Mongolia. Before 2010, the sector was under speedy start signing contracts with huge mining companies to build mines and exploit resources like coal and copper; however, after 2010, the sector had already reached its full potential to positively affect the whole economy.

Although the Mongolian economy is characterized by symptoms of the Dutch disease, no formal statistical work has been applied to this problem. The research fills this gap using monthly data from the National Statistical Office of Mongolia.

The rest of the paper is organized as follows. Section 2 reviews the theoretical and empirical literature on the effects of the natural resource boom on manufacturing. Section 3 explains

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the Mongolian experience with natural resource discoveries and developments, along with the changes in the manufacturing sector using descriptive statistics. Section 4 presents the VECM and ARDL methodology and data and reports the empirical results. Section 5 summarizes the significant findings of the analysis and concludes.

2 Theoretical and Empirical Literature

Khan et al. (2022) [2], Ploeg (2011) [3], Sachs and Warner (1999) [4] and many recognize the opportunities natural resources provide for economic growth and development. Still, many countries are not doing well despite of the natural resource abun-dance such as African economies (Sachs and Warner, 1997) [5], Venezuela (Sachs and Rodriguez, 1999) [6], Brazil (Caselli and Michaels, 2013) [7], Azerbaijan (Zulfigarov and Neuenkirch, 2019) [8] etc. Therefore, according to Tovrik (2009) [9], the key question is why resource-rich economies such as Botswana or Norway are more successful while others perform poorly despite their immense natural wealth. Is it because resource booms induce an appreciation of the real exchange rate and make non-resource sectors less competitive? In other words, is it because of the Dutch disease? More generally, as Ploeg (2011) [3] put it, are natural resources a “curse” or a “blessing”?

Ploeg (2011) [3] argues that empirically either outcome is possible. He surveyed a variety of hypotheses and supporting evidence for why some countries benefit and others lose from the presence of natural resources. He summarized the negative effects of the natural resource boom as follows: A resource windfall induces appreciation of the real exchange rate, de-industrialization (Dutch disease) and bad growth prospects, and that these adverse effects are more severe in volatile countries with bad institutions and lack of rule of law, corruption, and underdeveloped financial systems.

There are supporting studies of such adverse effects of resource endowments. Narankhuu (2018) [10] found that the rapid development of the mining sector created significant fiscal and monetary imbalances in the macro economy, and moreover, the institutional quality and governance in Mongolia had deteriorated noticeably at the same time when Mongolia started experiencing favorable global commodity markets. Robinson et al (2006) [11] argue that the political incentives that resource endowments generate are the key to understanding whether they are a curse. They show that resource booms tend to cause over-extraction of natural resources, and increase resource misallocation in the rest of the economy by providing incentives for politicians to stay in power by influencing the elections. They conclude that the overall impact of resource booms on the economy depends critically on institutions since these determine the extent to which political incentives map into policy outcomes, and countries without institutions that promote accountability and state competence may suffer from a resource curse. Caselli and Michaels (2013) [7] found that oil-rich Brazilian municipalities experienced increases in revenues and reported corresponding increases in spending on public goods and services; however, social transfers, public good provision, infrastructure, and household income increased less (if at all) than one might expect, given the higher reported spending.

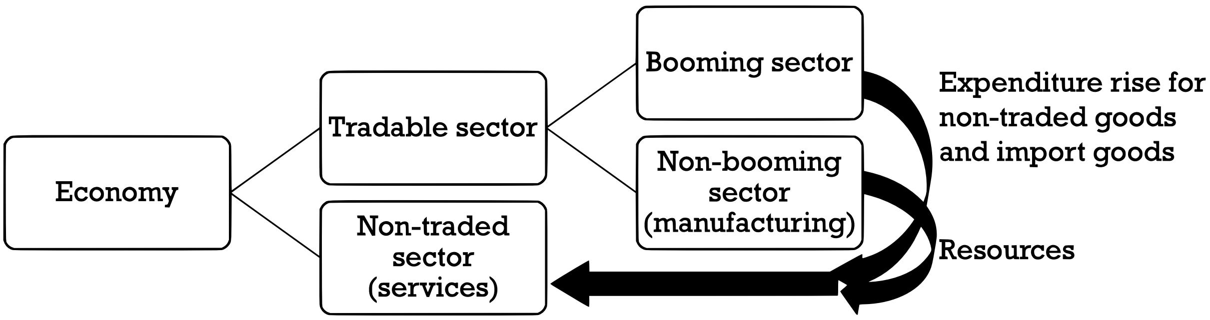
2.1 Theoretical explanations

Here, we discuss the theoretical support and evidence available for the effects of natural resources on the economy, particularly manufacturing.

The Dutch disease hypothesis predicts that natural resource windfalls cause de-industrialization [1]. According to the hypothesis, a resource windfall induces appreciation of the real exchange rate, contraction of the traded sector, and expansion of the non-traded sectors.

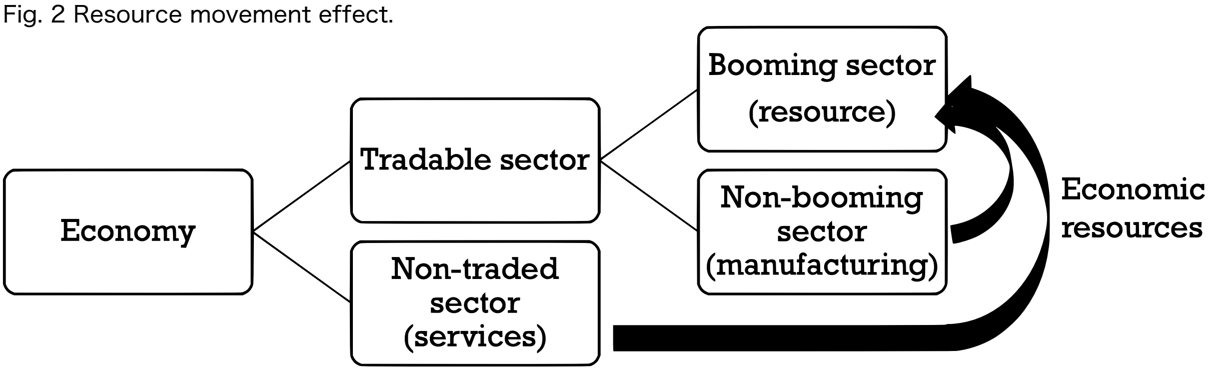
In the short-run, resource revenue increases national income and demand. Figure 1 summarizes the spending effect. rewrite: The spending effect works as the extra income from the booming resource sector is spent on the non-traded sector, raising its price and leading to real exchange rate appreciation. In Figure 1, we can see that more resources from manufacturing is drawn to the non-traded sector, which results in indirect de-industrialization. In addition, because of the real exchange rate appreciation, manufacturing is less competitive compared to the cheap imports [1].

Fig. 1 Spending effect (real exchange rate appreciation).



Note: This is the author’s imaging based on Corden and Neary (1982) [1]

Fig. 2 Resource movement effect.



Note: This is the author's imaging based on Corden and Neary (1982) [1]

For the longer run effects, one must allow capital and labor to be mobile across sectors and move beyond the specific factors framework. In an open economy the Heckscher-Ohlin framework with competitive labor, capital, and product markets, and constant returns to scale in the production of traded and non-traded goods, a natural resource windfall induces a higher wage-rental ratio if the non-traded sector is more labor-intensive than the traded sector. In any case, there is a rise in the relative price of non-traded goods, leading to an expansion of the non-traded sector and a contraction of the traded sector. Labor and capital shift from the traded to the non-traded sectors.

Morshed and Turnovsky (2004) [12] studied the effects of a resource boom in a dynamic dependent economy with adjustment costs for investment and allowed for costly sectoral reallocation of capital between non-traded and traded sectors. Turnovsky (1996) [13] used a model of endogenous growth in the dependent economy to explore the implications of a resource boom on economic growth.

What happens if the resource exploitation sector uses labor and capital as factor inputs? According to Corden and Neary (1982) [1], apart from the previously discussed spending effects of a resource boom, there is also a resource movement effect which is summarized in Figure 2. The resource movement effect explains that due to resource revenue increase, the labor movement from the non-traded and traded sectors towards the resource sector causes direct de-industrialization.

Looking at the longer run, where both factors of production (labor and capital) are mobile between the traded and non-traded sectors and the resource sector only uses labor, it helps to consider a mini-Heckscher-Ohlin economy for the traded and non-traded sectors. The Rybczynski theorem states that the movement of labor out of the non-resource towards the resource sectors causes the output of the capital-intensive non-resource sector to expand. This may lead to the paradoxical result of pro-industrialization if capital-intensive manufacturing constitutes the traded sector, despite some offsetting effects arising from the de-industrialization (Corden and Neary, 1982) [1]. If the non-traded sector is more capital-intensive, the real exchange rate depreciates if labor is needed to secure the resource windfall; the Rybczynski theorem then states that the non-traded sector expands and the traded sector contracts. This increase in the relative supply of non-traded goods fuels the depreciation of the real exchange rate. Real exchange depreciation may also result from a boost to natural resource exports if the traded sector is relatively capital-intensive and capital is needed for the exploitation of natural resources. Since less capital is available for the traded sector, less labor is needed, and thus, more labor is available for the non-traded sector. This may lead to a depreciation of the real exchange rate. This also occurs if the income distribution is shifted to consumers with a low propensity to consume non-traded goods (Corden, 1984) [14].

2.2 Empirical evidence of natural resource abundance on manufacturing

Although early evidence for a shrinking manufacturing sector in response to terms of trade shocks and real appreciation has been mixed, more recent evidence by Harding and Venables (2016) [15] based on averages across 1970-2006 for 41 resource net-exporters indicates that the response to a resource windfall is to decrease non-resource exports by 74 percent, and increase imports by 23 percent, implying a negligible effect on foreign savings. The negative impact on exports is larger for manufacturing than for other sectors. Thus, on average, resource exports reduce exports of manufactures by 46 percent, service exports by 17 percent, and agriculture and food exports by 6 percent.

Another study uses detailed, disaggregated sectoral data for manufacturing and obtains similar results: a 10 percent oil windfall is on average associated with a 3.6 percent fall in value-added across manufacturing, but less so in countries that have restrictions on capital flows and for sectors that are more capital intensive (Ismail, 2010) [16]. Using as a counterfactual the Chenery-Syrquin (1975) norm for the size of tradables (manufacturing and agriculture), countries in which the resource sector accounts for more than 30 percent of the GDP have a tradables sector 15 percentage points lower than the norm

(Brahmbhatt, et al., 2010) [17]. The macroeconomic and sectoral evidence thus seems to offer support for Dutch disease effects.

Interestingly, macro cross-country and micro U.S. county-level evidence suggest that resource-rich countries experience de-specialization as the least skilled employees move from manufacturing to the non-traded sectors, thus leading their traded sectors to be much more productive than resource-poor countries (Kuralbayeva and Stefanski, 2013) [18].

Within-country, quasi-experimental evidence on the Dutch disease in Brazil is also notable (Caselli and Michaels, 2013) [7]. The study exploits a dataset on oil dependence for Brazilian municipalities, which is useful as oil fields are highly concentrated geographically and local resource dependence is more likely to be exogenous as it is decided by the national oil company, Petrobras.It turns out that oil discoveries and exploitation do not affect non-oil GDP very much, although in line with the Dutch disease hypothesis, services expand, and industry shrinks somewhat. However, they boost local public revenue, 20-25 percent (rather than 10 percent) going to housing and urban development, 15 percent to education, 10 percent to health, and 5 percent to welfare. Interestingly, household income only rises by 10 percent, mostly through higher government wages. The lack of migration to oil-rich communities also suggests that oil does not really benefit local communities much. The evidence for Brazil thus offers support for the Dutch disease hypothesis.

There is also a wide range of hypotheses about the effects of natural resources on the economy and society. These include economic growth, institutions, corruption, rent-seeking, conflict and policy. Frederik van der Ploeg (2011) [3] provides systematic explanations in this context. The hypothesis regarding the effect of natural resources on economic growth say that if the traded sector is the engine of growth, a resource bonanza will lead to a temporary fall in growth. Early cross-country evidence indeed indicates a negative link between resources and growth. There is the hypothesis that the resource curse can be turned into a blessing for countries with good institutions. Ploeg (2011) [3] provides some evidence in support thereof. In addition, the hypothesis that presidential democracies are more likely to suffer a negative effect of resources on growth; econometric and quasi-experimental evidence for the hypothesis that resource windfalls increase corruption, especially in countries with non-democratic regimes, are discussed in his seminal paper. Econometric support for the hypothesis that the negative effect on growth is less in countries with well-developed financial systems and the hypothesis that resources induce voracious rent-seeking and armed conflict are also explained. There is also a discussion of the hypothesis that resource windfalls encourage unsustainable and unwise policies.

Why are many resource-rich developing countries unable to fully transform their large stocks of natural wealth into other forms of wealth? Ploeg (2011) [3] explains this with two hypotheses. First, the “anticipation of better times” hypothesis suggests that resource-rich countries should borrow in anticipation of higher world prices for resources and improvements in extraction technology in the future. Second, the “rapacious extraction” hypothesis explains how, in the absence of effective government intervention, conflict among rival factions induces excessive resource extraction and investment and negative genuine saving when there are wasteful rent-seeking and short-sighted politicians. There are no studies available yet that attempt to apply these political economy insights to a formal model addressing the optimal depletion of natural resources.

3 Mongolian Experience: Stylized Facts

Mongolia is abundant in natural resource minerals, such as coal, copper, gold, crude oil, iron, molybdenum, and zinc. The natural resource sector plays a large role in the economy, reaching 24 percent of the GDP and more than 90 percent of the exports in 2022. Clearly, the economy is heavily dependent on natural resources. In contrast to this, however, the manufacturing sector is underdeveloped and stagnant.

The very first step towards becoming a resource exporter was taken in 1978 by building and utilizing the Erdenet copper mine. The Erdenet mine is one of the largest factories in Asia with annual production of 530 thousand tons of copper concentrate and around 4.5 thousand tons of molybdenum concentrates.[3]

In 2009, the Oyutolgoi mine entered the industry with estimated deposits of 30 million tons of copper and 1.7 million ounces of gold, meaning that it is operable for more than 50 years. This makes Oyutolgoi one of the biggest mines in the world. Mine construction began in 2010, and the first exports were made in mid-2013. In 2021, Oyutolgoi earned sales revenue of 1,971 million U.S. dollars from sales of 669 thousand dry metric tons of concentrate with a metal content of 139 thousand tons of copper, 435 thousand ounces of gold, 783 thousand ounces of silver.[4]

Thus, the Mongolian economy is vulnerable to the volatility of world market resource prices due to heavy resource dependence. For instance, starting from July 2003, the copper price constantly

[3] Details can be found in the official webpage of the Erdenet mine at www.erdenetmc.mn

[4] See details in www.ot.mn

increased from 1700 to 8045 U.S. dollars in May 2006, almost five times higher than the initial level. During these three years, the Mongolian economy has enjoyed fast growth of 9 percent and a dramatic export increase from 0.5 billion U.S. dollars in 2003 to 1.5 billion in 2006.

The facts associated with the Mongolian experience are in many ways consistent with the Dutch Disease argument. The real mineral resources production grew rapidly over the years following the mineral resource booms. Mineral production was close to 7 million tons in 1989 following the resource boom of the Erdenet mine in the 1980s, and the number was more than 35 million tons in 2014, resulting from the Oyutolgoi mine resource boom, which is more than a five-fold increase.

Productivity increases in the mining sector worked to raise labor incomes. For example, from 2009 the Oyutolgoi's mine resource boom, along with its investments, was followed by an average 55 percent increase in the wages of the mining sector over five years. During the period, productivity in the mining sector jumped almost five-fold compared to the national level. During the period, productivity in mining sector jumped almost five-fold compared to the national level.[5] These observations, in fact, are consistent with the effect of resource movement in Corden and Neary's (1982) framework. In Figure 3, the share of in exports grew dramatically and it reached 90 percent on average for the last five years. This clearly shows that the economy is heavily dependent on the resource sector, and thus, more importantly, this is the indication that the booming resource sector is crowding out the other tradable sector, manufacturing.

The government budget is dependent on the mineral resource revenue as well. For instance, in 2006, a windfall tax was introduced in the mining sector, and as a result, the mineral resource tax revenues represented almost 45 percent of the total government budget. In 2010, the windfall tax was replaced by a royalty tax and the share decreased to 28 percent. However, starting from 2011, 3-year average tax revenue from the mining sector accounted for one-third of the total budget revenue. This rise in the government budget allowed the government sector expansion and was a major reason for aggregate demand and wage increases. Consequently, the expenditures on non-traded goods and imports rose, which in turn caused a currency appreciation. Furthermore, an increased foreign direct investment (FDI) aimed at Mongolia's mining sector also strengthened Mongolia's currency (Wei and Kinnucan, 2017) [20]. Thus, these facts imply that the spending effect of the Corden and Neary (1982) framework is in action.

The developments made by the government policies following the budget increase from the resource export are explicitly shifting the economy towards a generous welfare state. As a response to their electoral campaign promises, the government started to distribute money in 2008. Government spending and private consumption increased dramatically.

The theory by Corden and Neary (1982) [1] predicts that a resource windfall induces appreciation of the real exchange rate and, thus, deindustrialization. The mechanism behind this is clear. Part of the resource revenue is spent on non-traded goods, which leads to a real appreciation, i.e., a rise in the relative price of non-traded goods in terms of traded goods. This, in turn, draws resources out of the non-resource traded sector into the non-traded goods-producing sector (Corden and Neary, 1982). This simply means that for example, if the extra income from the resource sector is spent by government spending or private consumption, and not saved, our export price relative to foreign prices increases, making our exports not competitive on foreign market. If this continues in the long run, with the resource movement effect, our already small non-resource export sector or the manufacturing sector vanishes.

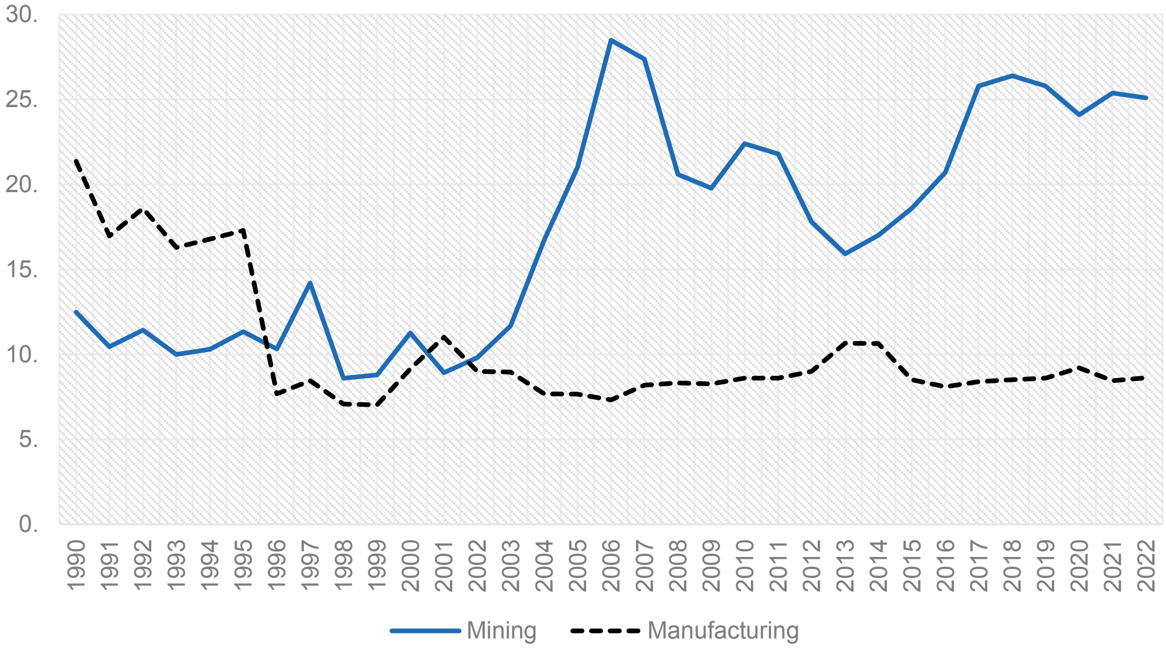
Consequently, the main concern of the natural resource dependent economies is the de-industrialization issue or declining of the manufacturing sector.

It is important to recognize, however, the fact that the economy is negatively affected by the natural resource windfall. Once it is recognized, learning from the abundant experiences of the other countries, we would be able to contribute to providing policy implications to avoid further worsening of the de-industrialization process.

Therefore, to see if the resource windfall has a negative effect on the economy, i.e., to see if there is a Dutch disease in the Mongolian economy, we should examine the manufacturing sector since it is the "victim" of the "disease". Let us see how the manufacturing sector changed from 1990 to 2022. Figure 3 shows the GDP share of manufacturing and mining. We can see and contrast the sectors. As expected, we see that Mongolian manufacturing has been declining or growing slower than the GDP. In contrast to this, the Mongolian mining industry grew rapidly from 2001 or grew faster than the GDP. In 2022, the mining to GDP ratio reached 25 percent, while the manufacturing to GDP ratio is not more than 7 percent. Using descriptive analysis, we, thus, have seen the symptoms of the Dutch disease in Mongolia. We now empirically test for evidence.

[5] National Statistical Office of Mongolia (NSO) [19]

Fig. 3 Mining and manufacturing output (percentage of GDP).



Note: This is the author's calculation based on NSO [19] data.

4 Methodology and Data

Before explaining our methodology, it is important to note that most of the studies in the literature use cross-section analysis with many countries (for example, Harding and Venables (2016) [15]) or many industries (for example, Ismail (2010) [16]) in certain point of times. Therefore, it is quite rare to find one country case with time series analysis.

It is quite complicated to examine the dynamics of manufacturing sector adjustment due to the natural resource discovery and exploitation. Thus, the underlying structural parameters, the adjustment speeds of the goods and asset markets, as well as the expectations and anticipations will differ from country to country and are difficult to obtain empirically in a structural econometric model. Therefore, we use the vector error correction modeling (VECM) strategy to decompose the variance of manufacturing output fluctuations into different time horizons with corresponding natural resource booms and world resource prices.

This methodology is particularly appropriate in cases such as this with potentially complicated dynamic relationships. The VECM gives us the possibility to create a short-run model with a given long run relationship. The model has a special explanatory variable – the error-correction term – which represents the long-run equilibrium equation. By means of this term, the restricted dynamic short-run model converges to the imposed long-run model.

Furthermore, we also adopt a relatively new cointegration technique, the Autoregressive Distributed Lag (ARDL) model, which gives us the advantage of testing the existence of a long-term relationship between the manufacturing sector and natural resource production, irrespective of whether the variables are mutually cointegrated.

4.1 The VECM Approach

Following Hutchison (1994) [21], we examine a multivariate system (Y_t) that includes real manufacturing output (y_t^m), natural resource production (y_t^r), the money supply (m_t) and real copper price (p_t^{cu}). This is referred to as the basic model. In an extension, the real effective exchange rate (e_t) is also included in Y_t. The only nominal variable here is the money supply, and the inclusion of the variable to the model makes possible the consideration of the expansionary government policy effects mentioned earlier to capture the essence of the spending effect.

Y_t is assumed to have vector autoregressive (VAR) representation with errors, u_t:

$$Y_t=A_0+A_1Y_{t-1}+A_2Y_{t-2}+\cdots+A_\rho Y_{t-\rho}+u_t \qquad (1)$$

where Y_t is a ρ x 1 (ρ represents the number of variables, it is four in basic model and five in the extended model) vector of time series, $A_1,\ldots,A_\rho$ are ρ x ρ coefficient matrices and u_t is a ρ x 1 unobservable zero mean white noise process.

In general, economic time series are non-stationary processes and it is useful to take the first difference by subtracting Y_{t-1} from both sides of (1). It can be written as:

$$\Delta Y_t=A_0+\Gamma_1\Delta Y_{t-1}+\cdots+\Gamma_{\rho-1}\Delta Y_{t-\rho+1}+\Pi Y_{t-\rho}+u_t \qquad (2)$$

where $\Gamma_i=-(I-A_1-\cdots-A_i)$, $i=1,2,\ldots,\rho-1$, and $\Pi=-(I-A_1-\cdots-A_\rho)$.

Except for the long-run equilibrium term or error correction term $\Pi Y_{t-\rho}$, equation (2) is nothing else but the traditional first difference VAR model.

The coefficient matrix Π contains information about the long-run equilibrium.[6] The rank (r) of Π matrix, is the cointegration rank, i.e., it shows how many long-run relationships exist between the variables of Y_t. Π can be expressed as $\Pi=\alpha\beta'$ where α and β are $\rho\times r$ matrices containing the loading coefficients and the cointegration vectors respectively (Johansen 1991) [22]. The $\beta' Y_t$ is stationary even though Y_t itself is non-stationary. Therefore, equation (2) can be interpreted as a vector error correction model (VECM).

Both trace and maximum eigenvalue tests are employed to determine the number of cointegrating vectors. The approach is to test the null hypothesis that there is no cointegration among the elements of vector Y_t; rejection of the null is then taken as evidence of cointegration. The long-run constraints expressed by the estimated cointegrating vectors ($\hat{\beta}' Y_t$) are then imposed to the differenced VAR model via error correction terms.

After estimating the VECM, impulse response functions and variance decompositions are calculated with the variables ordered as: manufacturing output, mineral production, money supply and real copper price. This ordering allows the three potential explanatory variables to exert the largest possible influence on manufacturing output movements.

The VECM is more appropriate for impulse-response analysis or dynamic forecasts as it models the feedback from the dependent variable to the weakly exogenous variables. However, VECM concentrates on cases where the underlying variables are integrated of order one. Hence, the method requires pre-testing to identify the long-run relationship among the variables.

4.2 The ARDL approach

The Autoregressive Distributed Lag (ARDL) model, a relatively new cointegration technique, tests the relationship between variables irrespective of whether the independent variables are integrated of order one, order zero, or mutually cointegrated (Pesaran and Shin, 1998) [23]. The ARDL model can be transformed into an error-correction (EC) form, which separates the long-run relationship from the short- run dynamics (Hassler and Wolters, 2006) [24]. Furthermore, the bounds procedure is implemented to test the existence of a long-run relationship based on the EC representation of the ARDL model (Pesaran *et al*. 2001) [25].

Using the advantages of the ARDL approach over the other cointegration techniques, we also test the existence of a long-run relationship between the levels of variables irrespective of whether they are a mixture of stationary and nonstationary variables.

Suppose we expect an equilibrium relationship between a variable y_t and a set of K explanatory variables $\boldsymbol{x}_t=(x_{1t},x_{2t},\ldots,x_{Kt})'$. Estimating the relationship among the variables in a simple static model by ordinary least squares will result in spuriously large coefficient estimates. Adding enough lags of dependent and independent variables in the regression equation, the regression error term is serially uncorrelated, and contemporaneous feedback from y_t to $\boldsymbol{x}_t$ will be ruled out. As a result, the problem can be prevented, and therefore, the following general ARDL ($p,q,\ldots,q$) model with intercept c_0 and lag orders $p\in[1,p^*]$ and $q\in[1,p^*]$ is derived:

$$y_t = c_0 + \sum_{i=1}^{p}\phi_i y_{t-i} + \sum_{i=0}^{q}\boldsymbol{\beta}_i'\boldsymbol{x}_{t-i} + u_t \qquad (3)$$

Hassler and Wolters (2006) [24] transforms the ARDL model in EC representation, which makes it possible to have a better interpretation of the regression coefficients:

$$\Delta y_t = c_0 - \alpha(y_{t-1} - \boldsymbol{\theta}\boldsymbol{x}_{t-1}) + \sum_{i=1}^{p-1}\psi_{yi}\Delta y_{t-i} + \boldsymbol{\omega}'\boldsymbol{\Delta x}_t + \sum_{i=1}^{q-1}\boldsymbol{\psi}_{xi}'\boldsymbol{\Delta x}_{t-i} + u_t \qquad (4)$$

The coefficients in model (3) and model (4) are mapped together as follows:

$$\alpha = 1 - \sum_{i=1}^{p}\phi_i, \boldsymbol{v} = \frac{\sum_{j=0}^{q}\boldsymbol{\beta}_j}{\alpha}, \psi_{yi} = -\sum_{j=i+1}^{p}\phi_j, \boldsymbol{\omega} = \boldsymbol{\beta}_0, \psi_{xi} = -\sum_{j=i+1}^{q}\beta_j \qquad (5)$$

The above model is not directly used for computation due to the nonlinear interaction between the parameters α and θ. Instead, it is slightly modified to get a computationally more convenient approach. Long-run coefficients θ and speed-of-adjustment coefficient α are derived from the transformed model.[7]

4.3 Data

Monthly data is used covering the period of 2003M1-2024M4. The variables are measured in natural logarithms. The data consists of real manufacturing output, actual physical production of mineral resources, nominal M2 as money supply, the real dollar price of copper, and the real effective exchange rate (REER)[8]. The main sources of data are the National Statistics Office of Mongolia (NSO) [19] and the Bank of Mongolia [27]. Complete definitions, units, and sources of the data are provided in appendix A.

6 For more detailed explanation see Johansen (1991) [22].

7 Refer to Kripfganz and Schneider (2023) [26] for the detailed procedure and estimations.

8 The real effective exchange rate index represents the price compared to the weighted average of the exchange rate index of the Mongolian currency against the currency of foreign trade partner countries.

5 Results

5.1 VECM results

We start by following the standard steps to conduct a time series analysis, starting with unit root tests and cointegration tests.

The Augmented Dickey-Fuller (ADF) and Phillips and Perron (PP) unit root tests suggest that all five variables appear to be integrated of order one or I(1), i.e., non-stationary in levels and stationary in first-differences[9]. A linear combination of two or more non-stationary series may be stationary as shown by Engle and Granger (1987) [28]. This stationary linear combination is called the cointegrating equation and can be interpreted as a long-run equilibrium relationship among the variables.

Johansen tests for the model indicate cointegrating relationships between real manufacturing output, mineral production, and other variables. One cointegrating vector is suggested in both the four-variable and five-variable models by maximum eigenvalue and trace statistics at the 1 percent significance level.[10]

The estimate of cointegrating vector β′ is reported in Table 1. The restriction for β′ matrix is imposed as a negative unity on the variable of primary interest, real manufacturing output (y_t^m). A negative coefficient on mineral production (y_t^r) would indicate a long-run tradeoff, or crowding out, between outputs in the manufacturing and natural resource sectors. Thus, Table 1 shows that in the long run, 10 percent growth in mineral resource production is estimated to bring almost a 2 percent contraction in the manufacturing output. This suggests that there is a long-run negative relationship between the resource output and manufacturing in Mongolia.

The variance decomposition results derived from the VECM estimates in Table 1 suggest, as expected, that natural resource sector innovations cause a major role in generating manufacturing output fluctuations.[11] However, surprisingly, the real copper price shocks seem to play a very small role as we were expecting that since the economy is heavily dependent on natural resource exports, particularly copper, the copper price shocks might be affecting all sectors, including manufacturing. The variance decomposition results also suggest that monetary factors play a relatively small, but not negligible, role in this context.

In summary, there is statistically significant evidence for the negative impact of the resource abundance on the manufacturing in Mongolia.

5.2 ARDL results

We can directly proceed to ARDL estimation and bounds testing without any conventional unit-root test, which is an advantage of the model, as it can deal with mixtures of I(0) and I(1) variables. The results are given as follows.

The test involves three steps, and rejecting all three null hypotheses leads to statistical evidence of a cointegrating relationship. The F and t statistics are sufficiently larger than the corresponding critical values, suggesting long-run relationships in both basic and extended models.[12]

The magnitude of coefficients on minerals output is about 0.1 percentage points lower than that of Johansen estimation, and it is not statistically significant (the p-value is 12.2% for the basic model and 13.3% for the extended model). However, the obtained coefficient signs are consistent and support the result of Johansen's estimation. A 1% increase in mineral output will lead

Table 1 Cointegration Coefficients in Johansen Estimation

	Basic model	Extended model
Real manufacturing output	-1.000	-1.000
Minerals output	-0.156***	-0.178***
Money supply	0.432***	0.447***
Real copper price	0.135**	0.111*
REER		0.147
Constant	8.211	7.771

Note: The coefficients are normalized with a negative unity on the manufacturing output. A negative coefficient indicates a long-run offset. ***, ** and * denotes statistical significance at 1%, 5% and 10% level respectively.

[9] Detailed results of the unit root tests can be found in Appendix B.1.

[10] Detailed results of the cointegration tests can be found in Appendix B.2

[11] Detailed results of VECM variance decompositions can be found in Appendix B.3

[12] The test statistic has a nonstandard distribution that depends on various model characteristics and the data, including the integration order of the variables. Pesaran, Shin, and Smith (2001) [25] propose a "bounds test," which involves comparing the values of conventional F and t statistics with pairs of critical values.

Table 2 ARDL long-run estimation results in EC representation

	Basic model	Extended model
Real manufacturing output	1.000	1.000
Minerals output	-0.099	-0.101
Money supply	0.407***	0.408***
Real copper price	0.160**	0.158**
REER		0.028
Constant	4.115	4.054
F◦	26.294***	20.949***
t◦	-10.096***	-9.996***

Note: The coefficients are normalized with a negative unity on the manufacturing output. A negative coefficient indicates a long-run offset. ***, ** and * denotes statistical significance at 1%, 5%, and10% level respectively. ◦ denotes the results of Pesaran, Shin, and Smith (2001) bounds test.

to a 0.1% and 0.11% decrease in real manufacturing output in basic and extended models, respectively.

5.3 Structural break analysis

In addition, we applied the extended VEC and ARDL models in different periods, setting 2010m3 as thresholds, which is found to be the structural break point of the data period from the Gregory-Hansen test. The test's null hypothesis is that there is no cointegration against the alternative of cointegration with a single shift at an unknown point in time. 2010m3 is found to be a breakpoint in both tests where there is a break in the constant and a break in the constant and the trend.

Although we must be careful about interpreting the estimates of the minerals output as they are not statistically significant when we divide the sample, we find interesting results from the subsample results. For both the VEC and ARDL models, minerals output has a negative long-run impact on the real manufacturing output before 2010m3. After 2010m3, the reverse sign is obtained so that the minerals output has a positive long-term impact on the minerals output.

The negative sign, as expected, can be explained by the resource movement effect, as the mining sector was at its early stage of development until 2010. This means resources were drawn from other sectors, such as manufacturing, causing contraction in the former sectors. However, the reverse sign since 2010 might be due to a huge expansion in mineral production, which may have had a positive effect on the whole economy.

Table 3 Results of Gregory-Hansen test, Break in the constant

	Test statistic	Date	Asymptotic critical values 1%
ADF	-9.33	2010m3	-6.05
Zt	-10.04	2010m3	-6.05
Za	-140.53	2010m3	-70.18

Table 4 Results of Gregory-Hansen test, Break in the constant and the trend

	Test statistic	Date	Asymptotic critical values 1%
ADF	-9.32	2010m3	-6.36
Zt	-10.03	2010m3	-6.36
Za	-140.38	2010m3	-76.95

Table 5 Results of VECM Extended model with full year, before 2010m3, and after 2010m3

	All period	Before 2010m3	After 2010m3
Real manufacturing output	1.00	1.00	1.00
Minerals output	-0.178***	-0.152	0.071
Money supply	0.447***	0.55***	0.379***
Real copper price	0.111*	0.04	0.24***
REER	0.147	1.426	0.52*
Constant	7.771	14.692	3.477

Note: The coefficients are normalized with a negative unity on the manufacturing output. A negative coefficient indicates a long-run offset. ***, ** and * denotes statistical significance at 1%, 5%, and 10% level respectively.

Table 6 Results of ARDL Extended model full year, before 2010m3, and after 2010m3

	Full period	Before 2010m3	After 2010m3
Real manufacturing output	1.00	1.00	1.00
Minerals output	-0.101	-0.011	0.052
Money supply	0.408***	0.438***	0.408***
Real copper price	0.158**	0.081	0.243**
REER	0.028	-0.011	0.478
Constant	4.054	6.021	1.911

Note: The coefficients are normalized with a negative unity on the manufacturing output. A negative coefficient indicates a long-run offset. ***, ** and * denotes statistical significance at 1%, 5%, and 10% level respectively.

6 Conclusion

The paper reviews the theoretical and empirical explanations of the effects of natural resource windfalls on the manufacturing sector of the economy. Within this context, we examined the experience of Mongolia. Thus, the main hypothesis examined is the argument that natural resource booms cause de-industrialization following Corden and Neary (1982) [1].

The descriptive statistics show that the Mongolian economy is already natural resource-dependent, with the natural resource share of exports exceeding 90 percent in 2022. In contrast, the manufacturing sector stayed stagnant at around 7 percent of the GDP. We used VECM and ARDL models to test for a long-run trade-off between the mineral production output and the manufacturing sector. Thus, our results suggest a long-run trade-off: a 10% increase in resource production is followed by a 1-2% contraction in manufacturing.

The structural break test suggests 2010m3 to be a breaking point in our data. Unfortunately, when we divide our data into two subsamples before and after 2010m3, the results of VECM and ARDL models are statistically insignificant in both sub-samples. However, interestingly, we saw a shift in the long-run relationship between mineral production and manufacturing, which was negative before 2010 and positive after 2010. This might be due to the resources drawn from the other sectors causing contraction in manufacturing before 2010 and due to a huge expansion in mineral production, causing an overall expansion of the economy.

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Appendix A Data table and explanation

We summarized our variables with respective measure units and sources in Table A1.

Manufacturing output is deflated by national Consumer Price Index with base year 2015. Mineral production is the total monthly physical production of coal, crude oil, copper concentrate, molybdenum concentrate, gold, iron ore, iron ore concentrate, flour spar, flour spar concentrate and zinc concentrate.

Appendix B Some results tables and explanations

B.1 Unit Root Tests

The t-statistics for the Augmented Dickey-Fuller (ADF) unit root tests are reported in Table B1. The tests were conducted both in log levels (x) and log first-differences (dx) and each time series includes a constant and both constant and time trend. The null hypothesis states that there exists a unit root in the time series, and failure to reject the null indicates that the variable may be non-stationary. The ADF statistics were estimated using Akaike Information Criterion (AIC) since it is recommended to use AIC instead of the Schwarz Information Criterion to determine lag length of the autoregressive process for the ADF statistic.[13]

The ADF tests are consistent in failing to reject the null in log levels (x) at 1% significance level, meaning the series are likely non-stationary in levels. ADF tests are consistent in rejecting the unit root hypothesis for all of the variables in log first-difference form (dx). Only the ADF test with trend for money supply is rejecting the null at 5% level, but the rest of the test statistics are sufficient to reject the null at 1% level. Consequently, we can say that all five variables appear to be integrated of order one or I(1), i.e., non-stationary in levels and stationary in first-differences.

B.2 Cointegration tests

Table B2 shows the Johansen cointegration tests consisting of trace and maximum eigenvalue test statistics as well as the critical values at 1% significance level for the number of maximum cointegrating vectors. We assumed a linear trend in data and allowed the cointegrating equation to have both intercept term and trend. The null hypothesis for each test is also included in Table B2.

We see that there are at most 2 cointegrating vectors in the basic model and at most 1 in the extended version.

Table A1 Data

Variables	Measurements	Source
Manufacturing output	Log of real manufacturing output (Million tugrugs)	National Statistical Office of Mongolia (NSO)
Mineral production	Log of physical mineral production (Thousand tons)	NSO
Money supply	Log of M2 money supply (Billion tugrugs)	NSO
Real copper price	Log of real copper price (US dollar per ton)	London Metal Exchange [29]
Real effective exchange rate (REER)	Log of REER (weighted average of exchange rate indices)	Bank of Mongolia

[13] See Stock and Watson (2011, Chapter 14)[30] for lag length selection in time series regression with multiple predictors.

Table B1 Augmented Dickey-Fuller Unit Root Tests

	Real manufacturing output	Mineral production	Money supply	Real copper price	Real effective exchange rate
ADF intercept (x)	-1.262	-1.034	-1.715	-3.086**	-2.359
ADF intercept + trend (x)	-3.198*	-2.581	-1.791	-3.186*	-2.398
ADF intercept (dx)	-4.076***	-4.216***	-3.564***	-4.651***	-5.359***
ADF intercept + trend (dx)	-4.081***	-4.205***	-3.823**	-4.685***	-5.353***

Note: x and dx refer to the variable listed in log level and log first-difference form respectively. *, ** and *** denote the individual test statistic statistically significant at the 10%, 5% and 1% levels respectively.
Source: Monthly data from 2003M1 to 2024M4 were used from the NSO.

Table B2 Johansen Cointegration Tests

Null hypothesis	Critical value at 1%		Test statistics	
	Trace	Max-Eigen	Trace	Max-Eigen
Basic model				
None	54.46	32.24	151.49***	103.33***
At most 1	36.65	25.52	48.17***	29.05***
At most 2	20.04	18.63	19.12	13.4
At most 3	6.65	6.65	5.72	5.72
Extended model				
None	76.07	38.77	77.31***	36.82***
At most 1	54.46	32.24	40.49	18.6
At most 2	35.65	25.52	21.89	10.76
At most 3	20.04	18.63	11.12	9.07
At most 4	6.65	6.65	2.06	2.06

Note: *** denotes the rejection of the null hypothesis at the 1% significance level. The critical values were taken from the Stata Software edition 17.

B.3 VECM variance decompositions and impulse responses

Table B3 reports the manufacturing output variance decompositions derived from the estimates of the VECM for basic and extended models. The VECM was estimated using the estimated cointegrating vector shown in Table 1. The estimation results suggest that natural resource sector innovations cause a major role in generating manufacturing output fluctuations. The estimated percentage impact of natural resource sector on manufacturing output error variance after a year is as high as 19 percent in the basic model and 21 percent in the extended model. The real copper price shocks seem to play small role. Monetary factors play relatively small, however, not negligible role in this context.

Figure B3 shows the accumulated impulse response functions of manufacturing output to a one-unit positive shock in real copper price, mineral sector and REER. Mineral sector shocks have significant and sustainable negative effects on manufacturing output. Thus, the result is supportive of our hypothesis that the natural resource production innovation has a long run negative effect on manufacturing production in Mongolia.

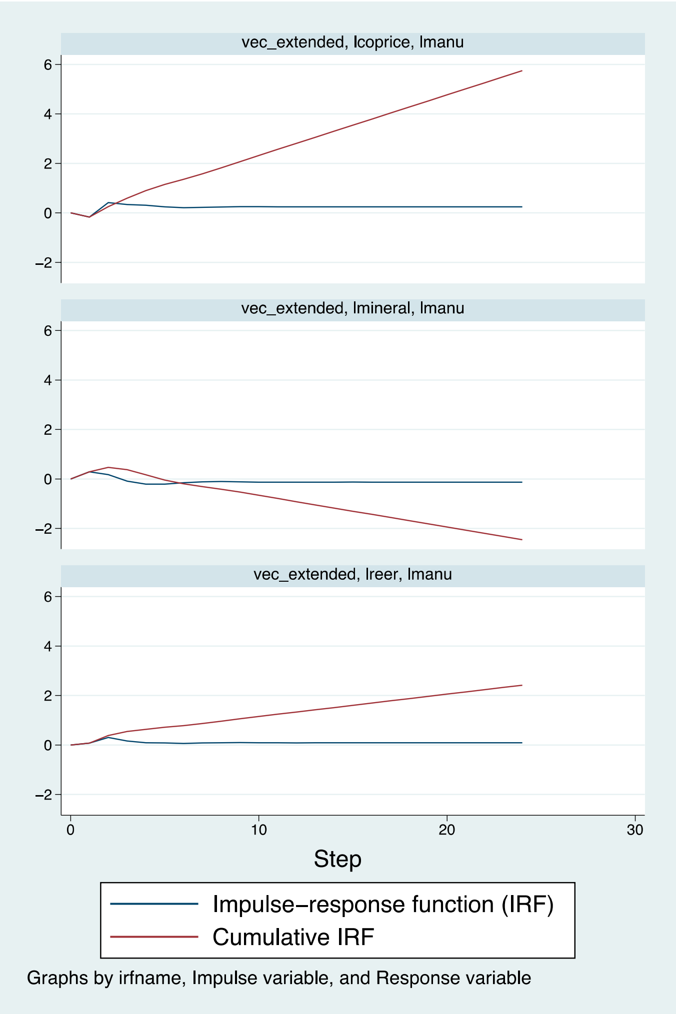
Table B3 Manufacturing variance decompositions (24-month time span)

Months	Four-variable Basic Model			
	Manufacturing	Mineral sector	Money supply	Real copper price
1	100	0	0	0
6	78	16	3	3
12	66	19	10	5
18	58	21	14	7
24	51	23	18	8

Months	Five-variable Extended Model			
	Manufacturing	Mineral sector	Money supply	Real copper price
1	100	0	0	0
6	76	17	3	1
12	64	21	4	1
18	56	24	5	1
24	49	26	6	1

Note: Variance decompositions report the percentage impact of the n months ahead manufacturing forecast error variance from corresponding variable listed in the column. VECM is ordered as real manufacturing output, mineral production, money supply and real copper price in basic model. REER is the last in order in extended model.

Figure B3 Impulse responses of manufacturing sector.



Note: Figure shows the impulse response func-tions of manufacturing output to a one-unit positive shock in mineral sector, real copper price and REER, respectively.

鉱業と製造業の間にはトレードオフが存在するのか？—モンゴル国における実証分析（要旨）

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要　旨

本研究は、モンゴル国における天然資源部門への極度の依存が経済に悪影響を及ぼす、つまり製造業の衰退を招いているのではないか、という主張のもと行われた。結果はこの議論を支持するものである。成長する資源部門と製造業の間には長期的に負の関係があり、資源部門の10%増加に対して、製造業は1～2%減少している。さらに、2010年から負の関係が正の関係に変化したことを示す構造変化が観察された。

キーワード: 製造業、豊富な天然資源、資源の呪い、オランダ病、VECM、ARDL
JEL分類: F14、F15、O13、O14、Q33

日本発着コンテナ貨物の釜山港における積替量の動向

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要　旨

釜山港は日本発着の輸出入コンテナ貨物の積替拠点のうち最大の港湾である。2種類の日本の公式統計データを用いて分析したところ、近年、釜山港で積み替えて日本に輸入する貨物量が減少する傾向が確認できた。特に日本海側東部地域において減少が顕著である。他の港湾での積替輸送にシフトしたことがその一因であると推察されるが、そのことを裏付けることはできなかった。

キーワード：釜山港、トランシップ、地方港、コンテナ貨物流動調査、港湾統計
JELコード：L92

はじめに

釜山港は、1990年代以降、北東アジア地域における国際コンテナハブ港として、取扱量を増加させてきた。しかしながら、近年は取扱貨物量の伸び悩み傾向がみられる。かつて、釜山港にとっての「主要顧客」となっていたのは、日本の地方港であった。その地方港のコンテナ取扱貨物量も近年は伸び悩みの状況がみられる。さらに、足元の状況を見ると、釜山港湾公社（2025）によれば、2024年の釜山港における日本方面の積替コンテナ数は対前年比3.7%減の170万TEUとなっている。

日本の国土交通省は、地方港と国際コンテナ戦略港湾（京浜港、阪神港）とを結ぶ国際フィーダー航路の開設、拡充を進めてきた。この政策は、国際コンテナ戦略港湾への集貨を目的としたものであり、国際戦略港湾競争力強化対策事業の実施により、京浜港、阪神港への国際フィーダー航路寄港便数が約3割増加した（国土交通省　2024）。これとは別に、コロナ禍に伴う物流混乱などを機に荷主企業の間では、貨物の遅延が発生した釜山港の利用を取りやめる動きが起こったとも言われている。[1]

こうした中で、実際に日本の地方港で釜山港離れが起こっているのかを検討することは、釜山港自体にとってはもちろん、日本の国際コンテナ戦略港湾や地方港にとっても、今後の発展展望を考えるうえで重要な意義がある。その検討の初歩的なステップとして、本稿では統計データを分析し、日本発着コンテナ貨物の釜山港における積替量の動向を描きだす。

1．分析に用いるデータ

本稿では、釜山港でのコンテナ貨物積替の状況を把握するため、2種類の公式統計調査データを利用する。一つは「全国輸出入コンテナ貨物流動調査」（以下、コンテナ流調）、もう一つは「港湾統計調査」（以下、港湾統計）である。

前者は、5年に1回、1か月間の期間を区切った全数調査である。この調査で取りまとめられている統計表のうち、本稿の分析では「表34. 船積港別仕向港別最終船卸港別貨物量」と「表35. 船卸港別仕出港別最初船積港別貨物量」を用いる。これらの統計表においては、主要な積替港として釜山、上海、香港、高雄、深圳、シンガポールの6港を設定し、これらの港湾を仕向・仕出港とするコンテナ貨物の主な最終船卸国・最初船積国別貨物量（トン数）及びそれらの地域別集計を示している。直近2回の調査は2018年11月と2023年11月に実施された。本調査は、1か月間の時限調査であり、季節的な変動が大きい貨物の取扱量が適切に把握できないことや、取扱量が小さい地方港などでは特異な大規模単発貨物の影響が大きいといった課題がある。

後者は、統計法に基づく基幹統計調査の一つである。この中で取りまとめられている統計表のうち、以下の分析では「第3表　海上出入貨物表　(4)輸出貨物品種別貨物形態別仕向国・地域別表」と「同　(5)輸入貨物品種別貨物形態別仕出国・地域別表」を用いる。これらの統計表においては、国内各港のコンテナ貨物について仕向・仕出国別、最終船卸国・最初船積国別の貨物量（トン数）が示されている。したがって、例えば韓国を仕向国とする貨物のうち、最終船卸国が韓国以外の国となっている貨物

[1] 2020年以降、何回か新潟港関係者と意見交換する中で、新潟港を利用していた荷主企業が京浜港利用に切り替えたといった話を聞いた。コロナ禍の時期の他、2023年秋以降の紅海通航リスク増大も影響があった。釜山での積替先の船舶のブッキングが取りにくくなったとのことである。

は、韓国で積み替えられた貨物として把握することができる。従前は、「貨物形態別」の区分が無く、コンテナ貨物と非コンテナ貨物が分別されていなかった。コンテナ貨物に限った分析が可能なのは、2020年調査以降で、本稿執筆時点では2022年調査までの3か年データが利用できる。2020年はコロナ禍が襲った年であり、その前後の比較を行うことができないという欠点がある。また、東京港など一部の港湾においては、最終船卸国・最初船積国が示されていないという問題もある。なお、筆者らは以前に2020年調査データを利用した分析を行った（新井、チェ　2024）が、本稿はその延長線上で、当時不可能であった経年変化動向を確認しようとするものである。

以上のように2種類の統計調査データには、それぞれ一長一短あるため、双方を活用して分析を行うこととする。

2. 全国輸出入コンテナ貨物流動調査を用いた分析

（1）分析対象港湾

本節の分析には、2018年及び2023年のコンテナ流調の結果を用いる。2018年の報告には66港が掲載されており、2023年の報告では掲載港が6港減って60港となっている。2018年調査掲載の66港を本稿の分析の便宜のため、表 1の通り、地域別に区分した。

（2）積替貨物量の動向

コンテナ流調の調査結果においては、日本発着コンテナにとっての海外における主な積替港湾である釜山、上海、香港、高雄、深圳、シンガポールの6港について、これらを仕向／仕出港とした貨物の最終船卸／最初船積国・地域・港別[2]の貨物量が示されている。これら6港発着の貨物総量から、当該港を最終船卸・最初船積港とする貨物量（直航貨物量）を除くと、それぞれの港で積み替えられた貨物量（積替貨物量）を計算することができる。図 1はこのようにして計算した値を図示したものである[3]。6港のうち、釜山が最大の積替港であり、上海、シンガポールがそれに続いている。2018年と2023年の2時点を比較すると、香港以外はいずれの港湾も積替貨物量が増加している。特に、上海における増加率が著しい。釜山港での輸出貨物積替量は、2018年の86.5万トンから2023年の120.5万トンへと39.3%増加した。同様に輸入貨物は、100.8万トンから106.9万トンへと6.1%増加した。

次に、日本の地方港発着貨物の釜山港における積替貨物量に注目する。地方港全体として、釜山港での輸出貨物積替量は、2018年の67.4万トンから2023年の72.2万トンへと7.1%増加した。これに対して、輸入貨物は同期間に85.2万トンから65.7万トンへと22.8%もの減少となった。ちなみに、五大港発着の釜山港での積替貨物量は、同期間に輸出が19.0万トンから48.2万トン（53.4%増）、輸入が15.6万トンから41.2万トン（64.5%増）となり、大幅な増加となった。五大港合計の積替量は地方港合計を下回っているとはいえ、決して小さい量ではなくなった。また、この間に大きく増加したことは五大港にとっても釜山港が重要な役割を果たすようになったことを示している。

また、地方港発着で釜山港を仕向／仕出港とする貨物の85.6%（2023年）が釜山港で積替されている。輸出入別では、輸出で90.8%、輸入で80.6%であり、輸出において積替貨物率が高い。地方港にとっての釜山港の存在意義は、まさに積替港としての役割にあると言える。

表 1　対象港湾の地域区分（コンテナ流調）

地域	対象港湾
北海道太平洋側（4）	釧路、苫小牧、室蘭、函館*
東北太平洋側・北関東（6）	八戸、釜石、仙台塩釜、小名浜、茨城、鹿島
南関東・中部（9）	千葉、東京、川崎、横浜、清水、御前崎、三河、名古屋、四日市
瀬戸内海（19）	堺泉北、大阪、神戸、和歌山下津、水島、福山、広島、大竹*、下関、宇部*、三田尻中関、徳山下松、岩国、徳島小松島、高松、松山、今治、三島川之江、大分
西日本太平洋側（5）	高知、細島、油津*、志布志、鹿児島
東シナ海（8）	三池、長崎、八代、熊本、川内、那覇、平良*、石垣*
北部九州（3）	博多、北九州、伊万里
日本海側西部（6）	伏木富山、金沢、敦賀、舞鶴、境、浜田
日本海側東部（6）	小樽、石狩湾新、秋田、酒田、新潟、直江津

注：カッコ内の数字は、当該地域内の対象港湾数。アスタリスク（*）付きは、2023年調査報告書に記載がない港湾（計6港）。油津港は2018年調査では取扱量ゼロであるにもかかわらず、掲載されていた。
出所：筆者作成。

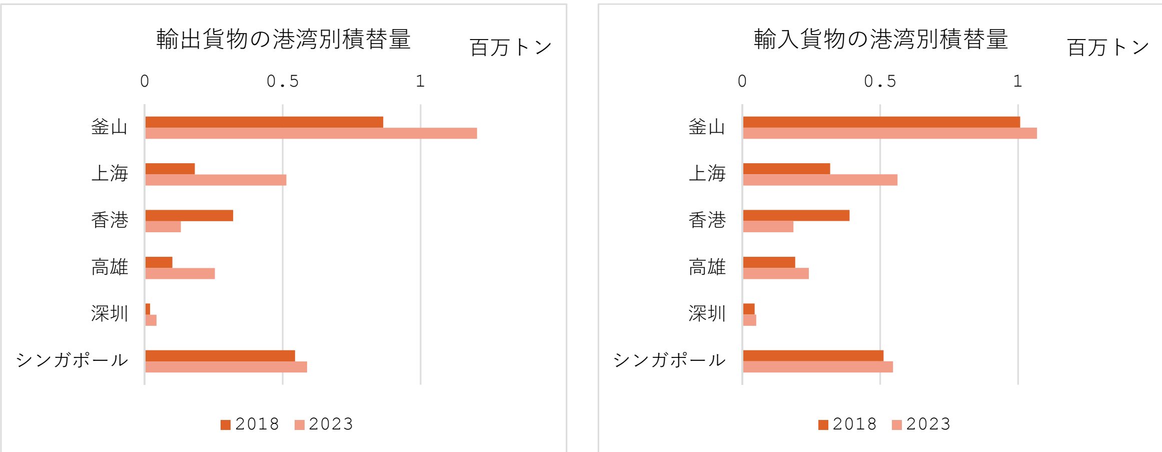
[2] すべての国、港湾の貨物量が示されているわけではなく、主要国及び主要港湾についてのみ貨物量が示されている。例えば、「中国」という地域設定の内訳として、上海、青島、蛇口、香港、その他中国の5区分の貨物量が示されている。
[3] 深圳については、最終船卸・最初船積港として掲載が無く、代わりに蛇口が掲載されているので、その貨物量を直航貨物量とみなすことにした。

地方港の立地地域別（図 2）に釜山港での積替貨物量をみると、2023年時点で輸出貨物量が多いのは北部九州、瀬戸内海である。これらに次いで、南関東・中部、日本海側西部、日本海側東部がほぼ同量である。2時点間の比較では、北部九州、瀬戸内海、南関東・中部では増加しているが、日本海側の2地域では減少している。他方、2023年時点で輸入貨物量が多いのは、瀬戸内海、北部九州、日本海側東部である。2時点間の比較では、これらを含めた多くの地域で貨物量が減少した。

釜山港経由コンテナ貨物の最終船卸・最初船積方面別の貨物量を表 2に示す。「東南アジア・南アジア・大洋州」方面への輸出入が多く、全体の約3分の1（2023年）を占める。これに続くのが、「中国・台湾」方面であり、全体の約3割（同）を占めている。地方港に限ると、これら2方面の占める割合が高まる。これらの2方面とも、2023年の輸出積替量は全体として2018年と比べて大幅に増加した。他方、輸入貨物はいずれの方面とも減少した。地方港の輸入貨物では、これら2方面に限らず、各方面とも軒並み大幅な減少となっている（韓国国内からの積替貨物を除く）。

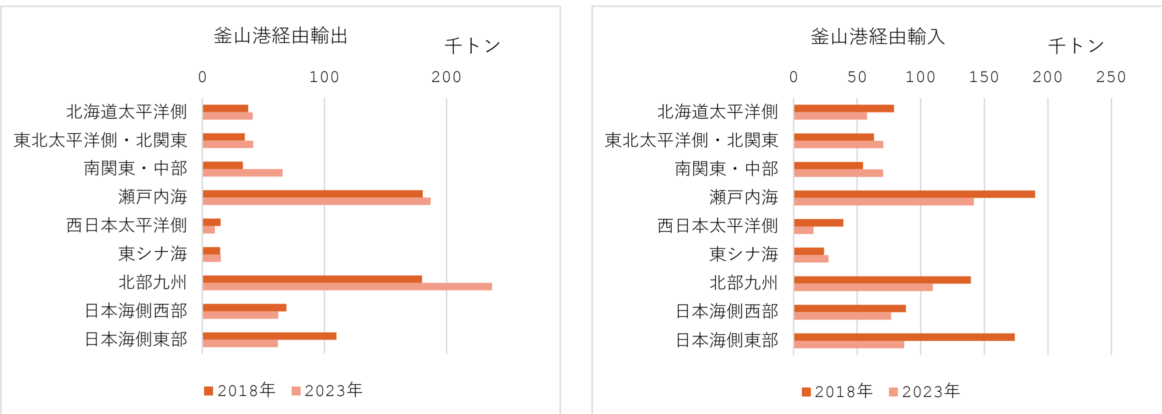
こうした状況を踏まえ、「中国・台湾」及び「東南・南アジア・大洋州」の2方面に限って、地方港発着貨物の釜山港での積替貨物量を整理した（図 3）。これに基づき、釜山港での積替貨物量が多い地域について、それぞれの状況、変化動向を確認していきたい。まず、瀬戸内海地域は、いずれの方面の輸出入とも積替量が多い。2時点比較をすると、輸出では2方面とも増加したが、輸入では減少している。次に、北部九州地域は、2018年時点では中国・台湾方面の取扱量が小さかったが、2023年にはこの方面への輸出貨物が急増した。あわせて、東南アジア・南アジア・大洋州向け輸出も増加した。直航もしくは他の寄港地経由で輸送されていた貨物の相当量が釜山積替ルートにシフトしてきたことが想像される。日本海側西部地域では、中国・台湾方面は輸出入とも減少したが、東南アジア・南アジア・大洋州方面は輸出入とも増加した。日本海側東部地域は、2018年時点では、主要な貨物発着地であったが、2023年にはいずれの方面の輸出入とも大きく減少し、存在感が低下した。それ以外の地域は、東北太平洋側・北関東や南関東・中部などで増加傾向にある。これらの地域の港湾に寄港する航路は五大港にも寄港することが多いと考えられ、上述したような五大港での増加傾向とも符合する動きである。

図 1　主な海外積替港湾における積替貨物量



出所：コンテナ流調に基づき筆者作成。

図 2　地方港発着貨物の釜山港での積替量（地域別）



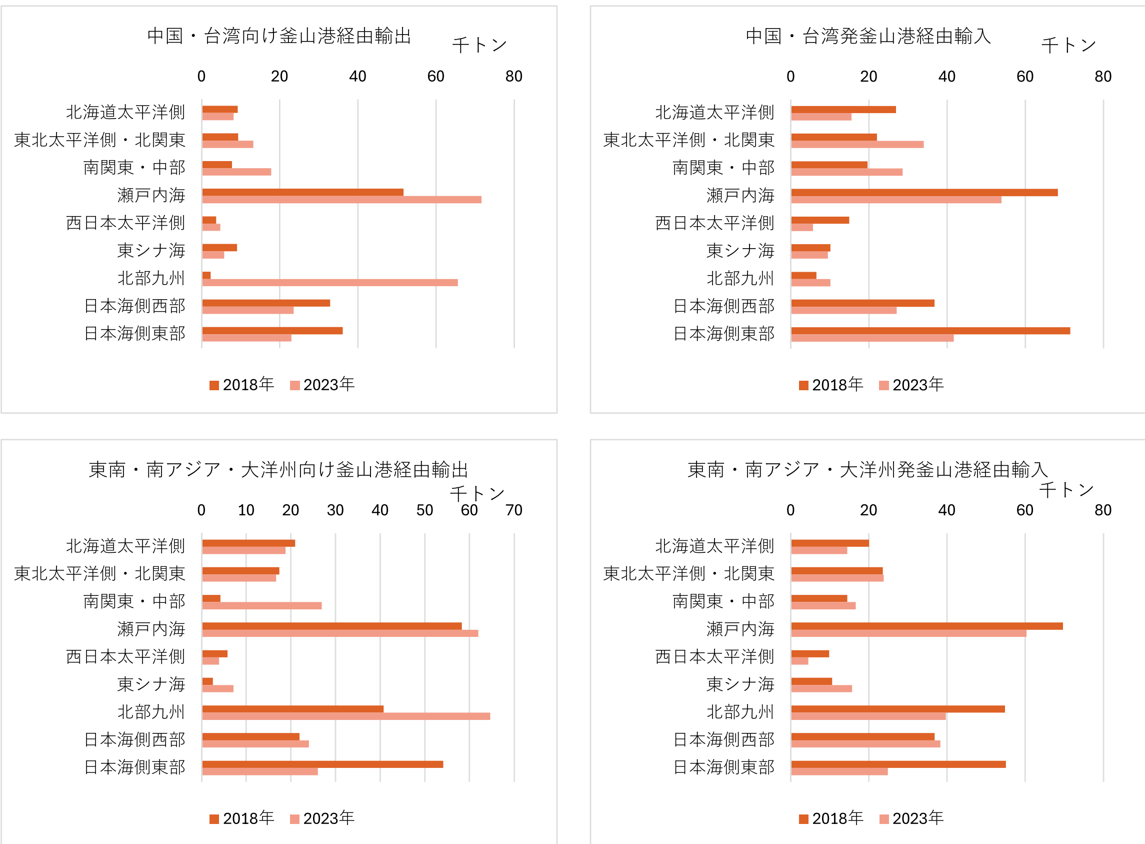
注：五大港を除く。
出所：コンテナ流調に基づき筆者作成。

表２　方面別釜山港積替貨物量（トン）

	2018年			2023年		
	輸出	輸入	計	輸出	輸入	計
韓国国内	45,170	16,195	61,365	25,178	18,332	43,510
	26,735	*10,797*	*37,532*	*19,959*	*16,443*	*36,402*
中国・台湾	166,758	293,046	459,804	360,444	285,489	645,933
	162,274	*276,871*	*439,145*	*233,582*	*226,145*	*459,727*
東南・南アジア・大洋州	245,580	330,768	576,348	409,850	327,063	736,913
	226,176	*294,789*	*520,965*	*250,338*	*238,198*	*488,536*
欧州（地中海含む）	73,814	95,636	169,450	112,299	158,013	270,312
	53,537	*75,630*	*129,167*	*61,583*	*55,041*	*116,624*
北米西岸	79,193	92,225	171,418	54,337	71,552	125,889
	47,441	*70,656*	*118,097*	*30,995*	*45,356*	*76,351*
その他	254,024	179,791	433,815	242,470	208,572	451,042
	157,958	*123,268*	*281,226*	*125,640*	*76,184*	*201,824*
総計	864,539	1,007,661	1,872,200	1,204,578	1,069,021	2,273,599
	674,121	*852,011*	*1,526,132*	*722,097*	*657,367*	*1,379,464*

注：下段の斜体字の値は、地方港発着の貨物量で内数。
出所：コンテナ流調に基づき筆者作成。

図３　地方港発着貨物の釜山港での積替量（方面別、地域別）



注：五大港を除く。
出所：コンテナ流調に基づき筆者作成。

日本海側東部地域の減少が目立つことから、この地域に限って詳細に検討してみたい。日本海側東部のコンテナ港湾は、小樽、石狩湾新、秋田、酒田、新潟、直江津の6港であるが、これらの港湾の定期コンテナ航路の寄港地は韓国及び中国に限られるため、利用できる積替港は事実上、釜山港、上海港のみである。表 3から分かるように、中国・台湾方面では「その他」に区分される貨物量も相当あるが、これらは定期航路が寄港するいくつかの中国港湾への直航貨物であると考えられる。さて、2時点間の変化に注目すると、いずれの方面についても輸出入量自体が大きく減少しており、それに伴って釜山港での積替のみならず、上海港での積替貨物量も減少している。さらに詳しく確認すると、中国・台湾方面への輸出貨物では、直航のシェアが低下して、釜山港積替のシェアが上昇している。これに対して、輸入貨物では上海港積替シェアが4.1パーセントポイント上昇して、釜山港積替と直航のシェアがそれぞれ2.3パーセントポイント、1.8パーセントポイント低下している。ただし、これらのシェアの変化は全体的な貨物量減少の影響に比べると小さく、釜山港積替貨物量の減少の理由を上海港積替へのシフトに帰することは適切ではない。また、秋田港、酒田港、新潟港、直江津港の立地県である秋田県、山形県、新潟県の中国からの輸入貨物量が合計で4.0万トン(32.0%)減少している など、アジア各地域からの輸入が軒並み減少しており、そのことが釜山港積替貨物の減少に直結していると考えることが妥当であるように見える。逆に言えば、京浜港などへのシフトが主因であるとはいいがたい状況にある。

(3) 本節のまとめ

2018年及び2023年のコンテナ流調データを用いて、2時点の比較などを行い、以下の事柄を確認した。釜山港が地方港にとって重要な積替港となっていることが改めて確認できたと同時に、五大港においても釜山港積替輸送が相当程度活用されるようになっていることが明らかになった。日本各地の地方港を地域区分して比較すると、瀬戸内海、北部九州、日本海側東部地域で、釜山港積替輸送が積極的に活用されている。地方港発着で釜山港を経由する積替貨物は、主に中国・台湾方面や東南・南アジア・大洋州方面との間で輸送されている。これらの方面では、比較した2時点間に輸出貨物量は増加したが、輸入貨物量が減少した。特に、日本海側東部での減少が著しいが、その主な理由を釜山港積替から上海港積替へのシフトに帰することは必ずしも適切ではない。

3. 港湾統計調査を用いた分析

(1) 分析対象港湾の抽出

港湾統計によれば、2020年～ 2022年の3か年に輸出入コンテナ貨物の取り扱い実績があった港湾は全国で65港湾あった。本来であれば、これらの全港湾を分析対象とすべきであるが、前述の通り、一部の港湾では最終船卸港・最初船積港の貨物量が示されていない。したがって、これらの港湾を分析対象から除外する必要がある。そこで、3か年の積替貨物量の合計がゼロである東京港、伏木富山港など11港を除いて、残りの54港を分析対象とした。コンテナ流調の場合と同様、地域別の分析を行う便宜上、これら54港湾を9地域に分類した(表 4)。なお、除外11港のコンテナ貨物取扱量が全国の総貨物取扱量に占める割合は19.9% (3か年平均)であり、決して小さい比率ではないが、このうち国内最大港湾である東京港が18.5%を占めている。したがって、上述の処理により11港を除外したデータは「東京港を除く全国の状況」を示すとみなすことができると考える。以下、本節での分析は抽出した54港を対象に行った結果である。

表 3　日本海側東部地域港湾発着の方面別・積替港別貨物量(トン)

	2018年			2023年		
	輸出	輸入	計	輸出	輸入	計
中国・台湾	**47,523**	**149,484**	**197,007**	**26,347**	**91,456**	**117,803**
釜山港積替	36,116	71,530	107,646	22,972	41,704	64,676
上海港積替	3,403	42,911	46,314	2,181	30,012	32,193
その他	8,004	35,043	43,047	1,194	19,740	20,934
東南・南アジア・大洋州	**55,959**	**55,488**	**111,447**	**27,803**	**25,849**	**53,652**
釜山港積替	54,113	55,027	109,140	26,075	24,837	50,912
上海港積替	1,846	461	2,307	1,173	987	2,160
その他	0	0	0	555	25	580

注 : 「その他」には積替なしの直航貨物量を含む。
出所 : コンテナ流調に基づき筆者作成。

[4] コンテナ流調の「表25　生産地・消費地別仕向国・原産国別貨物量」の2時点比較による。

表 4　対象港湾の地域区分（港湾統計）

地域	対象港湾	除外港湾
北海道太平洋側（3）	苫小牧、室蘭、函館	釧路
東北太平洋側・北関東（5）	釜石、仙台塩釜、小名浜、茨城、鹿島	青森、八戸
南関東・中部（8）	千葉、川崎、横浜、清水、御前崎、三河、名古屋、四日市	東京
瀬戸内海（15）	大阪、神戸、和歌山下津、水島、福山、広島、大竹、下関、宇部、三田尻中関、徳山下松、岩国、松山、今治、大分	堺泉北、徳島小松島、高松、三島川之江
西日本太平洋側（4）	高知、細島、志布志、鹿児島	
東シナ海（5）	三池、長崎、八代、川内、那覇	熊本
北部九州（3）	博多、北九州、伊万里	
日本海側西部（5）	金沢、敦賀、舞鶴、境、浜田	伏木富山
日本海側東部（6）	小樽、石狩湾新、秋田、酒田、新潟、直江津	稚内

注：カッコ内の数字は、当該地域内の対象港湾数。
出所：筆者作成。

もう一点、留意すべきは、港湾統計は国･地域を単位としており、港湾別のデータではないことである。本稿は、釜山港での積替貨物の分析を行うことを目的としているが、釜山港に限った取扱貨物量が得られないので、韓国として取りまとめられたデータで代用することとする。韓国の他の港（光陽港や仁川港など）での積替も少量ながら存在すると思われるが、無視できる水準であると仮定する。

また、中国をはじめとする複数港湾が存在する国に関しては、それぞれの国内フィーダー航路との積替も把握できない。具体的に例をあげると、上海港を仕向港とする輸出貨物が上海港で積み替えられて中国国内の他港に輸送されたとしても、港湾調査では「仕向国も最終船卸国も中国」として処理されてしまうため、積替貨物として数量化されない。中国の地方港向けの貨物が、釜山で積み替えられるのか、上海で積み替えられるのかといった比較分析を行うことができないという制約がある。

（2）積替の動向

2022年の全対象港湾の輸出入コンテナ貨物量の合計は2億44万トンで、このうち仕向・仕出港で積み替えられた貨物が6080万トンあり、総貨物量に占める積替貨物量の比率は30.3%であった（表 5）。輸出入別では、輸出貨物の積替率が38.5%であるのに対し、輸入貨物は24.7%で、輸出貨物の方が積替による輸送比率が高い。韓国発着の貨物に注目してみると、積替率は一層高まる。韓国向け輸出では約3分の2（63.5%）、韓国からの輸入では約半分（49.7%）が韓国で積み替えられている。後述するが、この積替比率は現実よりも小さいと思われ、港湾統計を積替分析に用いることの限界を示すデータでもある。

表 5　仕向国／仕出国での積替状況（千トン、%）

	年	輸出積替	輸入積替	輸出入合計
全世界	2020	29,760	27,027	56,787
		38.5%	*23.3%*	*29.3%*
	2021	32,325	27,301	59,626
		38.7%	*22.6%*	*29.2%*
	2022	31,611	29,188	60,798
		38.5%	*24.7%*	*30.3%*
韓国	2020	8,113	8,922	17,035
		58.7%	*50.5%*	*54.1%*
	2021	8,860	8,650	17,510
		59.9%	*47.7%*	*53.2%*
	2022	10,094	8,653	18,746
		6.5%	*49.7%*	*56.3%*

注：下段の斜体字の数字は、貨物総量に対する積替貨物量の比率。
出所：港湾統計に基づき筆者作成。

表 6　輸出入コンテナ貨物の積替量に占める韓国・中国のシェア(%)

	年	輸出積替	輸入積替	輸出入合計
韓国	2020	27.3%	33.0%	30.0%
	2021	27.4%	31.7%	29.4%
	2022	31.9%	29.6%	30.8%
中国	2020	13.2%	18.1%	15.5%
	2021	17.2%	21.3%	19.1%
	2022	18.1%	20.7%	19.4%

出所：港湾統計に基づき筆者作成。

経年変化についても表 5から確認しておくと、過去3年間に、韓国を仕向国とした輸出では、積替貨物の量・率とも上昇している。これに対して、輸入では2022年には2020年と比べて、量・率ともに低下している。同期間に、全世界を対象とした積替貨物量・率は上昇している。その上、この間に中国で積み替えられた輸入貨物量は約106万トン増加しているので、釜山港から中国港への積替港シフトが起こった可能性が示唆される。

そこで、日本にとって韓国に次ぐ積替拠点国[5]である中国と合わせて、それぞれのシェアの変化を確認したのが表 6である。輸出貨物については、両国ともシェアを伸ばしているが、輸入貨物では中国が2年間で2.6パーセントポイントシェアを拡大した一方で、韓国のシェアは3.4パーセントポイント低下している。積替港のシフトが、ある程度起こったものと推察される。

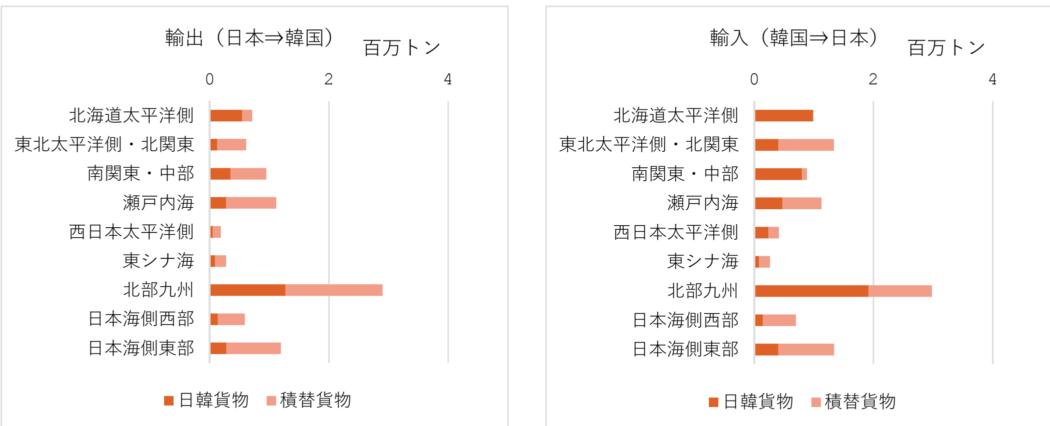
上述の通り、本稿では日本の港湾を9地域に分けて分析することとしている。図 4に2022年の韓国を仕向国・仕出国とするコンテナ貨物量を地域別に示した。輸出面で韓国での積替量が多いのは、北部九州(163万トン)、日本海側東部(92万トン)、瀬戸内海(84万トン)などであり、輸入面でも北部九州(106万トン)、日本海側東部(94万トン)が多い点は同じだが、その次に多いのは東北太平洋側・北関東(93万トン)である。なお、図 4では五大港を除いた貨物量を示しているが、神戸港では輸出貨物155万トン(韓国向け輸出量の75.2%)、輸入貨物104万トン(韓国からの輸入量の70.3%)が韓国で積み替えられているなど、五大港発着貨物でも韓国での積替輸送が活用されている。

積替貨物率に着目すると、輸出貨物においては東北太平洋側・北関東(79.3%)、日本海側西部(76.7%)、日本海側東部(76.6%)で比率が高い。輸入貨物は輸出貨物に比べて積替貨物率が低い傾向にあるが、日本海側西部(79.4%)、日本海側東部(69.9%)、東北太平洋側・北関東(69.8%)で積替貨物量比率が高い。

次に、韓国積替貨物量の3年間の変化を地域別に概観する(図 5)。積替貨物量が多い地域に着目すると、輸出では北部九州において増加がみられる一方、日本海側東部及び瀬戸内海では減少している。輸入では、ほぼすべての地域において減少傾向がみられる。

日本海側東部地域での韓国積替貨物が輸出入ともに減少していることから、主要貿易相手国である中国を例にとって、韓国経由貨物量と中国直航貨物量の比較を行った(表 7)。2020年と2022年を比較すると、輸出入いずれも全体として減少した中で、中国直航の輸出貨物だけが増加したが、それ以外の韓国経由の輸出入貨物及び中国直航輸入貨物は減少した。釜山経由から

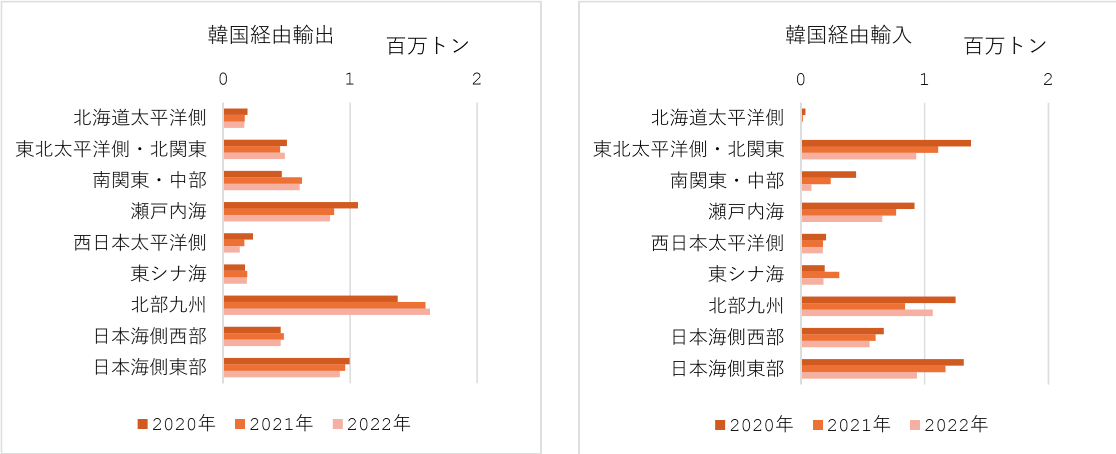
図 4　地域別の韓国発着貨物量(2022年)



注：五大港(ここでは横浜、名古屋、大阪、神戸)を除く、対象地方港49港。
出所：港湾統計に基づき筆者作成。

[5] この2国に、シンガポール、台湾、香港を加えて5カ国・地域で、日本発着コンテナ貨物の約9割が積み替えられている。

図５　地域別の韓国での積替貨物量の推移



注：五大港（ここでは横浜、名古屋、大阪、神戸）を除く、対象地方港49港。
出所：港湾統計に基づき筆者作成。

表７　日本海側東部地域発着のルート別対中国貨物量（トン）

	2020年	2021年	2022年
対中国輸出	401,004	417,475	364,334
韓国経由	292,514	273,877	250,208
中国直航	108,490	143,598	114,126
対中国輸入	1,582,189	1,540,774	1,409,286
韓国経由	599,024	578,388	458,433
中国直航	983,165	962,386	950,853

出所：港湾統計に基づき筆者作成。

中国直航へのシフトが起こったと考えることも可能ではあるが、このデータからは貿易量全体の減少の影響との判別はできず、明確な示唆は得られない。

（3）本節のまとめ

港湾統計データを用いた分析を行い、以下の事柄を確認した。韓国は、日本発着の輸出入コンテナ貨物の輸送にあたり最大の積替拠点国である。その役割は、日本の輸出貨物において特に重要である。日本の輸入貨物において、韓国での積替から中国での積替にシフトが起こった日本の各地域別では、北部九州や日本海側、東北太平洋側・北関東といった地域で、韓国積替輸送が活用されている。2020年と2022年を比較すると、輸出では北部九州において増加がみられる一方、日本海側東部及び瀬戸内海では減少している。輸入では、ほぼすべての地域において減少傾向がみられる。輸入貨物においては、韓国から中国への積替国のシフトがある程度起こったと推察されることから、より具体的に日本海側東部地域の対中国貨物を例として、韓国経由輸送から中国直航輸送へのシフトが起こったかについて検討したが、明確な結論は得られなかった。

4．考察

以上、第2節、第3節で、それぞれコンテナ流調及び港湾統計のデータを用いて、釜山港（韓国）でのコンテナ貨物積替の状況を整理した。これらに基づいて若干の考察を行う。

まず、「釜山積替輸送は地方港の専売特許」というステレオタイプにとらわれてはならない。五大港発着貨物の中にも、釜山港積替貨物は相当量あり、その量は近年増加傾向にある。実態として、どのような物流が展開されているのかについて、さらに掘り下げた分析が必要だと考える。

地方港を地域区分して比較すると、釜山港で積み替えられるコンテナ貨物の中では、瀬戸内海や日本海側に立地する港湾の発着貨物が比較的多い。これらの地域は、釜山港にとっての「お得意様」といえるだろう。

近年の動向を確認すると、輸入貨物において釜山港積替貨物が減少する傾向が確認できた。特に、日本海側東部地域発着貨物の減少が顕著である。データの制約上、この減少傾向が新型コロナウイルス禍以前から始まっていたのか否かの確認はできないが、少なくともそれ以降に減少傾向がみられることは確かである。ただし、こうした減少が上海港など他港での積替ルートや直航ルートにシフトしたことによると結論付けることまではできなかった。

冒頭にも述べた通り、港湾統計のデータにはいくつか不備がある。本稿での分析を通じ、さらに問題点が浮き彫りになった。コンテナ流調データの分析では、釜山港に向かう輸出貨物の90.8%、逆に釜山港からの輸入貨物の80.6%が同港での積替貨物であった。これに対して、港湾統計データでは、韓国に向かう輸出貨物に占める積替貨物は63.5%、韓国からの輸入貨物に占める積替貨物は49.7%にとどまっている。後者のデータにおいて、現実には最終船卸国・最初船積国が韓国以外のケースであっても、調査報告担当者がその国名に関する情報を入手できていないなどの事情で最終船卸国・最初船積国が空欄となっているケースが相当数あって、その分がこうした違いとなって表れているものと思われる。

5. おわりに

本稿では、2種類の統計調査結果に基づき、日本の地方港発着の輸出入コンテナ貨物の釜山港での積替量などについて、近年の変化状況を整理した。一定の傾向を確認することはできたが、釜山港積替輸送から他のルートのシフトが起こったのかなど、明確な結論が得られなかった点もある。釜山港でのコンテナ積替をめぐる状況について、日韓航路をはじめとする各航路のトランジットタイムや運行頻度、輸送キャパシティなどの情報なども交えて、より詳細な検討を行う必要があると考える。

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Recent Changes in Transshipment Volume of Container Cargo to and from Japan at Busan Port

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Busan Port is the largest transshipment hub for importing/exporting container cargo to/from Japan. An analysis of two sets of official Japanese statistical data shows that the volume of cargo imported into Japan transshipped at Busan Port has declined in recent years. The decline is particularly noticeable in the eastern area of the Sea of Japan region. This is assumed partly due to a shift to transshipment at other ports, but this study could not confirm the assumption.

Keywords: Busan Port, transshipment, local ports, the Container Cargo Flow Survey of Japan, the Port Statistics of Japan
JEL code: L92

A Comparison of Cost and Benefit in Rice Production between Farmer Economies in Japan and China

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Abstract

This study examines the cost-benefit dynamics of rice production in Japan and China, with a particular focus on farm size, cost structure, and productivity. Utilizing data from both countries, we classify farmers into two categories based on landholdings: those cultivating less than 6.67 hectares and those with 6.67 hectares or more. This distinction allows us to assess the impact of farm size on agricultural performance. Our analysis reveals that large-scale farmers in both Japan and China achieve higher yields per hectare. However, while large-scale farmers in Japan demonstrate superior cost control and profitability, their counterparts in China face higher per-unit area costs, particularly in labor and land, which often result in financial losses. Similarly, small-scale farmers in both countries tend to operate at a loss. A comparative analysis of cost structures indicates that labor and capital costs constitute a significant share of rice production expenses in Japan, whereas land costs are more prominent in China. These findings highlight the critical role of mechanization, labor expenses, and land costs in shaping the economic landscape of rice farming in both nations. The study suggest that policy interventions focusing on technological innovation, cost reduction, and farm-scale efficiency could improve the profitability and sustainability of rice farming in Japan and China. This research contributes to understanding the economic and structural challenges in rice production and offers insights for improving agricultural policies in both nations.

Keywords: Farmer economy; Economies of scale; Cost-benefit analysis
JEL Classification: O12; Q12; Q18

1. Introduction

Rice production plays a crucial role in ensuring food security and supporting rural development in both Japan and China, where rice serves as a staple food. Japan maintains a nearly 100% self-sufficiency rate for rice, despite an overall food self-sufficiency rate of only 38% in terms of caloric intake. China accounts for approximately one-third of Asia's total rice production and consumption, and rice contributes to 40% of calorie intake. The demand for high-quality and nutritious rice has been rising rapidly. While rice consumption in China is expected to decline due to an increasingly diverse food supply, its overall volume remains critical for such a populous nation. Meanwhile, Japan has experienced a shrinking domestic rice market over the past decade.

Rice production in both Japan and China is primarily carried out by farmers, the majority of whom operate on a small scale. Given this context, a comparative analysis of rice cultivation between the two countries is both necessary and insightful. This study examines the costs and revenues associated with rice farming in Japan and China, exploring differences in input-output dynamics and identifying key factors limiting income growth.

Studying this issue is of great significance for several reasons. First, the analysis helps us understand the cost and revenue structure of rice cultivation in both countries, thereby identifying the constraints on improving rice profitability and efficiency. Second, this provides valuable policy references for the formulation and implementation of agricultural development strategies in both countries. Japan's shift from the Gentan policy to promoting agricultural exports, with China as a key market, makes it essential to compare rice production costs and efficiency in both countries. This comparison can enhance productivity and support a more integrated agricultural market. For China, studying Japan's agricultural strategies and technologies offers useful lessons for improving rice farming efficiency and sustainability.

Finally, a common global challenge in agriculture is how to mitigate the impacts of climate change while ensuring sustainable agricultural production. Balancing sufficient food security with environmental concerns has become increasingly urgent. Agriculture must maintain adequate output to meet market demand, increase farmer incomes, and stabilize agricultural prices. As major rice-producing countries, both Japan and China are directly affected by these global challenges. A deeper understanding of their rice cultivation approaches and the constraints they face will provide valuable insights into how both nations can adapt to climate change while maintaining agricultural productivity and farmer livelihoods. In conclusion, comparing rice cultivation in Japan and China is not only crucial for ensuring stable rice production and improving farmers' income but also for understanding the differences in their agricultural systems and contributing to the broader dialogue on sustainable agricultural development and global challenges including climate change.

2. Stylized Facts of Rice Production in Japan and China

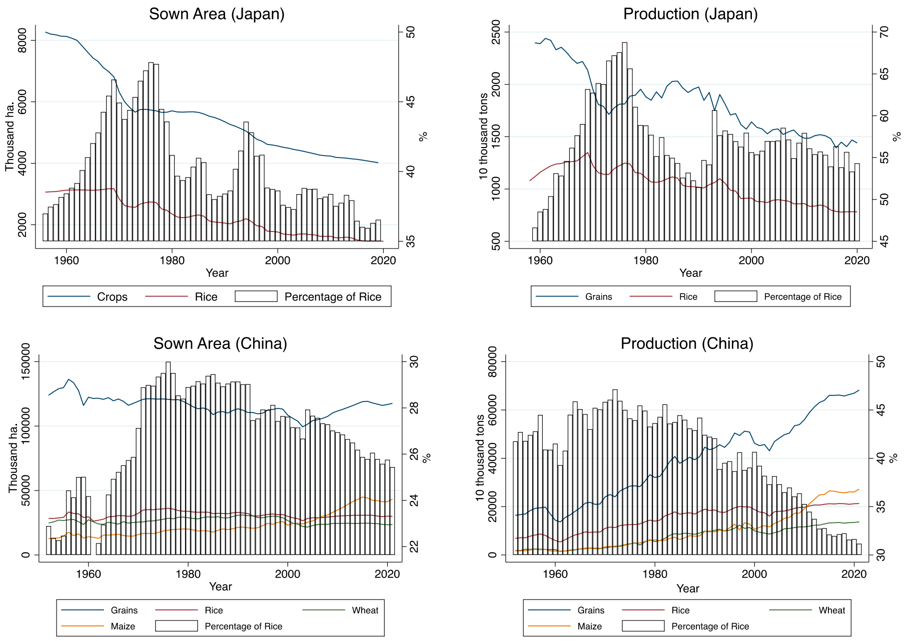
2.1 Domestic Rice Production and Trade

Japan's rice production is facing unprecedented challenges due to shifts in domestic food consumption patterns, an aging population, and a declining birthrate (Kusakari, 2011). The continuous decline in rice consumption poses a significant challenge to maintaining the domestic agricultural production base. As illustrated in Figure 1, Japan's rice cultivation area has steadily decreased since the 1980s. While the overall grain cultivation area has declined, rice's share of total grain sown area has dropped from a peak of 45% to the current 35%. Despite this reduction, rice remains Japan's dominant staple crop, accounting for more than 50% of total grain production.

In contrast, China has experienced a slow but steady increase in rice cultivation area and production since the 1980s. However, structural adjustments in cropping patterns and the loss of arable land due to urbanization have significantly impacted agricultural transformation (Hou et al., 2021). Rapid urbanization and the expansion of non-agricultural sectors have led to notable shifts in rice farming, particularly the transition from double cropping to single cropping. Due to labor shortages, approximately 37% of farmers have adopted single cropping, contributing to a decline in the total rice sown area and yield levels since the early 1980s (Chen et al., 2013). As a result, rice's share of total grain sown area has fallen below 26%, while its share of total grain production has declined to approximately 30%. In summary, Japan and China have experienced divergent trends in rice production and cultivation area since the 1980s. Japan has seen a continuous decline in rice cultivation area, with rice's share of total grain sown area decreasing, though it still maintains a dominant position in total grain production. Meanwhile, China's rice cultivation area and production have grown slowly, but the increasing demand for corn has led to a gradual reduction in rice's share of both the total grain sown area and total grain production. These trends reflect the differing challenges and shifts in food production priorities in both countries.

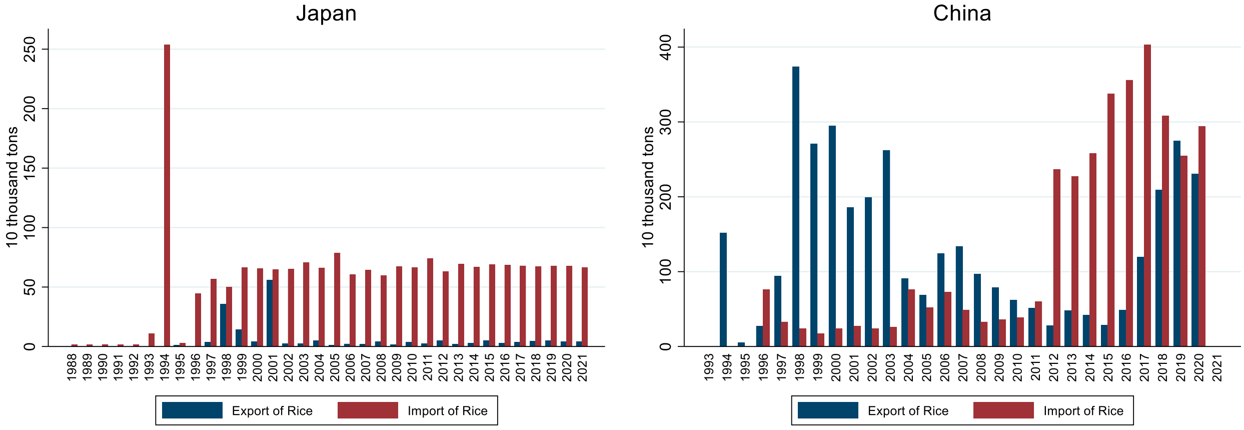
Japan, abolished the rice acreage reduction program (known as the Gentan Policy: 1970-2018) and attempts reduce agricultural production costs, in order to enhance the international competitiveness of agricultural products and promote the export of Japanese agricultural products, including rice. However, as shown in Figure 2, while Japan's rice export volume has been

Figure 1: Rice Production in Japan and China



Source: The data are from the database of the Ministry of Agriculture, Forestry, and Fisheries of Japan and the annual database of the National Bureau of Statistics of China.

Figure 2: Rice Export and Import in Japan and China



Source: The data are from the database of the Ministry of Agriculture, Forestry, and Fisheries of Japan and the annual database of the National Bureau of Statistics of China.

gradually increasing in recent years, its import volume remains substantial. A significant portion of rice imports is used for variety exchange and feed purposes.

In contrast, in China, due to the technical barriers in rice production and the continuous rise in production costs, stabilizing rice production to ensure food security and increasing the income of rice farmers have become the country's primary policy objectives. In the past decade, China's rice export volume has been increasing, but the import volume has grown even faster, resulting in a rice trade deficit.

2.2 Structure of Agricultural Entities in Rice Production

In both Japan and China, the primary producers of rice are farmers. According to Japan's 2020 Agricultural Census, there were 1.07 million farming households in the country, with 70% engaged in rice cultivation. In terms of farm size distribution, small-scale farmers (those operating on less than 3 hectares) accounted for 84% of all farming entities (see Figure 3). However, large-scale farmers managing over 20 hectares, though comprising only 3% of all rice producers, cultivated as much as 38% of Japan's total rice-growing area.

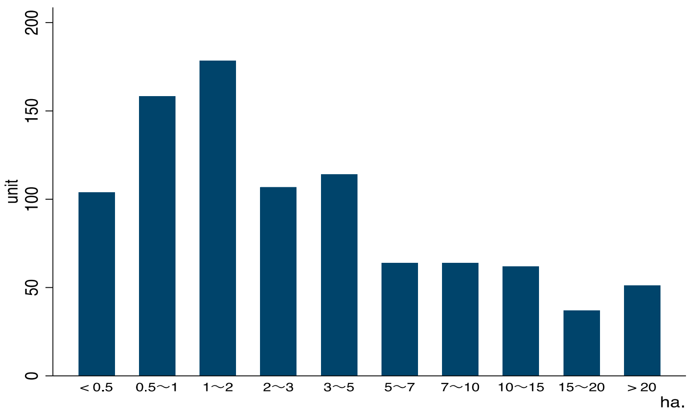
In China, the scale of rice farming is even smaller. As shown in Figure 4, 74% of Chinese farmers operate on less than 0.46 hectares of land, reflecting the highly fragmented nature of rice cultivation in the country.

2.3 Rice Processing and Distribution

Rice processing in Japan is characterized by a high degree of standardization and mechanization, with stringent quality controls imposed by the government to ensure both the safety and quality of rice. The sector is predominantly dominated by agricultural cooperatives and large enterprises, which oversee various stages of processing. In contrast, China's rice processing industry is highly diverse, encompassing both large state-owned enterprises and a vast number of small and medium-sized local businesses. While rice processing technology continues to advance, significant regional disparities persist, with some areas still relying on relatively basic equipment.

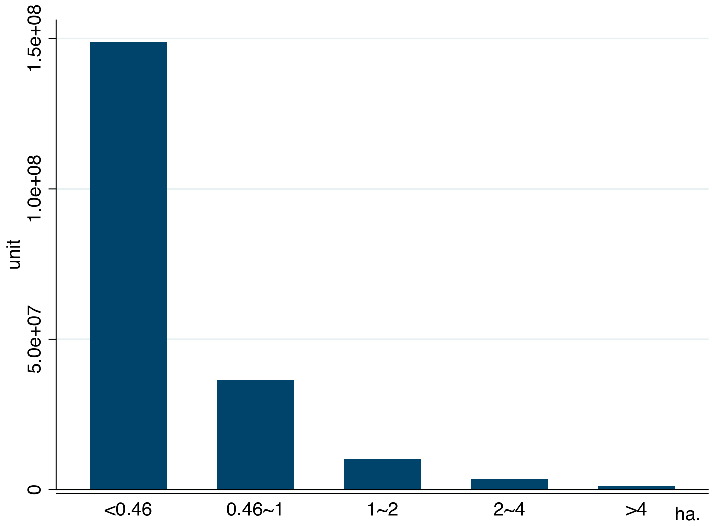
Regarding distribution, Japan's rice market is primarily managed through agricultural cooperatives (JA), which play a central role in procurement, storage, processing, and sales.

Figure 3. Distribution of Rice Farming Land Size in Japan



Source: The data are from Statistical Survey on Farm Management and Economy (Statistics Code: 00500201), Ministry of Agriculture, Forestry, and Fisheries of Japan.

Figure 4. The distribution of land size for farmers' operations in China



Source: The data are from China's Second National Agricultural Census (2006).

The distribution system is relatively closed, with rice mainly sold through traditional markets and supermarkets, and limited external demand. In contrast, China's rice distribution channels are more extensive, including wholesale markets, retail supermarkets, processors and millers, local shops and an expanding presence in e-commerce platforms. In recent years, online sales have played an increasingly significant role in the domestic rice market. Grain Minimum Purchase Price Policy was released in 2004. This policy ensures that the government purchases key grains (e.g., wheat, rice) from farmers at a pre-announced minimum price when market prices fall below the threshold. It aims to protect farmers' income stability and strengthen national food security.

Overall, Japan's rice supply system follows a model in which small-scale farmers are closely linked to agricultural cooperatives (JA), while in China, rice supply chain involves production by traditional small-holder farmers, new agricultural operators (such as specialized cooperatives and agribusiness enterprises), and family farms. It is characterized by decentralized small-holder farming, diverse participation and combination of scale and intensive farming, which is under transitioning toward market-oriented efficiency and greater scale while balancing food security with fiscal and competitive challenges.

3. Cost and Benefit Analysis in the Rice Sector

Given the critical role of land size in assessing and explaining agricultural production activities (Chayanov, 1991; Cornia, 1985; Hall & LeVeen, 1978; Helfand & Levine, 2004; Henneberry et al., 1991; Khataza et al., 2019; Lowder et al., 2016; Mottaleb & Mohanty, 2015; Weersink & Tauer, 1991; Wolf & Sumner, 2001), this study categorizes farmers into two groups: those operating on less than 6.67 hectares and those with 6.67 hectares or more. This classification aims to minimize the influence of land size on the analysis of rice production.

Table 1 presents operational data from farmers with landholdings below 6.67 hectares compared to those with larger holdings in Japan. The findings indicate that large-scale farmers achieve higher yields per unit area than small-scale farmers. Additionally, large-scale farmers demonstrate greater efficiency in fertilizer usage, applying a lower quantity of fertilizer per unit area. In terms of costs and revenues per unit area, large-scale farmers generate higher revenues and incur lower costs than their small-scale counterparts. As a result, the net profit for large-scale farmers is significantly higher. Notably, farmers with landholdings below 6.67 hectares report negative net profits, while those with larger holdings achieve positive net profits.

According to the data in Table 2, a similar pattern can be observed in rice production in China. Large-scale farmers attain higher yields per unit area than small-scale farmers. However, unlike in Japan, fertilizer usage per unit area is higher among large-scale farmers. Regarding per-unit area costs and revenues, large-scale farmers generate higher revenues but also incur higher costs compared to small-scale farmers. Although both groups operate at a loss, the financial performance of large-scale farmers is relatively better.

When comparing per-unit area rice yields between China and Japan, it is evident that Japan's yields are lower than those in China within the same farm size category. For instance, in the group with landholdings smaller than 6.67 hectares, the per-hectare yield in Japan is 4,707.17 kg, while in China, it is 7,627.50 kg. This suggests that, at the same scale, land productivity in China is superior. One possible explanation for this discrepancy is Japan's long-term policy of reducing

Table 1. Significance Test of Production Differences Among Rice Farmers of Various Scales (Japan, 2020–2021)

Variables	Rice Farmers (<6.67ha.)		Rice Farmers (>=6.67ha.)		Diff.
	Obs.	Means	Obs.	Means	
Yield (kg/ha.)	1242	4707.17	366	5507.90	-800.73***
Area (ha.)	1242	1.54	366	19.46	-17.92***
Fertilizer (kg/ ha.)	146	4807.62	52	2230.98	2576.64**
Nitrogen (kg/ha.)	128	129.73	91	82.51	47.23***
Phosphorus (kg/ha.)	150	263.15	44	113.25	149.90***
Potassium (kg/ha.)	66	126.21	15	34.33	91.88***
Others (kg/ha.)	20	1256.35	21	1021.00	235.35**
Organic fertilizer (kg/ha.)	146	4712.62	52	2133.21	2579.41**
Total income (JPY/ha.)	1242	981866.96	366	1130605.57	-148738.61***
Total cost (JPY/ha.)	1242	1629687.78	366	1045075.60	584612.20***
Fertilizer cost (JPY/ha.)	1239	95240.00	366	87115.00	8125.00***
Pesticide cost (JPY/ha.)	1239	82367.96	364	72966.43	9401.53***
Seed cost (JPY/ha.)	1237	54867.90	360	21022.36	33845.54***
Labor cost (JPY/ha.)	1242	464070.63	366	237142.19	226928.4***
Other cost (JPY/ha.)	1232	739794.79	358	449378.55	290416.2***
Farming profit (JPY/ha.)	1242	-647820.81	366	85529.97	-733350.8***

Source: Calculated by the authors. The data are collected as part of the Statistical Survey on Farm Management and Economy (Statistics code: 00500201) conducted by the Ministry of Agricultural, Forestry, and Fisheries of Japan.
Note: (1) Standard errors are reported in parentheses. (2) Significant levels are * 0.10, ** 0.05, *** 0.01.

Table 2. Significance Test of Production Differences Among Rice Farmers of Various Scales (China, 2016)

Variables	Rice Farmers (<6.67ha.)		Rice Farmers (>=6.67ha.)		Diff.
	Obs.	Means	Obs.	Means	
Yield (kg/ha.)	968	7627.50	250	8409.75	-782.25***
Area (ha.)	968	1.01	250	16.58	-3499.65***
Fertilizer (kg/ ha.)	968	550.35	250	614.55	-64.20***
Nitrogen (kg/ha.)	968	106.65	250	122.25	-15.60**
Phosphorus (kg/ha.)	968	13.35	250	14.7	-1.35
Potassium (kg/ha.)	968	24.75	250	30.6	-5.85***
Others (kg/ha.)	968	163.65	250	167.4	-3.75
Organic fertilizer (kg/ha.)	968	246.75	250	4.8	241.95*
Total income (RMB/ha.)	968	21107.70	250	25433.4	-4325.70***
Total cost (RMB/ha.)	968	25340.25	250	29530.65	-4190.40***
Fertilizer cost (RMB/ha.)	968	2016.75	250	1828.2	188.55***
Pesticide cost (RMB/ha.)	956	1250.34	249	1146.6	103.74*
Seed cost (RMB/ha.)	954	1062.45	250	892.5	169.95***
Labor cost (RMB/ha.)	968	7587.60	250	8340.3	-752.70***
Other cost (RMB/ha.)	952	13586.55	249	17375.55	-3789.00***
Farming profit (RMB/ha.)	968	-4232.55	250	-4097.19	-135.36

Source: Calculated by the authors. The data are collected by the project of "Differentiation on the output and efficiency of grain production and its mechanisms of improvement in China" led by the Institute of Crop Sciences, Chinese Academy of Agricultural Science which was implemented in 2016 including 1218 rice farmers covering 615 inbred rice farmers and 603 hybrid rice farmers, respectively.
Note: (1) Standard errors are reported in parentheses. (2) Significant levels are * 0.10, ** 0.05, *** 0.01.

Table 3. Comparison of Cost Structure between Japan and China

	Japan		China	
	(<6.67ha.)	(>=6.67ha.)	(<6.67ha.)	(>=6.67ha.)
Fertilizer cost (%)	6.63	10.04	7.91	6.18
Pesticide cost (%)	5.73	8.41	4.90	3.88
Seed cost (%)	3.82	2.42	4.17	3.02
Labor cost (%)	32.31	27.33	29.75	28.19
Other cost(%)	51.51	51.79	53.27	58.73
Benefit-cost ratio	0.60	1.08	0.83	0.86

Source: Calculated by the authors.

rice production, which has dampened farmers' motivation to enhance per-unit area yields. Additionally, compared to China, the shadow price of labor in Japan's rice sector is relatively high, reducing the incentive for productivity improvements.

To identify the profit constraints in the rice production sectors of Japan and China, let us examine the cost structure. In both countries, labor accounts for approximately one-third of the total cost. However, the proportion of labor costs is lower for large-scale farmers compared to small-scale farmers, indicating that smaller farms bear a higher share of labor costs.

Differences in fertilizer and pesticide usage also exist between the two countries. In Japan, the share of these inputs in total costs is generally higher across all farm size categories, except for the share of fertilizer costs among small-scale farmers. Furthermore, large-scale farmers in Japan allocate a higher proportion of their costs to fertilizers and pesticides compared to small-scale farmers. In contrast, in China, these costs constitute a larger share for small-scale farmers.

Since the current dataset does not provide specific values for land and capital, we utilize calculations from Dong (2024) to compare the share of land and capital in the total cost of the rice production sectors in both countries. Capital investment accounts for over 40% of the total cost in Japan's rice production, while in China, it is only 34%. Conversely, land costs constitute only 10% in Japan but 21% in China. This suggests a higher level of mechanization in Japan's rice production. The extensive use of machinery relies more on standardization and uniformity, facilitating the adoption of capital-intensive practices and contributing to cost reductions.

4. Conclusion

This study has provided an comprehensive analysis of the differences and similarities in rice production in Japan and China, focusing on farm size, cost structure, yield, and capital utilization. The key findings reveal distinct patterns in production efficiency, cost allocation, and economic outcomes across various farm sizes in both countries.

Firstly, both Japan and China exhibit a clear trend where large-scale farmers outperform small-scale farmers in terms of per-hectare yield, cost efficiency, and profitability. However, the cost structure between the two countries differs significantly. In Japan, labor and capital costs dominate, with labor accounting for approximately one-third of the total cost. The high share of capital costs in Japan suggests that the rice sector is more mechanized and relies on capital-intensive machinery to drive efficiency. On the other hand, land costs are a higher proportion of the total costs in China, indicating that land acquisition and utilization are more critical factors in China's rice production.

Moreover, the per-hectare yield comparison between the two countries reveals that China's land productivity is generally higher than Japan's, particularly in small-scale farming. This disparity can be attributed to various factors, including Japan's long-term policy of reducing rice production and the

Table 4 Land and Capital Cost in Rice Production between Japan and China

Per ha.	Japan	*China*
% of Raw Materials	18.53	15.03
% of Labor Cost	29.82	28.97
% of Land Cost	10.68	21.04
% of Capital	40.98	34.96
Cost Revenue Ratio	1.29	0.79

Source: Dong's study, 2024.

relatively high shadow price of labor in Japan, which dampens the incentive for higher productivity. In terms of fertilizer and pesticide usage, Japan's large-scale farmers tend to use higher quantities of these inputs, which contribute to higher production costs. In contrast, small-scale farmers in China exhibit a higher reliance on fertilizers and pesticides, impacting their overall cost structure. Despite these differences, both countries face challenges in controlling costs and achieving positive net profits, with small-scale farmers in both countries generally operating at a loss. The cost-revenue ratio and land and capital cost structure also highlight the underlying economic constraints in both countries' rice sectors. Japan's high capital investment and lower land costs suggest a higher degree of mechanization and standardized practices, whereas China's higher land costs reflect the continued reliance on labor-intensive methods for rice production.

Overall, while both countries encounter challenges related to rising costs, small-scale farming, and ensuring profitability, the solutions and strategies for improving rice production and farmer incomes may differ due to their unique agricultural structures. Policymakers in both Japan and China must focus on enhancing farm-scale efficiency, reducing labor costs, and increasing technological innovation to ensure sustainable rice production and secure farmer livelihoods amid changing economic and demographic conditions. This comparative analysis offers valuable insights into the efficiencies and constraints of rice production systems in both Japan and China, informing future policy decisions and further research on improving agricultural sustainability and food security in both nations.

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日中における稲作のコストと利益の比較分析（要旨）

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本研究は、日本と中国における米の生産のコスト・利益の動態を調査し、特に農場の規模、コスト構造、生産性に焦点を当てている。両国のデータを利用し、農家を土地保有面積に基づいて二つのカテゴリに分類する。すなわち、6.67ヘクタール未満を耕作する農家と、6.67ヘクタール以上を持つ農家である。この区別により、農場の規模が農業パフォーマンスに与える影響を評価できる。分析の結果、日本と中国の両方の大規模農家は、ヘクタール当たりの収量が高いことが明らかになった。しかし、日本の大規模農家は優れたコスト管理と収益性を示す一方で、中国の大規模農家は労働や土地における単位面積当たりのコストが高く、しばしば財政的損失を抱えている。同様に、両国の小規模農家も損失を出す傾向がある。コスト構造の比較分析により、日本においては労働費用と資本コストが米の生産費用の重要な割合を占めているのに対し、中国では土地コストがより顕著であることが示された。これらの発見は、両国の米農業の経済的な構造において、機械化、労働費用、土地コストの重要な役割を強調している。本研究は、技術革新、コスト削減、農場の規模効率に焦点を当てた政策介入が、日本と中国の米農業の収益性と持続可能性を向上させる可能性があることを示唆している。本研究は、米生産における経済的および構造的課題の理解に貢献し、両国の農業政策改善に関する洞察を提供する。

キーワード: 農家経済; 規模の経済; 費用便益分析
JEL分類: O12; Q12; Q18

サプライチェーンにおける中国からの生産移管 —イノベーション視点からの一考察

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要　旨

2018年の米中対立以降、日本企業は中国から国内回帰や東南アジアへの移転などサプライチェーン中断のリスクを分散するための動きを加速させた。その際、生産移管先の国の産業基盤やイノベーション力も考慮すべき要素である。本稿は日系企業の進出拠点数が最も多いアジア諸国を取り上げ、数値指標からそれぞれの国のイノベーション力を比較する。分析の結果、東南アジアは製造の重要な担い手であるが、地場企業のイノベーション力はまだ弱く、行政の効率がまだ低いことがわかった。イノベーション力を高めるために、政府の財政投入や政策支援は不可欠であると思われる。

キーワード：イノベーション力、サプライチェーン、生産移管
JELコード：O31、O34

はじめに

2012年、尖閣諸島にめぐって中国では反日デモが発生し、それに加えて、中国の労働力コストが上昇したため、その頃から日本企業の海外進出先に関して「チャイナ＋1」の動きが現れた。2018年に始まる米中対立以降、高い関税を避けるために外資系企業は中国から撤退し、他の国に移転する動きを加速させた。さらに、2020年に新型コロナウイルス感染拡大による中国政府の都市封鎖や工場の操業停止などは、世界のサプライチェーンを混乱に陥れた。そうした状況を受けて、日本企業も国内回帰や東南アジアへの移転などサプライチェーン中断のリスクを分散するための動きをさらに進めた。

中国に対するデリスキングから、東南アジアへの生産移管やサプライチェーンの再編は必要性がある。他方、移転先の国の産業基盤やイノベーション力も考慮すべき要素である。中国はかつて自前の技術を持っておらず、外国技術に依存していた。2000年代半ば以降、中国では国家イノベーション戦略を推進してきた。近年、中国の特許出願数は急速に増加し、電気自動車やAIなどの最新技術分野が急速に成長している。中国はかつての付加価値が低い労働集約的製品の組立工場から、資本財・中間財の輸出国になっている。また、中国は産業集積が成熟し、フルセットの産業チェーンができている。高い関税やチャイナリスクを回避するために、中国から生産を東南アジアなどの国に移転する必要性は少なからずあるが、生産移管先の国は中国での役割を代替可能なのであろうか。

本稿は、アジアの7か国（日本、中国、タイ、インド、韓国、ベトナム、インドネシア）を取り上げ、具体的な数値指標を使い、それぞれの国のイノベーション力を比較する。それにより、中国からの他国への生産移管はどこまで進むのかを展望する。日本以外の6か国は、2023年に日系企業の海外進出拠点数が多く、日系企業の人気な進出先であるので、本稿の比較対象とした。

1. 日系企業の海外進出先の変化

2010年頃まで、日本企業の最大の海外進出先は中国であった。外務省は企業支援及び企業活動の実態を把握するために、「海外進出日系企業拠点数調査」を実施している。また、2018年以前は「海外在留邦人数調査統計」で海外日系企業拠点数を調査していた。これらの調査によれば、2011年の在中国日系企業拠点数は33,420社で、世界合計62,295社の半分以上（53.6%）を占めていた。

表1は2016 ～ 2023年の海外進出日系企業拠点数をまとめている。上段は地域毎の日系企業拠点数である。下段は2023年の日系企業拠点数が最も多い7か国である。米国（第2位）を除き、いずれもアジアの国である。2023年、中国に進出している日系企業拠点数は31,060社で、国別で最も多いが、合計に占める割合は37.9%に低下した。2019年から2023年までの増減数を見てみると、中国は1,827社も減少し、インドは65社減少した。増加数が最も多いのは韓国で、2019年より2,088社も増加した。次に多いのはベトナムで、450社が増加した。インドネシアも173社増加した。タイに関しては、2019年に調査されなかったためデータがないが、2023年には5,856社の日系企業拠点数があり、2016年の1,783社より4,073社増加した。

2018年米中対立以降、中国に進出している日系企業拠点数は大

幅に減り、韓国やベトナムの拠点数が急速に伸びたことが分かった。

日本貿易振興機構（JETRO）も海外日系企業の現地法人向けの調査を行っている。2024年の調査によれば、「今後1～2年の事業展開の方向性」についての質問に対し、中国での事業展開を「拡大」と回答した企業はわずか21.7%で、2007年以来、過去最低の水準である。参考までに2011年をみると、中国での事業を「拡大」と回答した企業は66.8%であった。また、2024年、中国の事業を「現状維持」と回答した企業は64.6%で、「縮小」は12.3%である。「第三国（地域）へ移転、撤退」は1.4%にとどまっている。日系企業による中国での事業は「現状維持」が最も多く占めている。

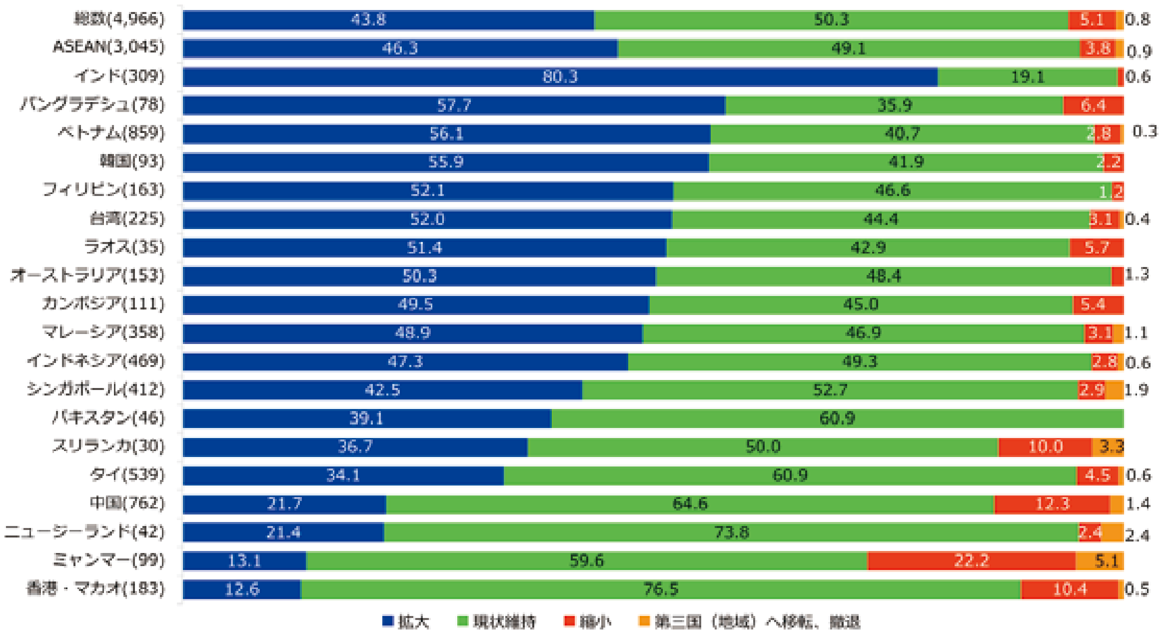
2024年、インドは最も人気が高い進出先であり、80.3%の企業は事業を「拡大」と回答している。ベトナムは56.1%、韓国は55.9%でいずれも平均の43.8%より高い（図1）。

表1　海外進出日系企業拠点数

国・地域	2023年	2021年	2019年	2016年	2019年～2023年 増減	2019年～2023年 増減率
合計	81,969	77,551	74,072	71,820	7,897	10.7%
アジア	57,082	53,431	50,171	49,673	6,911	13.8%
大洋州	1,315	1,337	1,297	1,287	18	1.4%
北米	9,964	9,827	9,866	9,225	98	1.0%
中南米	3,047	2,803	2,908	2,692	139	4.8%
欧州	8,619	8,300	7,959	7,354	660	8.3%
中東	994	926	961	851	33	3.4%
アフリカ	948	927	910	738	38	4.2%
中国	31,060	31,047	32,887	32,313	-1,827	-5.6%
タイ	5,856	5,856	-	1,783	-	-
インド	4,957	4,790	5,022	4,590	-65	-1.3%
韓国	3,003	754	915	695	2,088	228.2%
ベトナム	2,394	2,306	1,944	1,687	450	23.1%
インドネシア	2,182	2,046	2,009	1,810	173	8.6%
米国	8,982	8,874	8,959	8,422	23	0.3%

注1：本調査は、（1）日本企業の海外支店等、（2）日本企業が100%出資した現地法人及びその支店等、（3）合弁企業（本邦企業による直接・間接の出資比率が10%以上の現地法人）及びその支店等並びに（4）日本人が海外に渡って興した企業（日本人の出資比率10%以上）を対象としている。
注2：日本の各在外公館がそれぞれの管轄区域（兼轄国も含む）内にある進出日系企業の拠点数を調査したものである。日本の各在外公館は、原則としてそれぞれの管轄区域（兼轄国も含む）内にある進出日系企業へのアンケート調査を行って得た情報を集計しているが、一部の在外公館は、現地における公簿調査、現地日系団体の調査等をベースに集計している。
出所：外務省「海外進出企業拠点数調査」各年版に基づき作成。

図1　今後1～2の事業展開の方向性



出所：JETRO（2024）「2024年度海外進出日系企業実態調査|アジア・オセアニア編」, p.18。

また、前述したJETROの調査では、直近5年間、日本本国や中国からASEANへの生産移管が顕著になった。例えば、657社の回答企業（複数回答）のうち、176社はASEANへ生産移管し、さらにASEANへ移管した企業のうち、90社はベトナムへ移管した。移管理由はチャイナリスクの回避や米中貿易摩擦による関税対策である。

2. アジア7か国のイノベーション力

本節では、アジアの7か国を取り上げ、数値指標を使い、それぞれの国のイノベーション力を見る。

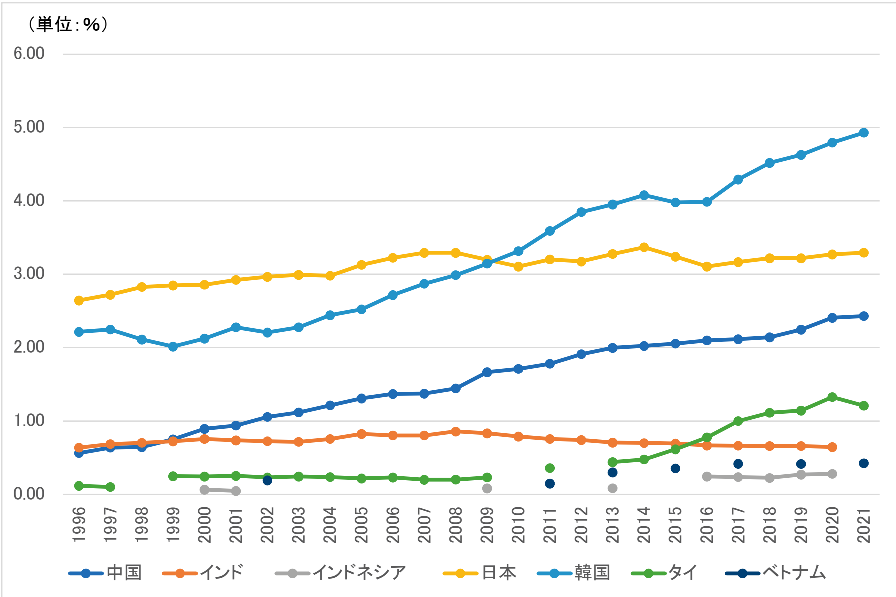
2.1. イノベーションの投入・産出

イノベーションの範囲は広いので、数値で測れないものが多い。一般的にイノベーションの投入の指標としてよく使われているのは研究開発（R&D）支出の対GDP比や研究開発者人数である。

図2は対象のアジア7か国のR&D支出の対GDP比を示している。2021年、韓国のR&D支出の対GDP比は4.93%で最も高い。日本は3.3%で2番目に高い。中国は2.43%で第3位であり、日本よりまだ低いが、OECD国の平均水準（2021年は2.72%）に近づいている。タイは近年上昇傾向にあり、2017年から1%を超えた。

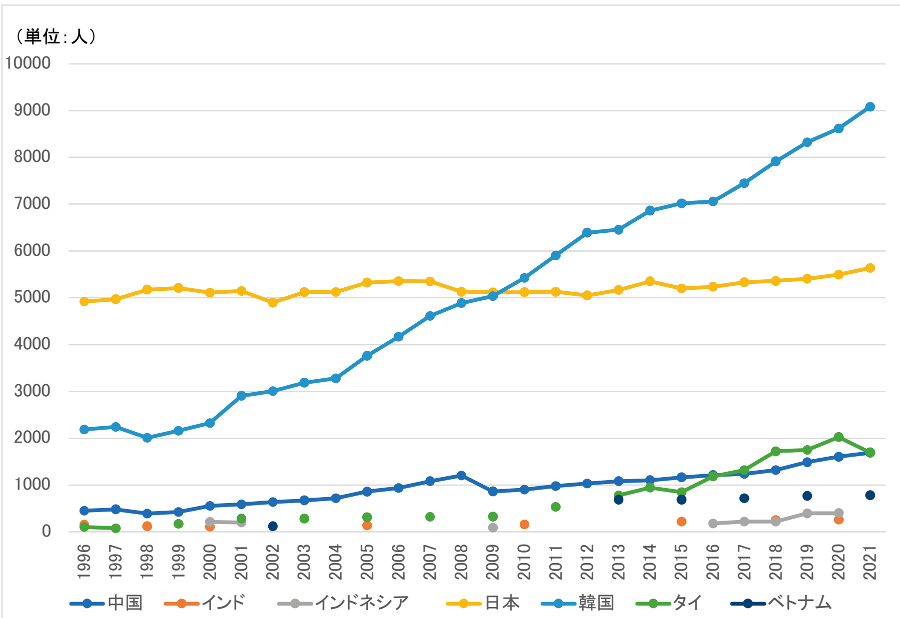
以上の4か国はR&D支出の対GDP比が高いか、中間レベルである。残りの3か国のR&D支出の対GDP比はまだ低いレベ

図2　R&D支出の対GDP比（%）



出所：World Bankのデータより作成。

図3　百万人当たりの研究開発者数



出所：World Bankのデータより作成。

ルにとどまっている。インドのR&D支出の対GDP比は2008年に0.86%になったが、その後低下傾向になり、2020年に0.65%まで低下した。ベトナムは2021年に0.43%である。インドネシアは一番低く、0.3%にも達していない。

中国は2001年まで、R&D支出の対GDP比は1%以下にとどまっていた。中国政府は中国の研究開発力の弱さを認識し、中国の重要な政策指針である5か年計画でR&D支出の対GDP比を数値目標とした。例えば、2001～2005年の第10次5か年計画期の目標は1.5%で、2016～2020年は2.5%であった。中国政府は研究開発を重視しているので、R&D支出の対GDP比は伸び続けてきた。長期的に見れば、タイは中国の2000年代前半の水準になったが、ベトナムは中国の1990年代の水準である。

図3は7か国の百万人当たりの研究開発者数を示している。2021年、韓国の百万人当たりの研究開発者数は9,082人で、7か国の中で最も多い。2番目に多いのは日本（5,638人）である。中国（1,687人）とタイ（1,699人）はほぼ同じである。中国は人口が多いので、百万人当たりで換算すると低い数値になっている。ベトナムは779人で、2013年から緩やかな上昇傾向が表れている。一方、2020年、インドネシアは400人で、インドは260人に過ぎない。

R&D支出の対GDP比や百万人当たりの研究開発者数といったイノベーション投入指標を見れば、取り上げたアジア7か国のうち、日本と韓国は投入が多いグループ、中国とタイは中間グループであるが、ベトナム、インド、インドネシアはまだ低いグループである。

また、イノベーションの産出指標としてよく使われているのは発明特許出願数である。表2は、7か国の特許出願数をまとめたものである。統計の基準は出願人居住国である。各国の表の1行目はその国の出願人による国内出願と外国出願の合計数であり、2行目は国内への特許出願数であり、3行目は外国への特許出願数である。2015年以降、特許出願数が最も多いのは中国である。2023年、居住国が中国の出願人は164万件超の特許を出願したが、そのうち152万件超は中国国内への出願で、合計の92.7%を占めている。つぎに特許出願が多い国は日本と韓国であり、それぞれ41.4万件、28.8万件の特許を出願した。特に、日本と韓国から外国への出願は多く、それぞれ合計の45%、34%を占めている。上記3か国に比べ、インドネシア、タイ、ベトナムの出願数はわずかな件数にすぎず、2,000件にも達していない。

表2　7か国の特許出願数（単位：件）

出願国	出願種別	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023
中国	合計	5,833	10,326	26,474	97,786	308,057	1,009,703	1,439,704	1,537,533	1,584,677	1,642,582
中国	国内出願	5,832	10,011	25,346	93,485	293,066	968,252	1,344,817	1,426,644	1,464,605	1,522,292
中国	外国出願	1	315	1,128	4,301	14,991	41,451	94,887	110,889	120,072	120,290
日本	合計	333,234	405,451	493,847	529,106	467,346	456,396	421,971	411,860	405,373	414,479
日本	国内出願	333,230	334,612	387,364	367,960	290,081	258,839	227,348	222,452	218,813	228,936
日本	外国出願	4	70,839	106,483	161,146	177,265	197,557	194,623	189,408	186,560	185,543
韓国	合計	9,086	66,463	86,091	162,602	178,575	238,028	260,169	267,171	272,326	288,001
韓国	国内出願	9,082	59,228	72,831	122,188	131,805	167,275	180,477	186,245	183,748	191,142
韓国	外国出願	4	7,235	13,260	40,414	46,770	70,753	79,692	80,926	88,578	96,859
インド	合計	1,147	1,708	2,885	7,758	14,664	23,535	37,196	42,366	55,746	64,510
インド	国内出願	1,147	1,545	2,206	4,721	8,853	12,579	23,141	26,267	38,551	49,860
インド	外国出願	0	163	679	3,037	5,811	10,956	14,055	16,099	17,195	14,650
インドネシア	合計	0	62	168	256	572	1,180	1,358	1,445	1,607	1,727
インドネシア	国内出願	0	61	157	235	508	1,058	1,309	1,397	1,549	1,682
インドネシア	外国出願	0	1	11	21	64	122	49	48	58	45
タイ	合計	73	148	580	1,000	1,389	1,395	1,487	1,548	1,416	1,308
タイ	国内出願	73	145	561	891	1,214	1,029	863	867	772	752
タイ	外国出願	0	3	19	109	175	366	624	681	644	556
ベトナム	合計	58	23	34	183	325	685	1,133	1,198	1,057	1,119
ベトナム	国内出願	58	23	34	180	306	582	1,021	1,066	895	991
ベトナム	外国出願	0	0	0	3	19	103	112	132	162	128

出所：WIPO statistics database. Last updated: December 2024のデータより作成。

表３　1,000億米ドルのGDP当たりの居住者申請数（2017年PPP）（居住国別）

出願国	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023
中国	312	301	503	1,163	2,134	4,814	5,060	4,950	4,934	4,875
日本	7,609	7,084	7,787	6,973	5,510	4,667	4,164	3,973	3,871	3,974
韓国	1,526	6,608	6,151	8,072	7,050	7,698	7,486	7,407	7,121	7,309
インド	60	63	67	105	141	146	223	231	317	381
インドネシア	0	5	12	14	23	37	38	40	42	43
タイ	15	21	77	93	106	78	60	60	52	50
ベトナム	36	10	10	38	48	68	88	89	69	73

出所：WIPO statistics database. Last updated: December 2024のデータより作成。

７か国の経済規模が違うので、特許出願の合計数だけではなく、GDP当たりの特許出願数も見る必要がある。表３は1,000億米ドルのGDP当たりの居住者申請数を示している。統計基準はそれぞれの国の出願人から世界のすべての国へ出願した発明特許の合計数である。2023年、韓国、日本、中国の1,000億米ドルのGDP当たりの特許出願数は多く、数千件にも達している。インドは381件で、中間レベルである。インドネシア、タイ、ベトナムは件数が少なく、数十件にとどまっている。2020年以降、タイやベトナムの1,000億米ドルのGDP当たりの特許出願数は若干減少傾向になっている。つまり、特許出願数はGDPの成長率ほど伸びていないことを意味している。

より長い期間で見れば、1990年から、アジアでは研究開発のリーダーは日本であり、韓国と中国も経済発展とともに、特許出願数は増加してきた。2005年以降、韓国は日本を上回り、中国も2015年から日本の件数を超えた。他方、タイ、ベトナム、インドネシアの特許出願数は中国の1990年代の水準よりも低い。研究開発では、これらの東南アジア諸国はまだ遅れていると思われる。

2.2. イノベーション分野での相互参入

韓国企業や日本企業は東南アジアの国に進出し、製造の段階に深く参入している。近年、中国企業も東南アジアへの進出は増えている。中国は東南アジアの重要なサプライチェーンの調達先になっている。

イノベーションの分野では、ここに取り上げたアジア７か国は相互に参入しているのか、ここでは対象の７か国はそれぞれ他の６か国にどのくらい特許出願しているのかを見ていく。表４の１列目は特許出願受理国で、２列目は特許出願人居住国（つまりどこの国からの出願か）である。例えば、2023年に中国が受理した特許出願数を見てみると、152万件以上は居住国が中国の出願人による出願である。日本と韓国からの出願数も多く、数万件ある。インドからの出願数は326件で、タイからは87件である。他方ベトナムやインドネシアからの出願数は１桁にとどまっている。日本や韓国が受理した特許出願も同じ傾向があり、中国や韓国は2010年以降毎年数千件の特許を日本に出願している。

インドに関しては、2023年に国内からの特許を49,860件受理し、自国出願人による出願は日本や韓国からの出願より圧倒的に多い。一方、タイやベトナムに関しては、日本、韓国、中国からの特許出願数が自国出願人からの出願よりも多い。例えば、ベトナムへの特許出願の内、外国からの特許出願は85%～ 90%くらいを占めている。

つまり、日中韓はベトナム、タイでイノベーション分野の存在感も強い。外国企業は製造段階で多く参入しているだけではなく、特許出願の分野でも参入を強めている。このことは、地場企業のイノベーション力の弱さを表している。イノベーションの産出指標を見るかぎり、ベトナムやタイはまだ遅れていることが分かった。

2.3. アジア７か国の特許審査における行政効率

ベトナムなどの東南アジア国やインドは日本企業に人気の海外進出先であるが､リスクもある。前述した日本貿易振興機構（JETRO）は海外日系企業の現地法人向けの調査では、投資環境上のリスクも調査している。JETROの2024年の調査によれば、ベトナムの投資環境上のリストの上位５位は、「行政手続きの煩雑さ」、「人件費の高騰」、「法制度の未整備・不透明な運用」、「税制・税務手続きの煩雑さ」、「現地政府の不透明な政策運営」である。インドネシアのリスクはベトナムと同じ（順位不同）である。インドについても「行政手続きの煩雑さ」は挙げられている。

表５では、特許審査請求から特許庁のファーストアクションまでの平均日数を取り上げ、イノベーション分野での行政手続きの効率を見ていく。ファーストアクションとは、特許庁が出願人の審査請求を受けてから、審査官による審査を経て、出願人への審査結果の最初の通知（主に特許査定、登録査定又は拒絶理由通知書）を出願人等へ発送することである。

日本、中国、韓国、インドの特許審査日数は少なく、ファーストアクションは１年前後で出されている。特許分野での行政効率が高い。一方、タイとベトナムでは特許審査請求からファーストアクションまで３年以上もかかるので、イノベーションの分野における行政手続きの非効率性がうかがえる。

表４　７か国の相互特許出願数

特許出願受理国	特許出願人居住国	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023
中国	中国	5,832	10,011	25,346	93,485	293,066	968,252	1,344,817	1,426,644	1,464,605	1,522,292
中国	日本		3,772	8,300	30,976	33,882	40,078	47,862	47,010	45,259	46,236
中国	韓国		857	1,579	8,131	7,178	12,907	16,725	17,691	18,262	20,016
中国	インドネシア			2		9	9	7	7	1	3
中国	インド		2	14	198	168	235	302	337	317	326
中国	タイ			1		15	20	76	92	80	87
中国	ベトナム					2	2	6	7	10	7
日本	中国		54	117	397	1,063	2,840	8,406	9,369	9,842	9,612
日本	日本	333,230	334,612	387,364	367,960	290,081	258,839	227,348	222,452	218,813	228,936
日本	韓国		1,780	2,993	6,845	4,872	5,222	5,881	5,936	7,149	7,920
日本	インドネシア					3	8	1	1	2	
日本	インド		6	34	154	162	235	219	233	259	284
日本	タイ					8	39	105	118	90	98
日本	ベトナム					1	4	6	6	2	3
韓国	中国		2	48	148	517	1,947	4,282	6,300	6,320	5,455
韓国	日本		7,585	12,261	16,468	14,346	15,283	14,026	14,165	13,861	14,192
韓国	韓国	9,082	59,228	72,831	122,188	131,805	167,275	180,477	186,245	183,748	191,142
韓国	インドネシア			1		1	2	1		1	2
韓国	インド		1	10	60	103	139	116	110	134	153
韓国	タイ					1	13	50	42	32	38
韓国	ベトナム					1	10	2	5	3	4
インド	中国		40	30	224	645	1,681	3,775	3,989	3,914	4,015
インド	日本		346	787	1,555	4,215	4,857	4,826	4,617	4,583	4,683
インド	韓国		204	157	679	707	1,664	2,682	2,639	2,817	3,344
インド	インドネシア				2	5	6	1	2	9	3
インド	インド	1,147	1,545	2,206	4,721	8,853	12,579	23,141	26,267	38,551	49,860
インド	タイ			7	8	4	14	21	24	20	20
インド	ベトナム					2	5	2	4	3	3
インドネシア	中国						333	746	1,216	1,396	1,288
インドネシア	日本						2,548	2,318	2,101	2,059	2,009
インドネシア	韓国						432	399	376	473	761
インドネシア	インドネシア		61	157	235	508	1,058	1,309	1,397	1,549	1,682
インドネシア	インド						80	125	210	255	202
インドネシア	タイ						13	17	12	24	14
インドネシア	ベトナム						4	1	1	2	1
タイ	中国			83		29	167	229	873	991	827
タイ	日本			1,110	2,150	430	2,947	1,444	2,921	2,697	2,868
タイ	韓国			45		9	140	124	293	245	371
タイ	インドネシア						4		1	2	1
タイ	インド					6	44	43	120	139	118
タイ	タイ	73	145	561	891	1,214	1,029	863	867	772	752
タイ	ベトナム						3		1		
ベトナム	中国		2			122	257	1,111	1,441	1,312	1,214
ベトナム	日本		141			823	1,341	1,700	1,620	1,530	1,602
ベトナム	韓国		12			192	527	1,074	1,229	1,006	1,062
ベトナム	インドネシア						4	1	1	3	
ベトナム	インド					31	34	72	99	97	79
ベトナム	タイ					3	11	17	21	20	15
ベトナム	ベトナム	58	23	34	180	306	582	1,021	1,066	895	991

出所：WIPO statistics database. Last updated: December 2024のデータより作成。

表５　特許審査請求から特許庁のファーストアクションまでの平均日数

特許出願受理国	特許出願人居住国	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
中国	全世界	348	342	345	327	375	384	387	n.a.	462	447	432	375	390	396
日本	全世界	861	777	603	375	279	291	285	279	279	285	306	303	303	285
韓国	全世界	555	504	444	396	330	300	318	309	309	324	333	363	430	483
インド	全世界	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2,160	1,560	1,080	810	540	180	120	318
インドネシア	全世界	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	150	n.a.	n.a.	3	60	n.a.	n.a.	n.a.
タイ	全世界	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1,740	630	1,170	960	1,183	1,116	965	1,106
ベトナム	全世界	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1,095	1,249	1,007	1,090	1,218	1,091	1,026	1,163

出所：WIPO statistics database. Last updated: December 2024のデータより作成。

2.4. グローバル・イノベーション・インデックス（GII）

ここまでは、特許出願からアジアの７か国のイノベーションの投入や産出を見た。イノベーションは特許出願だけでははかれないので、他の指標を見る必要もある。

WIPO（世界知的所有権機関）はイノベーションを五つのインプット項目（制度、人的資本と研究、インフラストラクチャー、市場の洗練度、事業の洗練度）と二つのアウトプット項目（知識および技術の産出、創造的なアウトプット）から評価し、毎年世界各国のグローバル・イノベーション指数（GII）を公布している。ここではWIPOが発表したグローバル・イノベーション指数を利用する。

2024年版のグローバル・イノベーション・インデックスによれば、2024年に世界133か国のうち、韓国のグローバル・イノベーション指数は世界第６位、中国は第11位、日本は第13位、インドは第39位、タイは第41位、ベトナムは第44位、インドネシアは第54位である。

表６はWIPOが評価したイノベーションのインプットとアウトプット項目毎のランキングをまとめている。韓国のイノベーションのインプットに関しては、人的資本および研究は世界第１位と高く評価されている。インフラストラクチャーやビジネスの洗練度もトップ10に入っている。また、韓国のイノベーションのアウトプットである知識と技術の生産は第10位、創造的な生産は第２位と評価が高い。日本や中国に関しては、人的資本および研究、インフラストラクチャー、市場の洗練度やビジネスの洗練度はいずれも順位が高い。ただ中国の制度（政治環境や規制）の項目は44位で低い。

他の４カ国を見てみると、インドの人的資本及び研究は51位で中間レベルであるが、タイ、ベトナム、インドネシアのこの指標はそれぞれ71位、73位、90位と順位は低い。インフラストラクチャーの順位は50～60位台で中間レベルである。制度に関しては、タイ、インド、ベトナムは中国よりも順位が低い。イノベーションのアウトプット項目については、インドネシアを除き、他の３か国は20～40位台で、上位中間レベルである。

WIPOのグローバル・イノベーション・インデックスから、東南アジ

表６　グローバル・イノベーション・インデックス（GII）の指標（2024）

	韓国	中国	日本	インド	タイ	ベトナム	インドネシア
総合ランキング	6	11	13	39	41	44	54
イノベーション・インプット項目毎のランキング							
1 制度（政治環境や規制）	24	44	23	54	74	58	40
2 人的資本および研究（教育、Ｒ＆Ｄ）	1	22	19	51	71	73	90
3 インフラストラクチャー	9	5	13	72	50	56	67
4 市場の洗練度（信用、投資、貿易、多様化、市場規模）	15	16	8	23	25	43	35
5 ビジネスの洗練度（知識労働者、イノベーションの連携、知識の吸収）	5	11	6	58	41	46	78
イノベーション・アウトプット項目毎のランキング							
6 知識と技術の生産（知財出願、労働生産性伸び率、ハイテク製品輸出等）	10	3	12	22	39	44	73
7 創造的な生産（商標等の無形資産、出版物等の創作物、オンライン創造性等）	2	14	22	43	38	34	65

出所：WIPO（2024）*Global Innovation Index 2024*に基づき作成。

表7　中国進出日系企業の業種別の拠点数

年	国・地域・在外公館名	企業拠点総数	業種																				
			農業、林業	漁業	鉱業、採石業、砂利採集業	建設業	製造業	電気・ガス・熱供給・水道業	情報通信業	運輸業、郵便業	卸売業・小売業	金融業・保険業	不動産業、物品賃貸業	学術研究、専門・技術サービス業	宿泊業、飲食サービス業	生活関連サービス業、娯楽業	教育、学習支援業	医療、福祉	サービス業（他に分類されないもの）	分類不能の産業	区分不明		
2021	中国	31,047	63	15	9	118	4,732	23	439	456	1,438	184	74	625	92	118	11	41	508	51	22,050		
2019	中国	32,887	69	22	18	133	5,808	21	502	502	1,515	228	94	637	109	140	17	50	651	28	22,343		
	国・地域・在外公館名	企業拠点総数	農業、林業	漁業	鉱業、採石業、砂利採集業	建設業	製造業	電気・ガス・熱供給・水道業	情報通信業	運輸業、郵便業	卸売業・小売業	金融業・保険業	不動産業、物品賃貸業	学術研究、専門・技術サービス業	宿泊業、飲食サービス業	生活関連サービス業、娯楽業	教育、学習支援業	医療、福祉	サービス業（他に分類されないもの）	分類不能の産業	区分不明	複合サービス事業	公務（他に分類されるものを除く）
2016	中国	32,313	84	24	13	96	3,646	20	246	288	626	164	54	242	79	122	17	19	269	29	26,148	119	8

出所：前掲外務省「海外進出企業拠点数調査」各年版に基づき作成。

ア諸国のイノベーションのインフラストラクチャーや人的資本などはまだ弱いことがわかった。

3. バリューチェーンからみた中国進出日系企業

表7は中国進出日系企業の業種別の拠点数をまとめている。2016～2021年、業種別に見ると、中国に進出している日系企業のうち、「学術研究、専門・技術サービス業」の企業数が増加している。2016年、その拠点数は242社であったが、2021年に625社まで増加し、業種別では3番目に多い。

電子産業のバリューチェーンでは、スマイルカーブ現象がよく知られている。スマイルカーブ現象とは、上流工程の商品企画・開発と下流工程の流通やサービスの付加価値が高く、中間工程の組立・製造工程の付加価値は低いという考えである。かつて中国は安い労働力が豊富で、研究開発力がなかったので、付加価値の低い組立工程を担っていた。近年中国企業の技術力も向上している。中国に進出している日系企業のうち、「学術研究、専門・技術サービス業」の企業数が増えていることから、中国の人材を活用していると考えられる。バリューチェーンのスマイルカーブの視点から見れば、中国は付加価値の高い開発工程やサービスにも参入している。組立・製造工程は比較的容易に代替できるが、開発工程になるとやはり質の高い人的資本が必要不可欠である。前述したWIPOのグローバル・イノベーション・インデックスを見ると、東南アジアの一部の国では、人的資本や研究はまだ弱いので、開発機能の東南アジアへの移転はまだ容易ではないと思われる。

まとめ

本稿は日本に加え、日系企業の拠点数の上位アジア6か国を取り上げ、イノベーションの投入や産出などの数値指標を利用し、アジア6か国のイノベーション力を見た。日本企業がサプライチェーン寸断のリスクや米中対立による高い関税を回避するために、中国から他の国への生産移管をすすめるのは合理的な判断であると思われる。

ただ、東南アジアは人気の生産移管先であるが、イノベーションの投入や産出、WIPOが出されたグローバル・イノベーション・インデックスなどの指標から見れば、地場企業のイノベーション力はまだ弱い。東南アジアの国はサプライチェーンの製造では重要な担い手であるが、研究開発ではまだ力が足りない。例えば、ベトナム統計総局の輸出入データを見ると、1995年のベトナム輸出の73%は地場企業によるものであったが、2023年にその割合はわずか27%まで低下している。米中対立により、中国に進出していた外資企業のみならず、中国企業もベトナムへの生産移管を進めている。2018年以降、ベトナムの輸出は急速に伸びている。日本税関の統計によれば、1995年～2016年の日本の貿易相手国上位10か国（輸出入総額）にはベトナムがランクインされなかったが、2017年、ベトナムは37,672億円の輸出入総額で日本の第9位の貿易相手国になった。2023年、日本とベトナムの貿易総額は60,434億円まで上昇した。ただ、ベトナムの輸出の大半は外資系企業に依存している。輸出の付加価値を高めるため、地場企業を育てることがベトナムにとって重要な課題である。

中国は歴史・政治的な要因から外国からの技術を習得し、自らのイノベーション力を高めるまで相当な時間を要した。中国政府が政策的にイノベーション戦略を開始したのは2000年代半ばからでその戦略のもとでハイテク産業を育成し、研究開発支出や研究者数を着実に伸ばしてきた。課題もあるが、二十数年の時を経て中国企業のイノベーション力は確実に高まっている。

こうした中国の事例に鑑みれば、東南アジアも付加価値の低い組立・製造工程にとどまらず、イノベーション力を高める方向性に向かっていく可能性がある。そのためには、政府の財政投入やインフラの整備など多くの課題をクリアしなければならない。例えば、政府の財政支出を見てみると、2007年以降、中国の政府財政支出の3.3%～4.0%は科学技術に使われている。しかし、ベトナムの政府財政予算を見ると、科学技術への予算は政府予算の0.6%～0.7%程度である。東南アジア諸国が中国と同様にイノベーション力を高めるためには、政府の財政投入や政策支援、地場企業の起業家精神が不可欠である。具体的には次のような手順を踏むことが考えられる。

第一に、外資企業が多く進出しているので、地場企業が技術のスピルオーバーを受けられる。かつて中国の貿易の重要な担い

手は外資企業であったが、地場企業は外資企業からの技術のスピルオーバーを受け、イノベーション力が少しずつ上昇し、付加価値の低い加工貿易の割合は次第に低下した。

第二に、現時点のタイやベトナムでは、国内出願人よりも外国からの特許出願が多いが、長期的に見れば、外資企業からの技術のスピルオーバーを受けて、国内出願人が増加する可能性がある。中国も特許制度が導入されたばかりの1980年代後半、国内出願人よりも外国からの特許出願数が多かった。Hu·Jefferson（2009）によれば、外国直接投資の増加が中国国内企業・外資企業双方に特許出願を促進する効果があったのに加え、中国政府の国家知的財産権戦略の実施や企業の努力により、中国国内出願人による特許出願数が急増したという。ただそれゆえに、特許出願補助金に依拠して利用価値が低い出願もあることも否定できない。

日系企業が中国から東南アジアに生産移管していく状況はこれからも進むと思われるが、上記のとおり東南アジア国のイノベーション力は可能性を含みつつまだ弱いので、中国から完全な移管は当面難しいと思われる。中国の生産工場は中国国内市場向け、東南アジアの工場は輸出向けといった分業になると思われる。

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Production transfer from China in the supply chain: A study from an innovation perspective (Summary)

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Since the US-China conflict in 2018, Japanese companies have accelerated their actions to disperse the risk of supply chain disruption by returning production from China or relocating production to Southeast Asia. In that context, the industrial fundamentals and innovation capacity of the country to which production is being transferred also need to be considered. This paper takes the Asian countries with the largest number of Japanese company subsidiaries as an example to compare their innovation capabilities from numerical indicators. The analysis reveals that Southeast Asia is an important manufacturing region, but local enterprises have weak innovation capabilities and low administrative efficiency. In order to improve innovation capacity, government financial input and policy support are indispensable.

Keywords: innovation capabilities, supply chain, production transfer

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